



# Reducing Environmental Impacts

WITH THERMASET® PET TECHNOLOGY



Ever since its invention more than 100 years ago, plastic has helped shape our world by playing a vital role in keeping consumer goods safe. It extends shelf life, preserves food, prevents product loss and even childproofs household and pharmaceutical products.

Although the plastic industry has recently received negative attention on social and traditional media, plastic packaging can actually lead to reduced pollution and lower energy usage than other forms of packaging available today. When used responsibly, recyclable and reusable plastic helps create a circular economy where valuable resources are conserved rather than wasted.

Still, many challenges must be overcome to bring sustainable plastic packaging solutions to market. These challenges have pushed plastic manufacturers to find innovative solutions, like increasing their use of post-consumer resin, improving recyclability, exploring bio-based alternatives and decreasing their environmental impact through robust sustainability programs.

**Challenge #1:  
Increasing Government  
Regulations**

Much of the media conversation about plastic has centered on ocean-bound pollution and what governments, companies and consumers are doing to combat it. Many cities are also taking steps to ban or tax single-use plastics to help cut down on landfill and ocean-bound waste.

**Challenge #2:  
New Retailer & Consumer  
Expectations**

Large retailers and shoppers have shifted their buying habits to favor sustainable packaging made with larger amounts of post-consumer resin.<sup>1</sup> This has required the plastic packaging industry to find new ways to obtain and use recycled resin in its products.

**Challenge #3:  
Emphasis on Environmental  
Impact**

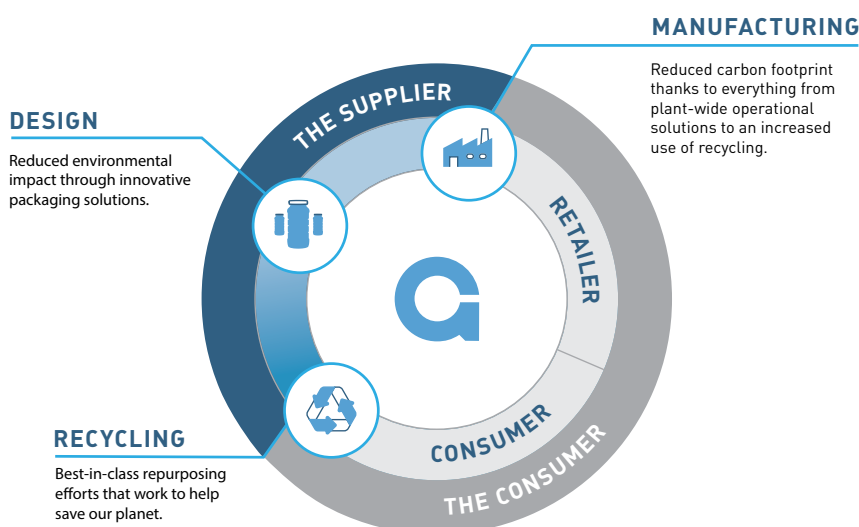
Environmental concerns have prompted plastic manufacturers to take a closer look at their products from a sustainability perspective. By evaluating the “cradle-to-grave” impact of their products, companies can understand and communicate the full effects of their manufacturing.

# Creating a Circular Economy

Companies are embracing the circular economy, which aims to minimize waste while maximizing resources.

In the plastic industry, that means exploring chemically recycled plastics, bio-based plastics and new technologies to reduce or eliminate barriers to recyclability. It also means viewing plastic as a valuable, finite resource and finding ways to collect and reuse the bottles that exist today through vigorous recycling efforts. As consumer recycling rates climb, so does the amount of recycled content available to manufacturers, who can then use it to make new products for consumers.

Reducing material consumption is another key step toward a circular economy. Every material choice has impacts across its life cycle. Raw materials must be mined or harvested and then transported for processing. The material's properties can affect the design and function of the final product and how much material is needed for the design. Some materials are more easily recycled, reused and reworked than others based on their molecular content. The weight of the material affects its transport throughout its life cycle, and different materials can have different disposal and recycling options at end of life.



## SPOTLIGHT ON

### What barriers prevent people from recycling?

Boosting recycling rates is an important first step to creating a circular economy. However, there are still significant barriers at every level of the recycling process that make it difficult for consumers to recycle and, therefore, difficult for plastic manufacturers to create sustainable packaging. Some of the most commonly cited barriers to recycling include:

- Inconsistent collection and recycling efforts along the entire value chain
- Misinformation about effective methods for preventing pollution
- Lack of consumer understanding of what is recyclable and how to recycle it
- Little or no access to recycling and waste collection services

# Taking PET Into New Markets With Upgraded Thermal Performance

Some plastics are easier to work with — and easier to recycle — than others. One example is polyethylene terephthalate, or PET. Prized for its strength, thermal stability and reduced weight, PET is a popular choice for packaging in industries like food, beverage, personal care and household cleaning.

PET is often compared to glass because of its transparency, with many consumers considering glass to be a more sustainable alternative to plastic packaging. However, the energy involved in producing glass, as well as the freight and fuel costs involved with shipping such a heavy material, have challenged this proposition. Not to mention, glass packaging can lead to breakage, which results in an increase in production downtime and product loss. But even with some of these environmental drawbacks, one lingering problem remains.

Certain foods and beverages are thermally processed at very high temperatures and pressures which, historically, PET has not been able to withstand. However, with technological advancements to Graham's blow molding process, the molecular orientation of the PET resin can be altered, driving greatly enhanced performance into the blown container. Jars manufactured using this advanced process, called ThermoSet, have thermal stability above 300° Fahrenheit and 50% greater sidewall rigidity than standard PET.



JARS MANUFACTURED USING THIS ADVANCED PROCESS, CALLED THERMASET, HAVE THERMAL STABILITY ABOVE 300° FAHRENHEIT AND 50% GREATER SIDEWALL RIGIDITY THAN STANDARD PET.



CONTINUED

# Taking PET Into New Markets With Upgraded Thermal Performance



## Production & Performance Benefits of ThermaSet

ThermaSet is a patented heat-set process that allows PET containers to be used in challenging fill processes like hot fill, pasteurized and retort. This process can be completed using a container made of bottle-grade PET with no special additives. As a production solution, ThermaSet affords products the benefits of being packaged in plastic. It promotes longer shelf life and maintains glass-like clarity. It also works with metal lug, metal CT closures, can ends and plastic closures to fit into existing fill lines.

Another performance benefit of ThermaSet is the ability for the thin-walled PET containers to be heated up and cooled down quickly, without the risk of thermal shock and breakage that glass has. This is especially beneficial for food and beverage products because it minimizes the total amount of time the product is exposed to elevated temperatures, thus optimizing both flavor and nutrition profiles.

ThermaSet PET containers also deliver a two-year shelf life at ambient temperatures thanks in part to a nano-thin gas barrier layer of silicon oxide applied to the interior of the container after it's blown. These containers are also shatter-resistant, which translates into less breakage and downtime during filling, transportation and consumer handling. Best of all, this barrier layer allows the PET containers to remain 100% recyclable.



# What Is a Life-Cycle Assessment?

A life-cycle assessment, or LCA, is a quantitative, science-based method that rigorously evaluates the environmental impact of a product across its entire life cycle. The focus on multiple environmental impact categories provides a holistic view that can be used to identify and implement improvement opportunities for reducing the environmental footprint.

There are several areas of consideration when conducting an LCA:



**Global warming potential, or carbon footprint**, is the amount of greenhouse gases released during the production and use of a product, which can have a significant impact on climate change.



**Energy use or energy footprint** is the amount of direct or indirect energy consumed across the entire life cycle of a product. Saving energy uses less fossil fuel while reducing air pollution and greenhouse gas emissions.



**Acidification** is the damage to ecosystems caused by acid rain, nutrient runoff and other man-made pollutants. Plant growth and animal health can be affected by acidification.



**Particulate matter** is a mixture of small particles, like dust, smoke and fumes, that are present in air pollution. Health problems, such as damaged lungs and impaired breathing, are linked to air particulates.



**Smog** is a mixture of air pollutants made up mostly of ground-level ozone. It results from a chemical reaction between sunlight and air pollution from vehicles, factories and power plants. It can cause respiratory infections as well as impaired lung function.

The power of LCA provides an objective, science-based perspective needed to understand the benefits and trade-offs of material choices in packaging applications. These insights allow manufacturers to make a clear, informed choice about existing material applications as well as the technologies that can be developed to make packaging materials even more sustainable.

A LIFE-CYCLE ASSESSMENT






# PET as an Environmentally Responsible Alternative to Glass<sup>2</sup>

To verify the benefits of ThermaSet, Graham commissioned an independent research firm to conduct a life-cycle assessment of 1,000 24-ounce ThermaSet PET pasta sauce jars and compare them to their glass counterparts. The goal of the study was to document the life-cycle environmental impact of these jars, with special emphasis on measuring energy depletion and climate change impacts.

This study, which was peer reviewed, calculated the environmental impact of the following:

- Manufacturing the jars, caps and packaging materials
- Shipping the jars to their filling locations
- Filling the jars with pasta sauce
- Shipping the filled jars to grocery stores
- Disposing of unrecycled jars in landfills

The LCA study found that over multiple environmental impact categories, ThermaSet PET jars had a lower impact on the environment than glass jars.

IMPACT CATEGORY	THERMASET (PET)	GLASS	% REDUCTION FROM GLASS TO PET*
 <b>Global warming potential</b> [kg CO2 eq]	347	557	47%
 <b>Energy</b> [MJ]	7,458	8,910	18%
 <b>Acidification</b> [kg SO2 eq]	1.45	3.19	75%
 <b>Human Health Particulate Air</b> [kg PM2.5 eq]	0.093	1.26	173%
 <b>Smog Air</b> [kg O3 eq]	20.7	46.2	76%

\*Percent difference is calculated as the difference between glass and ThermaSet, divided by the average of glass and ThermaSet.

Raw material and manufacturing impacts per jar were also lower for PET than glass jars. They consumed 14% less energy and released 54% less greenhouse gas emissions. PET jars release fewer emissions over their life cycle because PET manufacturing techniques are more efficient, and less material is used. The reduction in material usage and the lighter weight of PET jars also require less energy to make, fill, package, transport, and recycle or landfill than glass jars.

Finally, because of their lighter weight, 40% more PET jars can be put on each truck for transport, requiring fewer shipments and less fuel during transport to recycling or end-of-life disposal. Since they are virtually shatterproof, they need less packaging during transport than glass containers.





# Crucial Conversation Starters

Recent advancements in PET technology now allow companies to enjoy the benefits of plastic packaging with none of the drawbacks. Get the conversation started at your organization about using PET packaging.

## 1 PET plastic packaging helps keep products safe, fresh and visually appealing.

### For Brands

Clear PET packaging allows consumers to view the contents of a container before it's opened, which boosts shelf appeal. Because it's both lightweight and strong, PET can endure shipping without danger of breakage, reduce transportation costs and enhance energy efficiency for facilities that produce it. It also allows for more design flexibility, whether you want to create a funky new bottle or a functional new feature on your packaging.

### For Consumers

PET packaging is lightweight and shatter-resistant, so it's easier to lift and unlikely to break if dropped. Because of its lighter weight, it's also more cost-effective to ship when products are ordered through e-commerce platforms. Additionally, PET packaging is FDA compliant and 100% recyclable, so it contributes to a healthy circular economy when disposed of properly.

## 2 PET plastic packaging is sustainable when manufactured responsibly and disposed of correctly.

### For Brands

PET packaging can be made with up to 100% post-consumer resin to meet new regulations and shopper preferences. Advanced technologies like ThermoSet don't affect a PET container's recyclability. According to the LCA, PET was more sustainable in a "cradle-to-grave" test than popular alternatives like glass. Plus, it uses less material and requires fewer shipments to transport.

### For Consumers

The biggest barrier to PET being a sustainable packaging solution is that much of it ends up in landfills rather than being properly recycled. In the U.S., the recycling rate of PET bottles and jars is only 29.9%.<sup>3</sup> As recycling rates climb, so does the amount of recycled content available to manufacturers, who can then use it to make new products for consumers, so proper recycling is a big contributor to a successful circular economy.

# Crucial Conversation Starters

## 3 Emerging PET technology has made it possible to use PET in applications where it wasn't previously used.

### For Brands

For foods and beverages that are thermally processed at very high temperatures and pressures, PET is now a solution. ThermaSet is an advanced blow-molding process that alters the molecular orientation of the PET resin, driving greatly enhanced performance into the blown container. ThermaSet jars have thermal stability above 300 degrees Fahrenheit and 50% greater sidewall rigidity than standard PET.

### For Consumers

Foods that were previously packaged in glass because of production constraints can now be packaged in lightweight, recyclable plastic containers thanks to advanced technologies. ThermaSet PET jars are not only easier to handle than glass, but they also deliver a two-year shelf life.

## 4 Overall, ThermaSet PET jars are more environmentally friendly than glass across several environmental categories.

### For Brands

The results of the LCA study found that ThermaSet PET jars have lower life-cycle impacts than glass jars in the following categories: global warming potential (47% less), energy use (18% less), acidification (75% less), particulate matter (173% less) and smog (76% less). Raw material and manufacturing impacts per jar are lower for PET than glass jars too, as they consume 14% less energy and release 54% less greenhouse gas emissions. Finally, because of their lighter weight, 40% more PET jars than glass jars can be put on a single truck for transport.

### For Consumers

Glass is widely considered a more sustainable option than plastic by consumers. However, the energy involved in producing glass, as well as the freight and fuel costs involved with shipping such a heavy material, have shown the opposite to be true. Glass packaging can also lead to breakage, which results in an increase in food waste. This reduction is significant, considering that if food waste were its own country, it would be the third-largest emitting country in the world.<sup>4</sup>

## Sources

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3. <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/plastics-material-specific-data>
4. <http://www.fao.org/3/a-bb144e.pdf>



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