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American chemistry is...

Driving innovations that create a healthier, safer and more sustainable future.

Creating jobs and powering economic growth that keeps America competitive.

Enhancing safety, both through the products of chemistry, and by continuously working to provide chemicals that are safe for their intended use.

Polystyrene Info

Polystyrene ≠ Styrene

Polystyrene and styrene are different substances. Although polystyrene is made from styrene, equating polystyrene with styrene is like equating a diamond with carbon. They're not the same substance.

National Toxicology Program: "Let me put your mind at ease ..."

NTP Director Dr. Linda Birnbaum, Ph.D., was quoted widely in Associated Press reports in June 2011: "Let me put your mind at ease right away about polystyrene foam*...In finished products, certainly styrene is not an issue."

Polystyrene is Being Recycled

Polystyrene foam foodservice packaging is being recycled in many communities across the country. For example, more than 20 percent of Californians can recycle polystyrene foam in curbside programs.

FDA: Polystyrene Foam is Safe

The U.S. Food & Drug Administration, the agency charged with scientific review and approval of food contact applications, has determined for more than 50 years that polystyrene is safe for use in foodservice products.

Polystyrene Foam Foodservice = 1.5% of Litter

Polystyrene foam foodservice packaging makes up 1.5 percent of litter, according to a May 2012 national report by environmental consulting firm Environmental Resources Planning.

For further information:
Plasticfoodservicefacts.com

* Original quote used the term "Styrofoam". STYROFOAM™ is a registered trademark of The Dow Chemical Company that represents its branded building material products, including rigid foam and structural insulated sheathing, and more. The brand name often is misused as a generic term for polystyrene foam foodservice packaging.

American Chemistry Council

The Safety of Polystyrene Foodservice

Health Experts' and Agencies' Views

U.S. National Toxicology Program (NTP)

Dr. Linda Birnbaum, Ph.D., Director, U.S. National Toxicology Program was quoted widely in Associated Press reports in June 2011: "Let me put your mind at ease right away about polystyrene foam*" … [the levels of styrene from polystyrene containers] "are hundreds if not thousands of times lower than have occurred in the occupational setting...In finished products, certainly styrene is not an issue." *Source: news reports of Associated Press story, June 2011*

John Bucher, associate director of the National Toxicology Program, was quoted in Associated Press reports in August 2011: "The risks, in my estimation, from polystyrene are not very great," he said. "It's not worth being concerned about."
Source: news reports of Associated Press story, August 2011

U.S. National Institutes of Environmental Health Sciences (NIEHS)

NIEHS in June 2011 noted: "Styrene should not be confused with polystyrene (foam)*. Although styrene, a liquid, is used to make polystyrene, which is a solid plastic, we do not believe that people are at risk from using polystyrene products."
Source: NIEHS web site

Otis Brawley, Chief Medical Officer, American Cancer Society

Bloomberg News in June 2011 reported that Brawley said, "Consumers don't need to worry about polystyrene cups and food containers..." Quote: "I see no problems with polystyrene foam* cups."
Source: Bloomberg News, June 2011

Food & Drug Administration

Based on scientific tests over five decades, FDA has determined that polystyrene is safe for use in foodservice products. Polystyrene meets the FDA's stringent standards for use in packaging both to store and to serve food.

Harvard Center for Risk Analysis

A twelve-member panel of international experts selected by the Harvard Center for Risk Analysis reported in 2002 that the very low levels of styrene present in foods – whether naturally occurring or from polystyrene foodservice products – does not represent a concern to human health.

For more information on polystyrene foodservice: www.plasticfoodservicefacts.com
For more information on styrene: youknowstyrene.org

* Original quotes used the term "Styrofoam". STYROFOAM™ is a registered trademark of The Dow Chemical Company that represents its branded building material products, including rigid foam and structural insulated sheathing, and more. The brand name often is misused as a generic term for foam foodservice products.

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John Bucher, associate director of the National Toxicology Program, was quoted in Associated Press reports in August 2011: "The risks, from exposure from polystyrene are not very great," he said. "It's not worth being concerned about."
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For more information on polystyrene foodservice, visit www.polystyrenefoodservicefacts.com
For more information on styrene, visit www.styrene.org

* Original article used the term "Styrofoam". STYROFOAM™ is a registered trademark of The Dow Chemical Company that represents an extruded polystyrene material used for building insulation and floral and craft applications, including insulating. The brand name often is misused as a generic term for foam foodservice products.

CAPITOL WEEKLY
COVERING CALIFORNIA GOVERNMENT AND POLITICS

Safety not the issue with polystyrene foam

By George Cruzan
May 24, 2017

If you've been following the debate in Sacramento over the use of foam cups and food containers in California, you probably have heard some rather outlandish allegations related to their safety.

After 40-plus years as a toxicologist, I can clearly state: There are no adverse health effects on humans from polystyrene foam food and drink containers. As California's elected officials review various proposals, such as recycling these containers, the issue of safety can be set aside.

As we look at the safety of a polymer/plastic such as polystyrene, we should focus on the polymer, not its precursors. And polystyrene polymer is safe.

I suspect that much of the confusion over the safety of polystyrene stems from the similarity in names between polystyrene, a solid plastic, and styrene, a liquid chemical. Although the names sound familiar, polystyrene and styrene are different and have completely different properties. Styrene is a reactive substance that combines to form inert polystyrene. In other words, polystyrene does not have the properties of styrene.

This is true of all polymers (what we typically call plastics): they are different from the substances they are synthesized from. A common example is the difference between sugar and wood. Sugar is a substance with distinct properties. Join many sugar molecules together, and you get cellulose, the main polymer in wood.

So as we look at the safety of a polymer/plastic such as polystyrene, we should focus on the polymer, not its precursors. And polystyrene polymer is safe.

Some have questioned the potential impact of the tiny amount of styrene that can remain in the polystyrene polymer. The amount is minuscule and was difficult to detect until recent technological advances. The amount that potentially can transfer into foods is even smaller and is dwarfed by the amount of styrene that we all come into contact with in our daily lives.

A naturally occurring chemical, styrene was first extracted from the oriental sweetgum tree (also called levant styrax, after which styrene is named). The natural resin can be used as incense or to add a vanilla-like scent, while the oil has a woody aroma. Styrene's chemical structure is similar to cinnamic aldehyde, the chemical component that creates cinnamon's flavor.

Styrene is naturally present in several foods. It has been measured in foods that have not had contact with polystyrene containers. It is present in the highest concentration in coffee, cinnamon, beer and nuts.

In fact, styrene is everywhere in minute amounts. The air surrounding us always contains styrene from automobile exhaust, smoke, plant emissions and other sources. We also may recognize styrene by its distinctive odor (described by some as sweet) when using certain products such as latexes and paints.

The minute amount of styrene that may transfer from polystyrene containers into food or drink is about one-twentieth the overall amount we encounter every day when eating and breathing. Based on U.S. FDA's safety calculations, this overall amount is orders-of-magnitude less than the agency's "acceptable daily intake" of styrene.

In other words, there is no measurable risk. No governmental safety entity considers polystyrene a health risk. Numerous U.S. and state agencies, including the FDA, National Toxicology Program, National Institutes of Environmental Health Sciences, and Cal EPA, have stated such.

There are real risks out there that require our attention. And it's important to make sure we use the best available science to measure and reduce those risks. Polystyrene foam just isn't one of those risks.

Toxicologist George Cruzan has a PhD in chemistry from The King's College and a PhD in biochemistry from Purdue University. He has been a Diplomate of the American Board of Toxicology from 1980 to 2015. He has served as president of ToxWorks, a toxicology consulting firm, since 1995, during which time he occasionally provided professional services to the American Chemistry Council.

http://capitolweekly.net/polystyrene/

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MD Written Testimony

1. Credentials

George Cruzan, PhD. BA in chemistry 1965 The King's College. PhD in biochemistry 1969 Purdue University. Professional toxicologist 1976 to present (41 years), Diplomat of American Board of Toxicology 1980-2015. President of ToxWorks (toxicology consulting firm) 1995 to present (22 years).

Studying health and environmental effects of styrene and leading $20 million research program, 1989 to present (28 years)

2. Sources of Styrene Exposure

Styrene is everywhere in minute amounts. Ambient air always contains styrene from automobile exhaust, cigarette smoke, wood smoke, plant emissions. Average concentration is about 4 microgram (ug)/ cubic meter (m^3). Typical human breathing is 20 m^3/day. Therefore, normal inhalation of ambient styrene from air is 80 ug/day (4 $ug/m^3 * 20\ m^3$).

Styrene is naturally present in several foods. It has been measured in foods that have not had contact with polystyrene containers. It is present in the highest concentration in coffee, cinnamon, beer and nuts. Based on average consumption, it is estimated that the average person ingests 9 ug styrene per day from naturally occurring styrene in their food.

Polystyrene contains some residual unreacted styrene. Typical products contain less than 300 ppm. Thus a typical foam cup, weighing 1.6 grams, will contain less than 0.5 milligram (mg) styrene trapped within the polymer. The residual styrene will migrate from areas of higher concentration to lower areas of concentration. The only styrene that can migrate into food or drink is the styrene that is at the interior surface of the cup. As this styrene migrates from the surface of the cup into the food or drink, additional molecules of styrene migrate to the surface and then into the food. About half of the unreacted styrene will migrate over time to the inside surface and half to the outside surface.

3. Polystyrene

Polystyrene is a polymer synthesized by connecting many molecules of styrene together. Styrene is a liquid; polystyrene is a solid. Styrene is reactive; polystyrene is inert. In other words, polystyrene does not have the properties of styrene. This is true of all polymers; they are different from the monomer they are synthesized from. A common example is the difference between sugar and wood. Sugar is a monomer with distinct properties. Join many sugar molecule together and you get cellulose, the main polymer in wood.

Thus the health effects of polystyrene are based on polystyrene, not on styrene.

4. Health Effects of Styrene

Fiberglass workers have highest exposures, especially in the past. Exposure greater than 50 ppm for 8 hrs may cause headaches, slowed reaction time. Exposures greater than 30 ppm 8 hr/day for more than 10 years may cause a slight reduction in hearing.

US National Toxicology Program lists styrene as reasonably anticipated to be a human carcinogen in Report on Carcinogens. This is based largely on increased lung tumors in mice exposed for styrene for 2 years. Recent research has demonstrated that this is caused by specific metabolism of styrene in mouse lung, which does not occur to a significant extent in rats or humans.

An enzyme CYP2F2 is present in high concentration in mouse lungs. It causes the formation of different metabolites from styrene. In genetically modified mice that do not produce CYP2F2, styrene has not effect in the lung. Rats and humans have much lower levels of CYP2F in the lung and do not have any lung toxicity from styrene.

5. Risk Assessment

Total styrene naturally in food results in ingestion of 9 ug/day styrene. Total styrene migration from all PS foam food service products results in ingestion of 4 ug/day styrene. Inhaled styrene from ambient air results in intake of 80 ug/day styrene. The total styrene intake is about 96 ug/day. Banning PS foam products would reduce that by less than 5%.

US EPA acceptable exposure is 20,000 ug/day. Exposure from PS foam is less than 4 ug/day. 5000 fold safety factor.

The amount of styrene migrating from PS foam foodservice products is so small that there is no measurable risk. Styrene from foam is Not a health issue.

Styrene is a clear, colorless liquid that is a component of materials used to make thousands of everyday products for home, school, work, and play. Products made from polymers derived from styrene add convenience, value, and quality to daily life. They range from packaging such as jewel cases that protect CDs and containers that keep yogurt fresh to toys, recreational equipment, and myriad consumer electronics as well as construction, transportation, medical, health and safety applications. Probably the most recognizable material is polystyrene, often encountered as expanded polystyrene foam.

Scientific Experts Report That Styrene Does Not Threaten Human Health

www.dart.biz/styrene

[1] Tang Weici, Ingrid Hemm, and Gerhard Eisenbrand, "Estimation of Human Exposure to Styrene and Ethylbenzene," *Toxicology* 144, 1-3 (April 2000), pp. 39-50.

[2] U.S. Department of Health and Human Service, National Toxicology Program, Center for the Evaluation of Risks to Human Reproduction, *NTP-CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Styrene* (Washington, D.C.: U. S. Government Printing Office, NIH Publication No. 06-4475, February 2006), Table 5, p. II-7.

[3] See, for example, David H. Steele; Michael J. Thornburg; John S. Stanley; Roland R. Miller; Richard Brooke; Janette R. Cushman; and George Cruzan, "Determination of Styrene in Selected Foods," *Journal of Agricultural and Food Chemistry* 42, 8 (August 1994), pp. 1661-1665.

[4] Most of these data are compiled from Table 5 in U.S. Department of Health and Human Service, National Toxicology Program, Center for the Evaluation of Risks to Human Reproduction, *NTP-CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Styrene* (Washington, D.C.: U. S. Government Printing Office, NIH Publication No. 06-4475, February 2006), p. II-7. The data on styrene exposure owing to residual migration from a polystyrene foam cup is extracted from two sources: S. L. Varner and Charles V. Breder, "Headspace Sampling and Gas Chromatographic Determination of Styrene Migration from Food-Contact Polystyrene Cups Into Beverages and Food Simulants," *Journal of the Association of Official Analytical Chemists* 64, 5 (September 1981), pp. 1122-1130, and Gregory L. Durst and Edward A. Laperle, "Styrene Monomer Migration as Monitored by Purge and Trap Gas Chromatography and Sensory Analysis for Polystyrene Containers," *Journal of Food Science* 55, 2 (March 1990), pp. 522-524. Based on these studies, 5 to 10 part per billion is a reasonable estimate for the amount of styrene migrating into a contained liquid from polystyrene foam cups.

A version of the table found in *NTP-CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Styrene* (with a polystyrene foam cup added from the Varner and Breder & Durst and Laperle sources) can be found below. The data indicate that compared with these six common foods, the high end of styrene exposure from a polystyrene foam cup is slightly higher than beef and coffee beans and considerably lower than styrene exposure from cinnamon. At the low end, styrene exposure from a polystyrene foam cup is comparable to styrene exposure from beef:

Food (except 2) (with no packaging contact)	Range of Styrene Exposure Levels (parts per billion)
1. Cinnamon	170-39,000
2. Beer	10-200
3. Polystyrene Foam Cup	5-10
4. Beef	5.3-6.4
5. Coffee Beans	1.6-6.4
6. Strawberries	0.37-3.1
7. Peanuts	1-2.2
8. Wheat	0.4-2

[5] "SIRC: Frequently Asked Questions," Styrene Information & Research Center web site. <http://www.styrene.org/ faqs.html#health>

[6] The Harvard Center for Risk Analysis (J. T. Cohen; G. Carlson; G. Charnley; D. Coggin; E. Delzell; J. D. Graham; H. Greina; D. Krewski; M. Medinsky; R. Manson; D. Paustenbach; B. Petersen; S. Rapport; L. Rhomberg; P. B. Ryan; and K. Thompson), "A Comprehensive Evaluation of the Potential Health Risks Associated with Occupational and Environmental Exposure to Styrene," *Journal of Toxicology and Environmental Health* 5, 1-2 (January 2002), pp. 1-263.

The Safety of Styrene

in Selected Foods and in Polystyrene Foam Cups

DART

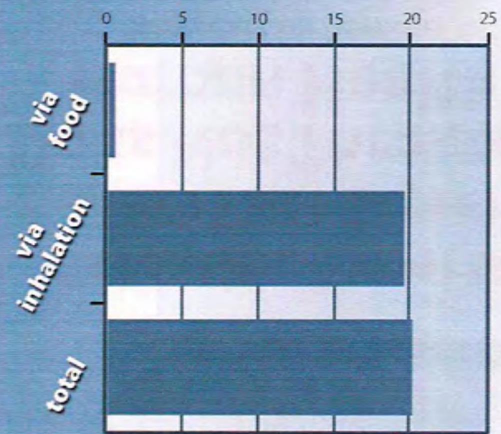


Figure 1 Average Annual Styrene Intake - High End Range

Most people are exposed to styrene every day in tiny amounts that may be present in the air, primarily from automobile exhaust and cigarette smoke, or that occur naturally in food such as cinnamon, beef, coffee beans, peanuts, wheat, and strawberries. These generally are trace amounts, which were difficult to detect until recent technological advances improved scientists' ability to measure minute amounts of chemicals. Figure 1 shows the average annual styrene intake (at the high end of the range) based on sources of exposure.[1]

Figure 2 shows levels of naturally occurring styrene in selected foods as compared with styrene that migrates from a polystyrene foam cup.[2] In the final analysis, all credible research indicates that it is safe for consumers to consume cinnamon, beef, coffee beans, peanuts, wheat, and strawberries and to use polystyrene foam foodservice containers.[3]

Numerous studies have found that styrene is not harmful in the amounts we sometimes encounter in air or food. In 1994, after an exhaustive assessment of styrene's possible health and environmental effects, the Canadian government ministries Health Canada and Environment Canada concluded that styrene is "non-toxic" for regulatory purposes. Health Canada found that styrene "does not constitute a danger to human life and health" and "does not constitute a danger to the environment on which human life depends."[5] In 2002, a twelve-member panel of international experts selected by the Harvard Center for Risk Analysis reported that styrene is naturally present in foods, and the styrene levels in these foods does not represent a threat to human health.[6]

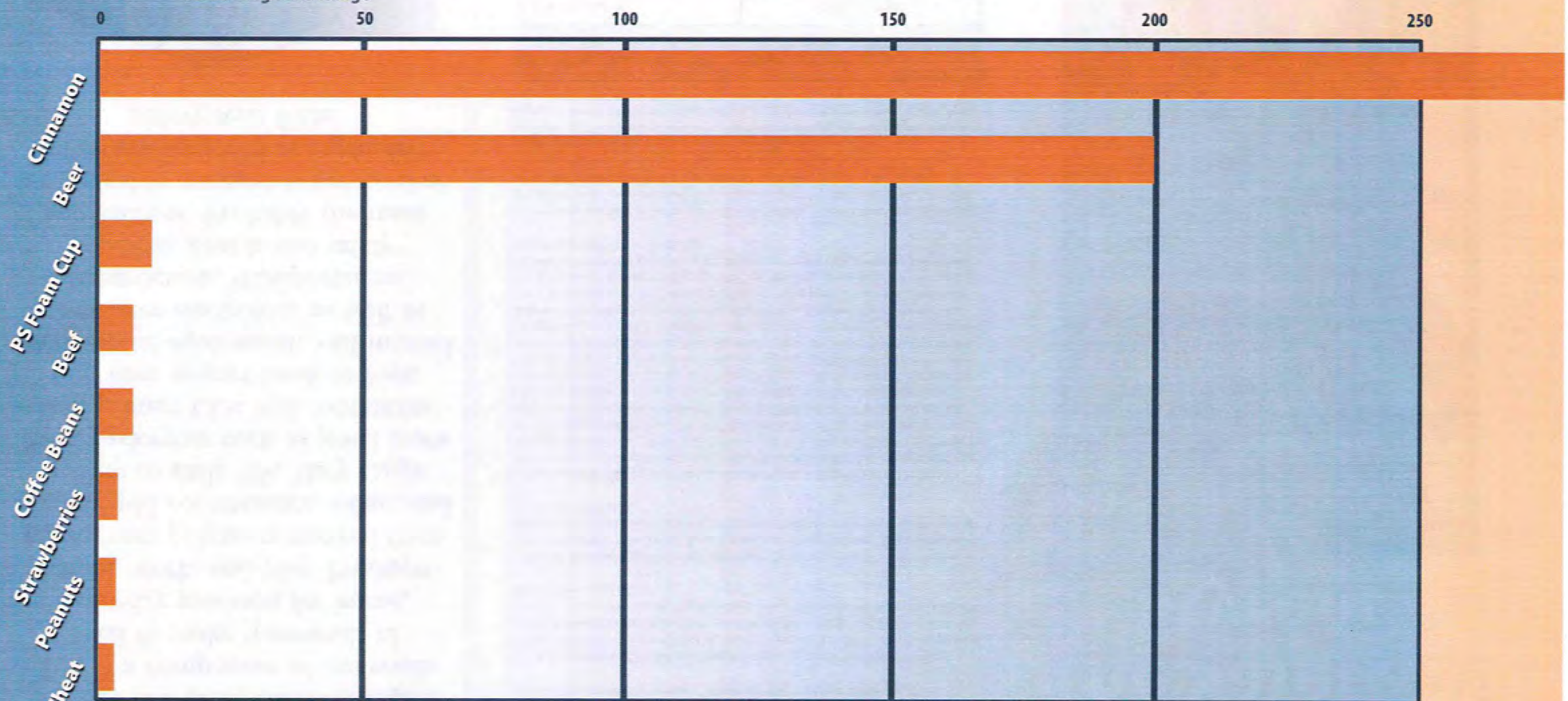


Figure 2 Styrene in Selected Foods and Polystyrene Foam Cup Migration (Parts Per Billion)

What makes polystyrene so different from styrene? It's a matter of chemistry

BY AMERICAN CHEMISTRY ON JULY 29, 2014 IN INDUSTRY

The U.S. National Academy of Sciences (NAS) has released its review of the U.S. National Toxicology Program's (NTP) June 2011 decision to include styrene in its 12th Report on Carcinogens (RoC).

In reviewing the NAS findings, it's important to understand the differences between the two. Styrene, a liquid, and polystyrene, a solid, are fundamentally different. Styrene is a liquid that can be chemically linked to create polystyrene, which is a solid plastic that displays different properties.

Polystyrene is used to make a variety of important consumer products, such as foodservice containers, cushioning for shipping delicate electronics, and insulation.

Although the names sound familiar and may be confusing, styrene and polystyrene are different and have completely different properties.

Polystyrene's safety profile is so strong that the U.S. Food and Drug Administration (FDA) has reviewed the safety of polystyrene to be used in direct contact with foods and beverages – and for 50 years, has confirmed polystyrene to be safe for this use. The NTP agrees that the safety of polystyrene in foodservice is not in question – pointedly saying that the safety of styrene is "not an issue."

And, styrene's appearance in the 12th RoC doesn't change the decades of research that demonstrate ***polystyrene's*** safe use in foodservice packaging.

For more information on the benefits and safety of polystyrene, click here.

Two different chemistries

Polystyrene

The Basics: When styrene molecules become linked together into a polymer, polystyrene is created. Polystyrene is an inert plastic that can be used to make many products, such as polystyrene foam used to make disposable plates, cups and other foodservice packaging products.

How It's Used: Polystyrene is used in many applications. One application is foodservice – polystyrene foam is a clean and affordable option to insulate food and to keep it fresher for a longer period of time. Polystyrene foam is a lightweight material, about 95% air, with very good insulation properties and is used in many types of products, such as cups that keep your beverages hot or cold. Polystyrene foam is also widely used in cushioning or protective packaging that helps keeps computers and appliances safe during shipping. Most people incorrectly use the name STYROFOAM® to refer to polystyrene; STYROFOAM® is a registered trademark of The Dow Chemical Company that refers to its branded building material products.

Styrene

The Basics: Styrene is a clear, colorless liquid that is a component of materials used to make thousands of everyday products. Styrene occurs naturally in many foods, such as cinnamon, beef, coffee beans, peanuts, wheat, oats, strawberries and peaches. Synthetic styrene, which is chemically identical to naturally occurring styrene, is manufactured as a chemical building block for materials used to make packaging, insulation, automobiles, electronics, boats, and recreational vehicles.

How It's Used: For more than 70 years, styrene has been used a chemical building block used to manufacture many familiar products, such as food containers, rubber tires, building insulation, carpet backing and reinforced fiberglass composites such as boat hulls, surfboards, residential kitchen countertops, bathtubs and shower enclosures.

American Chemistry Council | Plastics Food Service Packaging Group

Carroll County Environmental Advisory Council (EAC)
Follow up information from May 16, 2018 Agenda Item
Expanded Polystyrene (EPS) Foam Reduction Project - Discussion
August 13, 2018

Follow up information to discussion provided by Sarah Peters, representing Dart Container Corporation and the Plastic Foodservice Packaging Group (PFPG), of which Dart is a member

Introduction: My name is Mike Levy, Director, Plastics Foodservice Packaging Group (PFPG) of the American Chemistry Council, a group which represents the leading suppliers and manufacturers of plastics foodservice packaging products, including polystyrene food and beverage containers. Several of our industry companies and customer groups in Maryland are also here today to participate in this discussion of the proposed ordinance. Dart Container Corporation is a member of our group, and we are providing you information that we hope will be helpful as the EAC develops a report with various options on expanded polystyrene foam (EPS) foodservice and how they can contribute to waste reduction in Carroll County.

What we support: Instead of banning or restricting a valuable product such as polystyrene foam (EPS) as the EAC studies this issue and develops reports and recommendations for Carroll County,, we support the concept of litter education and prevention, waste minimization and recycling, and providing these low cost, safe and hygienic foodservice products that hospitals, schools, nursing homes, and cafeterias in Carroll County and throughout MD have used for decades. Our industry has been a big supporter of these programs nationwide, and polystyrene foam foodservice is both an economical and overall sustainable choice for food establishments and consumers.

Why are providing you with this information on EPS foodservice?: We have found ordinances and bans several cities and counties are based on many misperceptions about polystyrene foam foodservice products in schools, retail, cafeterias, nursing homes – that it cannot be recycled, that it is not the most sustainable foodservice materials to use (compared to alternative foodservice), that there are health and safety issues with using EPS foodservice, and that EPS foodservice contributes a large part of the litter and waste stream. Several cities and states like Maryland have proposed bans on safe products like polystyrene foam foodservice as a way to solve the litter or waste problem. We know from experience that bans do not solve these issues, and merely substituting one type of foodservice mare trial for another will not result in any environmental improvement. The state of Maryland rejected proposals in both 2017 and 2018 to enact a statewide ban on polystyrene foam foodservice. No state has ever enacted a ban on an FDA approved foodservice item like polystyrene foam.

We believe in working collaboratively with cities and counties like Carroll County who want to achieve the same goals we do – less waste less litter, and use of products like EPS foodservice that for 50 years bring value and performance to food establishments who use them, at a very low cost.

Building on Sarah Peter's attendance and discussion with you at the May 16th EAC meeting and discussion on EPS foam foodservice,, I'd like to highlight some of the uses, costs and environmental benefits of polystyrene foam foodservice, and hopefully lease the way toward keeping these products and choice available to all Carroll County residents – as well as answer any questions you may have.

Polystyrene foam foodservice uses and benefits and cost compared to alternative foodservice

PS foodservice is a safe, low cost, and efficient foodservice packaging that has been used for over 50 years. It has performance benefits that make it a preferred choice – from PS lids used on all hot beverage material (paper and plastic) to prevent burning from leaky seals, to PS foam cups and clamshells that utilize 98% air as insulation, keeping hot foods hot and cold liquids cold. Polystyrene foodservice containers – both foam polystyrene (e.g., cups, clamshells, plates) and solid polystyrene (e.g. cups, lids) are anywhere from 2-3 less expensive than coated bleached paperboard items, and 2-4 times less expensive than compostable alternatives.

Fiscal impact restricting EPS foam foodservice in cities, counties and in the state

As Carroll County prepares a report on EPS "foam foodservice, you should examine the fiscal impact of what this would have for users of these packaging. A recent 2017 independent study (https://plasticfoodservicefacts.com/Pages/Fiscal-Impacts-of-Prohibiting-Expanded-Polystyrene-Food-Service-Products-in-Maryland.pdf) on the fiscal impacts the impacts of statewide ban proposals just for polystyrene foam foodservice finds: (a) estimated purchases of all PS foam foodservice products in state of MD is estimated at $41.0 million dollars; (b) the overall cost to the state of banning PS foam foodservice (to restaurants, agencies, convenience stores, grocery stores, non-commercial) is $34.9 million dollars; (c) the percentage for the cost increase is 85%; and (d) that means for every $1 now spend on polystyrene foam foodservice ware, state agencies, schools, hospitals, nursing homes, cafeterias, and businesses will have to spend at least $1.85 on the alternatives replacements (biodegradable, compostable, coated paperboard), effectively doubling the costs to businesses and consumers. This study incorporated all the MD DGS procurement prices along with a couple of other state agencies, and two county school agencies. It also adjusts for the two existing bans in Montgomery County and Prince Georges County. Independent price lists show the cost of paper and compostable product alternative to expanded polystyrene foam (cups, trays, and dinnerware) would range from 2-4 times more than expanded polystyrene foam. At a time when Maryland and counties like Carroll County looking to reduce costs, eliminating an environmentally preferable and low cost product from both state procurement and retail like polystyrene foodservice containers and beverage packaging would be counterproductive. This means Carroll County would see these kinds of cost impacts if EPS foam foodservice were restricted or banned.

Environmental Footprint – A full environmental picture is critical when comparing foodservice options – and we ask that when you evaluate polystyrene foam foodservice you do so in comparison to substitute products. It's easy to focus only on a product's end of life since that's what consumers see – but the environmental footprint of any product includes all of its impacts, such as raw material use, resources used in manufacture, fuel use and emissions in transport and more (see Sanitation above). A peer reviewed study finds that commonly used cups, plates, and sandwich containers made of polystyrene foam use significantly less energy and water than comparable paper-based or corn-based (polylactic: PLA) alternatives, primarily due to polystyrene foam's lower weight. A Life Cycle Inventory (LCA) study[1] conducted on foam polystyrene, paper-based, and PLA (corn-based) foodservice products showed PS foam containers have very low footprint compared to alternatives. Key findings from this study were:

- Energy use: Polystyrene foam products consume significantly less energy than the alternatives- half as much as wax-coated paperboard cups and one-third as much as PLA clamshells.
- A polystyrene hot beverage cup requires about 50% LESS energy to produce than a similar plastic-coated paperboard cup with a corrugated cup sleeve
- Water use: Polystyrene foam products use significantly less water than the alternatives-up to four times less than PLA clamshells.

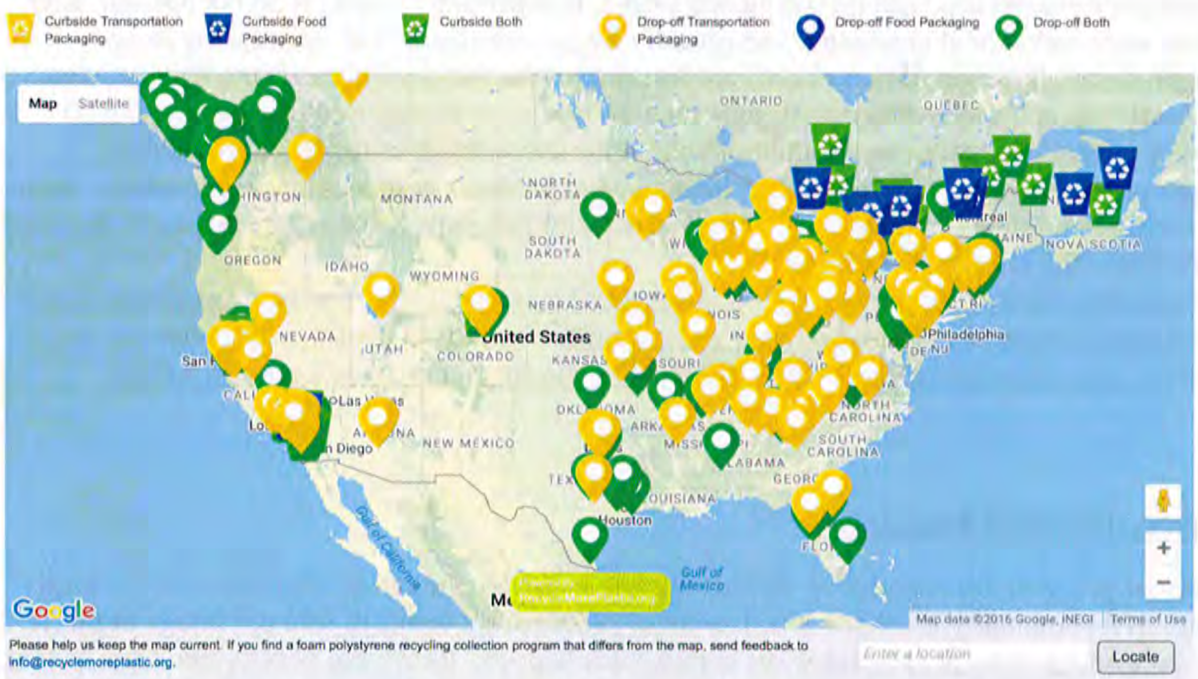
[1] Life Cycle Inventory of Foam Polystyrene, Paper-Based, and PLA Foodservice Products, Franklin Associates, A Division of ERG, Feb 4, 2011

- Solid waste: Polystyrene foam products create significantly less solid waste by weight than the alternatives-up to five times less than paperboard and PLA products.
- Greenhouse gases - A polystyrene foam cup creates significantly fewer greenhouse gas emissions than a similar coated paper-based cup with its corrugated sleeve. If paperboard products do not degrade after disposal, they store carbon and generate fewer greenhouse gas emissions than polystyrene foam foodservice produces; however, if paperboard product degrade to the maximum extent, they generate more greenhouse gas emissions than polystyrene foam products, so comparison of greenhouse gas emissions vary widely depending on assumptions about the degradation of paperboard products.
- Lower weight products – The study found that lower weight products with similar functionality – such as polystyrene foam products composed of more than 90% air generally produce smaller environmental burdens. A link to the release of the study: (http://www.americanchemistry.com/Media/PressReleasesTranscripts/ACC-news-releases/New-Study-Polystyrene-Foam-Cups-and-Plates-Use-Less-Energy.html) as well as to the full peer reviewed study is provided here - http://plasticfoodservicefacts.com/Life-Cycle-Inventory-Foodservice-Products.

Variety of Polystyrene Recycling Programs:

Polystyrene foodservice products are recycled in various ways in many communities, depending on the local solid waste program. If a community, a school, a restaurant or supermarket wants to take advantage of plastic foodservice product recycling, there are several ways to make that happen. Recycling polystyrene foam is fairly simple. The plastic products must be collected (free of major food debris) and delivered to a facility close enough to make the transport economical. (Because foam packaging is more than 90% air, most programs "densify" the products to get more on a truck.) The plastic is then ground up, heated and recast into plastic pellets. These pellets are sold to companies that make products such as "green building" construction materials, consumer products and plastic packaging. The website below highlights different venues – schools, restaurants, cities, national parks – that recycle foam and also contain videos that walk through the various aspects of polystyrene foam recycling: There are over 500 curbside/drop off programs nationwide recycling polystyrene foam foodservice and protective packaging. These sites are regulatory updated, have 511 locations as of November 2016, and there is a spot-check of the website link:

regulatory:http://www.recyclemoreplastic.org/plastics/eps_map.html



Many schools that use expanded polystyrene foam have recycling programs. One particular organization, Foodservice Sustainability Solutions (FSS), http://www.styrosmart.com/modx/ specializes in waste stream reduction and recycling for commercial and institutional foodservice expanded polystyrene waste and school waste. They provide real results from the six schools in the Houston Integrated school District involving recycling of expanded polystyrene foam foodservice resulting in 100% landfill diversion, reduction greenhouse gases, cutting waste removal cost by 70%, reduction trash bag costs, and trash bag usage. This is a model that can be used in many schools.

Recycling solutions for post-use foodservice are emerging – new grant program for polystyrene foam announced.
Polystyrene foam foodservice packaging is being recycled in many communities across the country. The foodservice industry through its Foam Recycling Coalition's launched a new grant program this year to help fund infrastructure for the collection, processing and marketing of products made for polystyrene foam (www.fpi.org/recyclefoam). The grant program targets post-consumer polystyrene foam products such as foodservice packaging (i.e., cups, plates, bowls, clamshells, cafeteria trays); egg cartons; meat rays; and protective "transport" packaging. Albany County can apply for such grants.
A new study by the Berkeley Research Group (*Market Analysis of End Uses for Recycled Post-Consumer expanded polystyrene food ware*) found nearly 140 companies that process or use recycled post-consumer foam, including food ware, in the U.S. and Canada (http://www.fpi.org/fpi/files/ccLibraryFiles/Filename/000000000779/BRG%20Memo%20Report%2010-9-2014.pdf) .
Banning this product when it can be recycled is not a sustainable solution.

Litter will not be reduced if EPS foam foodservice were restricted in Carroll County– and bans do not work

Polystyrene foam foodservice, which makes up a very small amount of the litter stream (according to a 2012 study, commonly used polystyrene foam foodservice products make up 1.5 percent of litter), will not reduce litter. The reason is simple: the substitute foodservice products in ordinances or policies that restrict EPS foam foodservice that are required are littered as well. **Substituting one type of litter for another is not a smart strategy.** For example, when San Francisco placed restrictions on the use of certain plastic foodservice products, the city found that alternatives became more littered. (Source: "The City of San Francisco Streets Litter Re-Audit 2008, prepared for the City of San Francisco Environment Department, July 4, 2008, http://sfenvironment.org/downloads/library/2008_litter_audit.pdf)

How much of the litter in the Anacostia River Shed comes from polystyrene foam foodservice?

With the assistance of Metro COG, Anacostia Watershed Society and a former Ocean Conservancy staffer, an independent firm Environmental Resources Planning conducted a comprehensive litter survey of the Anacostia Watershed in 2014. The survey area encompassed portions of Montgomery and Prince George's counties and D.C. in order to credibly gauge the amount and composition of litter adjacent to indicator streams identified by Anacostia Watershed Society. The methodology consisted of tallying each littered item and noting its material composition, the methodology generally used with litter surveys conducted throughout the U.S.

This study, however, was an unprecedented collaboration between the environmental community and industry. Since industry contributed to funding this study, it was decided that the environmental community would play an active role in this project all along the way. Metro COG, Jim Foster, President of the Anacostia Watershed Society and Masaya Maeda, their chief scientist, all provided information used for the site selection process. Anacostia Watershed Society selected a number of the non-roadway sites. Sonya Besteiro, formerly Ocean Conservancy's Associate Director of their International Coastal Cleanup for 11 years, was one of the field surveyors.

Results: The data, vetted by a Ph.D. statistician, showed that polystyrene foam food service items totaled 2.4 percent of visible litter on roadways and 4.8 percent on non-roadways. These same items totaled 0.4 percent of small litter on roadways and 3.8 percent on non-roadways.

The data from this study are being used by Maryland State Highway Administration to address EPA litter abatement initiatives with which they have been tasked to address. Survey and detailed site data were also provided to Montgomery County DEP and Metro COG, at their requests.

And economic studies demonstrate that bans adversely affect the economy, as consumers and business absorb increased costs of alternatives. For example, more than a decade and a half after the city of Portland, OR, restricted polystyrene foam foodservice products at certain venues in 1990, the Cascades Policy Institute reviewed the economic effects, environmental myths and the reaction of the community: "Studying the true environmental effects of this law shows that due to the methods used to produce alternatives and their poor insulation qualities, the ban keeps one of the best environmental choices off the market."

Composting: Not a Simple Solution – Many people believe that communities could easily compost paper-based and other "biodegradable" foodservice products. But it's not that simple. These used foodservice items would still need to be collected, separated and delivered to a large-scale compositing facility, of which there are few in the U.S. In the absence of such a facility, these products generally end up in landfills. Once in landfills, they do not readily break down because modern landfills are actually designed to retard decomposition. Anne Arundel County does not have an infrastructure or meaningful industrial composting facility to compose food service ware. This waste is going to the same landfills polystyrene foam went to, and weights 3-4 times more – generating more waste than before the ban.

Landfills, Biodegradation and Litter – – According to the most recent USEPA Characterization of Municipal Solid Waste report – link http://www.epa.gov/osw/nonhaz/municipal/pubs/MSWcharacterization_fnl_060713_2_rpt.pdf, all plastic foodservice products contribute approximately 1% of waste generated, whereas paper and paperboard make up the largest components of MSW materials generated (28%). Landfills are not filling up with polystyrene foam or plastics – they are filling up with paper and paperboard as the largest contributors. While popular culture has led many to believe that burying our nation's garbage in landfills is sort of like creating big compost heaps, modern landfills are specifically designed to minimize decomposition. The small amount of degradation that does occur in a landfill often generates methane, a much more potent greenhouse gas than CO_2. By requiring biodegradable alternatives to polystyrene foam foodservice ware, Carroll County my perpetuate the myth that "biodegradable" foodservice will "disappear" as litter or degrade in landfills – neither has been proved scientifically. Products like polystyrene foam are inert and do not break down in landfills – that is a positive attribute. The Biodegradable Products Institute (BPI), a not-for-profit association of key individuals and groups from government, industry, and academia, has a mission to education manufacturers, legislators and consumers about the importance of scientifically based standards for compostable materials which biodegrade in large composting facilities.

Under their "Myths of Biodegradation", BPI states:

Myth: Biodegradable products are the preferred environmental solution because waste simply biodegrades in the landfill.

Reality: Nothing biodegrades in a landfill because nothing is *supposed* to.

http://www.bpiworld.org/Default.aspx?pageId=190439

Keep America Beautiful and its affiliates provide expertise and research in successfully reducing litter. For instance: Keep Los Angeles Beautiful conducted a study (*Littering and the iGeneration – City-Wide Intercept Study of Youth Litter Behavior in Los Angeles*, prepared by Keep Los Angeles Beautiful by S. Groner Associates in collaboration with Action Research, January 21, 2009, http://webcache.googleusercontent.com/search?q=cache:n4sSMRAfFdIJ:www.cleanup-sa.co.za/images/Littering%2520and%2520the%2520iGeneration_Youth%2520Litter%2520Study%2520for%2520KLAB%2520.pdf+&cd=1&hl=en&ct=clnk&gl=us) to better understand littering behavior among 16-24 year olds. The study helped identify a set of barriers and situations/issues that prevented this age group from properly disposing of trash. The study found that waste perceived as biodegradable was also more likely to be littered which may explain why littering of alternatives increases after foam bans. The report is available for municipalities who seek to design successful litter reduction programs in their communities.

Plastics and marine debris – prevention and solutions

A recent 2015 study released by Ocean Conservancy's *Stemming the Tide: Land-based strategies for a plastic-free ocean* conducted with the McKinsey Center for Business and Environment, that evaluates specific land-based solutions for plastic waste in the ocean, provides the roadmap for a more targeted offense to tackle "ocean plastic". Recent research by Dr. Jenna Jembeck published in *Science* Magazine estimated that roughly 8 million tons of plastic enters the ocean each year and that 57% of it originates in five countries (China, Indonesia, Philippines, Vietnam and Thailand). These are rapidly developing economies in areas where waste management infrastructure hasn't yet caught up to a growing population's ability to consume more goods. Similar factors could easily give rise to these conditions in other regions (e.g., Brazil, India or countries in Africa). *Stemming the Tide* builds on these findings by highlighting solutions to contain waste—in essence to stop the "leakage" at the source. Solutions like, containing landfill waste, stopping illegal dumping, increasing recycling, and incorporating energy recovery technologies, such as gasification and pyrolysis, are featured as possibilities for change. *Stemming the Tide* is a welcome resource that helps us understand and prioritize solutions.

A 2015 UNEP (United Nations Environmental Programme) report, *"Biodegradable Plastics & Marine Litter – Misconceptions, Concerns and Impacts on Marine Environments"*, was commissioned to provide a concise summary of some of the key issues surrounding the biodegradability of plastics in the oceans, and whether the adoption of biodegradable plastics will reduce the impact of marine plastics overall. One of the key conclusions was a statement, "On the balance of the available evidence, biodegradable plastics will not play a significant role in reducing marine litter". This reinforces the findings of the Stemming the Tide: Land-based strategies for a plastics-free ocean report, described above.

Foodservice Safety:

For more than 50 years, the U.S. Food and Drug Administration has approved the use of polystyrene for foodservice products. Polystyrene foodservice products offer a sanitary way to serve fresh food and to help prevent the spread of disease at school, restaurants, hospitals ... even at home.

While some have raised questions about occupational exposures to styrene, the U.S. National Institutes of Environmental Health Sciences made clear that these don't apply to polystyrene, noting in June 2011: "Styrene should not be confused with polystyrene (Styrofoam). Although styrene, a liquid, is used to make polystyrene, which is a solid plastic, we do not believe that people are at risk from using polystyrene products."

The toxicologist who heads the National Toxicology Program was widely quoted in June 2011 news reports: "Let me put your mind at ease right away about Styrofoam" and noted that levels of styrene from polystyrene containers "are hundreds if not thousands of times lower than have occurred in the occupational setting ... In finished products, certainly styrene is not an issue." John Bucher, associate director of the National Toxicology Program, was quoted in Associated Press reports in August 2011: "The risks, in my estimation, from polystyrene are not very great," he said. "It's not worth being concerned about."

Health experts and agencies have all agreed and stated that styrene should not be confused with polystyrene, and levels of styrene in polystyrene foodservice products pose no risk to consumers. It's important to understand the differences between styrene and polystyrene. Styrene, a liquid, and polystyrene, a solid, are fundamentally different. Styrene is a liquid that can be chemically linked to create polystyrene, which is a solid plastic that displays different properties. Polystyrene is an inert plastic that can be used to make many products, such as polystyrene foam used to make disposable plates, cups and other foodservice packaging. The amount of styrene in polystyrene is extremely small. These agencies include the National Toxicology Program (NTP), U.S. National Institutes of Environmental Health Sciences (NIEHS), American Cancer Society, FDA, and the Harvard Center for Risk Analysis. **Attachment A** is provided with this expert and agencies views.

Sources of Styrene Exposure – How much styrene is in our foods and packaging?

Styrene is everywhere in very small amounts. The air we breathe always contains styrene from automobile exhaust, cigarette smoke, wood smoke, plant emissions. *So what does this mean for the average consumer?* Styrene is naturally present in several foods. It has been measured in foods that have not had contact with polystyrene containers. It is present in the highest concentration in coffee, cinnamon, beer and nuts. Based on average consumption, it is estimated that the average person ingests 9 micrograms (*ug*) styrene per day from naturally occurring styrene in their food. Compare that to the FDA acceptable daily intake (ADI) value for styrene which is considered to be 90,000 *ug*/person/day – and you can see consumers can feel assured their estimated dietary intake of styrene is more than four orders of magnitude less than the ADI. (https://plasticfoodservicefacts.com/main/Safety/Safety-of-PS-Foodservice-Products) **There is more styrene in cinnamon (170 to 39,000 parts per billion), beer (10 to 200 parts per billion), and beef (5.3 – 6.4 parts per billion) than there is in a polystyrene foam cup (5 to 10 parts per million).** It makes no sense to promote public policy to ban a product like polystyrene foam foodservice because of its alleged styrene levels when it has less exposure to consumers than everyday foods we eat – like cinnamon, beer and beef. The key is how much styrene do consumers get exposed to – and the answer is, very little

Sanitation: Studies at foodservice operations demonstrate that polystyrene foodservice packaging can be more sanitary than reusable china or glassware that are dependent on proper washing. A 2012 sanitation study in Sacramento, CA, found that reusables had higher microbial levels than single use items. A 2007 study in Wisconsin found that unprotected tables and trays had 7 to 23 times higher bacterial counts than those with single-use placemats and tray covers. And a 2002 study in Las Vegas found that 18 percent of reusable items tested had higher than acceptable bacterial counts.

Reusable cups, dishes, plates, utensils, place mats, table coverings and other products require copious amounts of water and energy to clean, time and time again. Polystyrene foodservice packaging conserves these important resources and allows our schools and hospitals to save the water, energy, detergents – and money and labor – required to sanitize reusables. And when dishwashers are down or malfunctioning, foodservice operators actually are required to use sanitary, single-use foodservice under code requirements in order to protect health and safety.

Conclusion:
As Carroll County and the EAC discusses, researches and examines this scientific and economic data about EPS foam foodservice and determines policies on how this product fits into the Counties waste management and reduction plans, we hope you will see that banning or restricting EPS foodservice in the County is both costly to the County and results in no environmental benefit (substitute biodegradable and compostable food service ware products have a higher footprint than polystyrene foam foodservice ware), and would be counter to all other states, and most cities, who have concluded that bans on low cost foodservice ware like PS foam do not work. The plastics foodservice industry has experience and interest in working with localities, and feels positive programs like recycling, recovery from waste, and waste reduction go a long way in meeting sustainability goals for government and industry alike. Recycling expanded polystyrene foam foodservice is a much better alternative than a ban or restriction.

To summarize, we hope you will take up our offer to use our resources to work with you to examine all foodservice packaging as part of the Counties report on how they can take measures to reduce the amount of packaging to the waste stream. We hope you will incorporate common sense approaches such as recycling and anti-litter partnerships that already are proving successful in the EAC report and recommendations. As for the public health and sanitation benefits of polystyrene foodservice, public schools and public institutions of higher education, nursing homes, hospitals, cafeterias, and consumers can be assured these are very safe and economical products for Anne Arundel County residents to continue to use.

Thank you for your consideration in this matter, and feel free to contact us.

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FOODSERVICE PACKAGING INSTITUTE

FOAM RECYCLING COALITION GRANT PROGRAM

Since 2015, the FRC has awarded grants used to increase foam recycling. Additional grant recipients will be announced on an ongoing basis. See the dropdowns below for more information.

+ **Eligible Entities**

+ **Funding Source, Grant Amounts and Cash Match**

+ **Contract Requirements and Terms**

+ Application Instructions, Due Date and Selection Process

+ Questions

DOWNLOAD GRANT APPLICATION

GRANT RECIPIENTS

- Alpine Waste and Recycling, Commerce City, Colorado - $45,000 | Case Study
- Colchester County, Nova Scotia, Canada - $50,000 | Case Study | Video tour of Colchester Materials Recovery Facility
- Athens-Clarke County, Georgia - $29,000 | Press release
- McLeod County, Minnesota - $50,000 | Press release
- City of Redding, California - $49,000 | Case Study | Press release
- Madison County Department of Solid Waste, Canastota, New York - $42,925 | Press release
- Agilyx, Tigard, Oregon - $50,000 | Press release
- Pyrowave, Montreal, Quebec - $50,000 | Press release

- Gaudreau Environnement, Victoriaville, Quebec - $49,250 | Press release

Executive Summary

EXTENSION OF 2006 LIFE CYCLE INVENTORY OF FOODSERVICE PRODUCTS:

ADDITION OF PLA PRODUCTS, END-OF-LIFE CARBON FOOTPRINT, AND WATER USE

Prepared for

THE PLASTIC FOODSERVICE PACKAGING GROUP

by

FRANKLIN ASSOCIATES, A DIVISION OF ERG
Prairie Village, Kansas

February 4, 2011

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ABBREVIATIONS

CO_2 eq: Carbon dioxide equivalents

EMR: Energy of material resource

EOL: End of life

EPS: Expanded polystyrene

GHG: Greenhouse gas

GPPS: General purpose polystyrene

GWP: Global warming potential

IPCC: Intergovernmental Panel on Climate Change

LDPE: Low density polyethylene

LF: Landfill

LFG: Landfill gas

MSW: Municipal solid waste

PLA: Polylactide resin

PS: Polystyrene resin (used to refer to both EPS and GPPS)

WTE: Waste to energy

EXECUTIVE SUMMARY

INTRODUCTION

A life cycle inventory examines the sequence of steps in the life cycle of a product system, beginning with raw material extraction and continuing on through material production, product fabrication, use, reuse or recycling where applicable, and final disposition. For each life cycle step, the inventory identifies and quantifies the material inputs, energy consumption, and environmental emissions (atmospheric emissions, waterborne wastes, and solid wastes). The information from this type of analysis can be used as the basis for further study of the potential improvement of resource use and environmental emissions associated with product systems. It can also pinpoint areas (e.g., material components or processes) where changes would be most beneficial in terms of reduced energy use or environmental emissions.

This study is an extension of a peer-reviewed life cycle inventory (LCI) completed in 2006 for the Polystyrene Foodservice Packaging Council (PSPC), which is now known as the Plastic Foodservice Packaging Group (PFPG). Although the study is conducted as a life cycle inventory, this analysis includes the evaluation of the impact category global warming potential (GWP) using 100-year GWP factors from the Intergovernmental Panel on Climate Change (IPCC).

STUDY GOAL AND INTENDED USE

The goal of this study is to extend the scope of the 2006 PSPC LCI to include the following additions:

1. Production and disposal of available PLA products corresponding as closely as possible to the average weight foodservice products in the original LCI,
2. Modeling of the carbon footprint implications of landfilling and waste-to-energy (WTE) incineration of the average weight foodservice products from the original study and the PLA products,
3. Addition of water use to the life cycle inventory results.

The primary intended use of the study results is to provide PFPG with more complete information about the environmental burdens and greenhouse gas impacts from the life cycle of disposable foodservice products. Because this study is based primarily on **average weight** polystyrene foam and paperboard products from the original PSPC study, plus limited availability of PLA product samples, **the results of this study should *not* be used to draw general conclusions about comparative results for the full range of product weights available in each product category**.

Because the study will be made publicly available on the ACC website, the completed report has been peer reviewed prior to release. The peer review report is included as an appendix to this report.

SYSTEMS STUDIED

The following foodservice product categories are included in the analysis:

- 16-ounce hot cups (EPS foam, poly-coated paperboard with and without a corrugated sleeve, PLA-coated paperboard with and without a corrugated sleeve)
- 32-ounce cold cups (EPS foam, poly-coated paperboard, wax-coated paperboard, solid PLA)
- 9-inch high-grade plates (GPPS foam, poly-coated paperboard, bleached molded pulp, solid PLA)
- Sandwich-size clamshells (GPPS foam, corrugated paperboard, solid PLA)

EPS and GPPS foam products have different structures because of differences in how the blowing agent is added. For EPS products, the blowing agent is incorporated into the resin bead. At product manufacture, the beads are expanded with steam, resulting in products consisting of fused expanded beads. For GPPS products, the resin delivered to the converter is solid and does not include blowing agent. The converter introduces the blowing agent into the molten resin, producing a product with a continuous foamed structure.

For the most part, the products modeled in this analysis are based on the average weight products in the 2006 PSPC study. For the new category of PLA products, a literature search was conducted for published information on weights of PLA foodservice products, and product samples were ordered from several companies.

Although the goal of the study was to model PLA products that corresponded as closely as possible with the PSPC study foodservice products, no PLA foam products were found. Therefore, for the cold cup, plate, and clamshell applications, solid PLA products are analyzed. Since the properties of PLA are not suitable for hot cups to be made entirely from PLA, in the hot cup category a 16-ounce hot cup PLA-coated paperboard hot cup is evaluated.

For the category of plates, the 2006 PSPC study analyzed plates that were categorized as heavy-duty plates. These were the heaviest and sturdiest plates available; however, information on the relative strengths of these plates was not available. This report also includes results for two lighter-weight plates from a 2009 study. The 2009 plates are in a different weight class from the heavy-duty plates from the 2006 study and should not be directly compared to the 2006 heavy-duty plates. Results for the two lighter class plates are provided for two reasons: (1) to illustrate how LCI results can vary based on the weight of the product, and (2) to present a comparison based on actual equivalent strength (since strength information was not available for the heavy-duty plates).

The product weights analyzed in this study are listed in Table ES-1, together with a brief description of the source of the weight data.

SCOPE AND BOUNDARIES

The PSPC LCI included all steps in the production of each foodservice item, from extraction of raw materials through production of the finished product. In this analysis, the evaluation of foodservice products utilizing PLA uses corresponding scope and boundaries. The modeling for PLA production begins with corn growing and continues through production of PLA resin and fabrication of PLA foodservice products.

This analysis builds upon the original 2006 study, using the average product weights from that study. The scope of this study did not include updating the full range of product weights available in the marketplace. Readers interested in results for the full range of product weights for polystyrene foam and paperboard products are encouraged to refer to the 2006 study.[1]

In the U.S., municipal solid waste (MSW) that is not recovered for recycling or composting is managed by landfilling and waste-to-energy (WTE) incineration. The relative percentages of MSW managed by these methods is approximately 80 percent by weight to landfill (LF) and 20 percent by weight to waste-to-energy (WTE) incineration.[2] For material that is disposed by WTE combustion, an energy credit is given based on the amount of each material burned, its higher heating value, and the efficiency of converting the gross heat of combustion to useful energy.

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1 "Final Peer-Reviewed Report: Life Cycle Inventory of Polystyrene Foam, Bleached Paperboard, and Corrugated Paperboard Foodservice Products." conducted by Franklin Associates, Ltd. for PSPC in March 2006. Available at http://www.americanchemistry.com/s_plastics/bin.asp?CID=1211&DID=9088&DOC=FILE.PDF

2 U.S. EPA. Municipal Solid Waste Facts and Figures 2008. Accessible at http://www.epa.gov/msw/msw99.htm.

Table ES-1. Products Modeled

16 oz Hot Cups	grams/ item	Source	Weight ratio compared to avg PS foam product	Wt range in 2006 study (g)
EPS	4.7	average weight cup from 2006 PSPC study		4.4 - 5.0
LDPE-coated Paperboard	13.3	average weight cup from 2006 PSPC study	2.8 for cup only; 4.1 for cup + sleeve	12.3 - 15.0
PLA-coated Paperboard	12.7	average wt of 16 samples from one manufacturer	2.7 for cup only; 3.9 for cup + sleeve	N/A
Unbleached Corrug Sleeve	5.8	average weight cup sleeve from 2006 PSPC study		4.1 - 7.5

32 oz Cold Cups	grams/ item	Source	Weight ratio compared to avg PS foam product	Wt range in 2006 study (g)
EPS	8.8	average weight cup from 2006 PSPC study		8.1 - 10.0
LDPE-coated Paperboard	19.8	average weight cup from 2006 PSPC study	2.2	19.8 - 23.3
Wax-coated Paperboard	31.3	average weight cup from 2006 PSPC study (one producer)	3.5	
Solid PLA 1	35.0	estimated based on weight of a 32 oz PP cup (23.3 g) and the weight ratios of samples of 24 oz PLA and PP cups produced by the same manufacturer (1)	4.0	N/A
Solid PLA 2	32.4	estimated based on the weight of 32 oz PP cup and ratio of densities of PLA and PP (2)	3.7	N/A

9-inch Heavy Duty Plates	grams/ item	Source	Weight ratio compared to avg PS foam product	Wt range in 2006 study (g)
GPPS Foam	10.8	average weight plate from 2006 PSPC study		10.4 - 11.1
LDPE-coated Paperboard	18.4	average weight plate from 2006 PSPC study	1.7	18.2 - 18.5
Solid PLA	20.7	estimated based on weight of solid PS plate samples (18 g) and the weight ratio of solid PLA and solid PS clamshells produced by the same manufacturer (3)	1.9	N/A
Molded Pulp	16.6	average weight plate from 2006 PSPC study	1.5	16.2 - 17.4

9-inch Lightweight Plates	grams/ item	Source	Weight ratio compared to avg PS foam product
GPPS Foam	4.7	separate 2009 study	
Competing LDPE-coated Paperboard	12.1	separate 2009 study	2.6

Sandwich-size Clamshells	grams/ item	Source	Weight ratio compared to avg PS foam product	Wt range in 2006 study (g)
GPPS Foam	4.8	average weight clamshell from PSPC study		4.4 - 5.0
Fluted Paperboard	10.2	average weight clamshell from PSPC study	2.1	10.2 - 10.3
Solid PLA	23.3	average weight of actual samples of PLA clamshells obtained and weighed by Franklin Associates	4.9	N/A

(1) For samples of 24 oz PLA cups and 24 oz PP cups made by the same producer, the PLA cup was 50% heavier than the same size PP cup. This weight ratio was applied to the weight of a 32 oz PP cup (23.3 g) to estimate the weight of a 32 oz PLA cup (23.3 x 1.5 = 35.0 g).

(2) Using resin densities of 0.90 g/cm3 for PP and 1.25 g/cm3 for PLA, a product made of PLA would weigh 1.39 times as much as a product made of the equivalent volume of PP resin. 23.3 g PP cup x 1.25/0.9 = 32.4 g PLA cup.

(3) For samples of PLA clamshells and solid (non-foam) PS clamshells made by the same producer, the PLA clamshell was 15% heaver than the same size PS clamshell. This weight ratio was applied to the weight of a solid PS plate (18 g) to estimate the weight of the same size solid PLA plate (18 g PS plate x 1.15 = 20.7 g PLA plate).

Source: Franklin Associates, A Division of ERG.

In this analysis, the end-of-life carbon footprint for each product is extended to include estimates of carbon dioxide from WTE combustion of materials, methane from decomposition of degradable landfilled material, emission credits for avoided grid electricity displaced by electricity generated from WTE energy and landfill gas combustion, and carbon sequestration in landfilled biomass-derived material that does not decompose. The primary sources of information for modeling the carbon footprint for landfilling and incineration were U.S. EPA reports containing information on generation and management of landfill methane[3,4], and a published article on methane generation from decomposition of materials in simulated landfill conditions.[5] According to the website of NatureWorks LLC, the sole commercial producer of PLA in the U.S., PLA does not biodegrade in landfills.[6]

Assumptions about the decomposition of landfilled paperboard foodservice products have a significant effect on the end-of-life global warming potential results for paperboard products. This analysis includes end-of-life results for decomposition scenarios ranging from no decomposition to maximum decomposition of bleached paperboard from landfill simulation experiments. The greenhouse gas emissions are based on anaerobic decomposition, producing an equimolar mixture of carbon dioxide and methane. Additional sensitivity analyses are shown in Chapter 3 examining the effects of alternative scenarios for reduced gas production and higher oxidation rates of methane in landfill cover.

The focus of this analysis is on the differences in environmental profiles for the products themselves. Secondary packaging is not included. The scope of this analysis does not include recycling or composting of any of the products studied. These issues were addressed in the 2006 PSPC study. Readers interested in the contribution of secondary packaging or the impacts of low levels of composting and recycling of foodservice products are encouraged to refer to the 2006 study.

FUNCTIONAL UNIT

In a life cycle study, products are compared on the basis of providing the same defined function (called the **functional unit**). The function of disposable foodservice products is to contain beverages or food for a single use. The functional unit in this analysis is 10,000 items of each foodservice product.

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3 U.S. EPA. **Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks.** Third Edition. September 2006. http://www.epa.gov/climatechange/wycd/waste/downloads/fullreport.pdf

4 U.S. EPA. **Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006** (February 2008). Calculated from 2006 data in Table 8-4. Accessible at http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

5 Barlaz, Morton, et al. "Biodegradability of Municipal Solid Waste Components in Laboratory-Scale Landfills." Published in Environmental Science & Technology. Volume 31, Number 3, 1997.

6 NatureWorks LLC website, "Fact or Fiction?" section. http://www.natureworksllc.com/product-and-applications/fact%20or%20fiction.aspx#meth. Accessed in March 2008.

In the hot cup application, corrugated cup sleeves are evaluated as an optional add-on for the poly-coated and PLA-coated paperboard cups. Because paperboard cups do not provide as much insulation as foam cups, it can be uncomfortable for consumers to hold paperboard cups containing extremely hot beverages. Thus, it is common practice for cup sleeves to be used with paperboard cups to provide additional insulation.

RESULTS

The presentation of results focuses on energy, solid waste, global warming potential, and water use for each product studied. Because there are large uncertainties about the actual decomposition of landfilled paperboard products, two sets of results are shown for paperboard products. One scenario is based on maximum decomposition of the paperboard, and the other is based on no decomposition. Tables containing additional detail on each system are provided in Chapter 2. Observations and conclusions are summarized at the end of the Executive Summary.

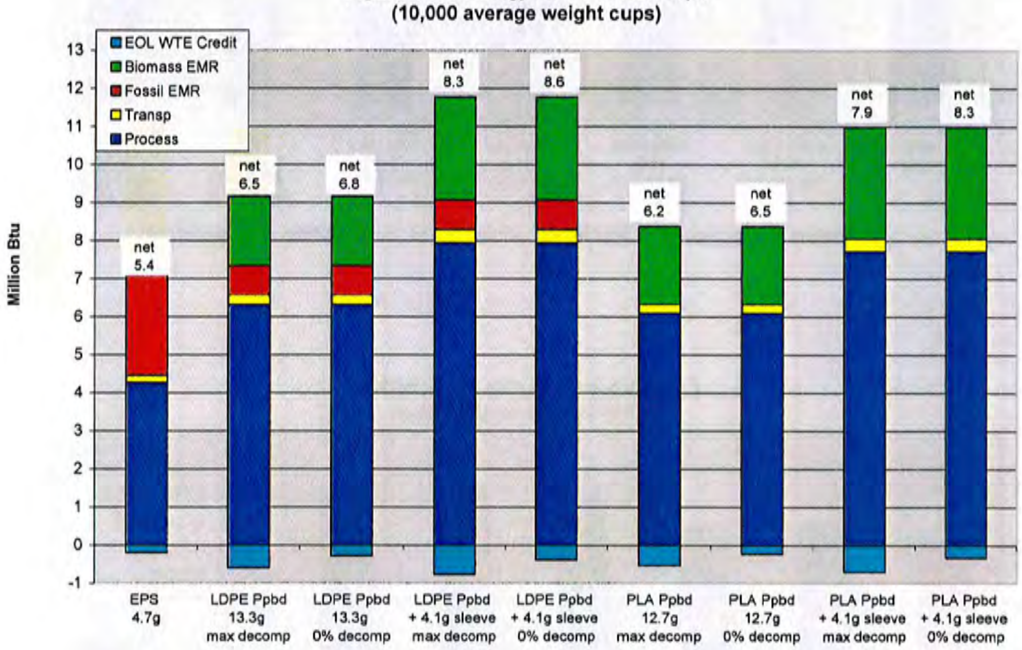
Energy Results

Total energy results for each foodservice product are shown in Figures ES-1 through ES-4, using the following categories:

- **Process energy** includes energy for all processes required to produce each foodservice item, from acquisition of raw materials through manufacture of the finished item, as well as operation of equipment used in landfilling postconsumer items.
- **Transportation energy** is the energy used to move material from location to location during its journey from raw material to finished product, and for collection and transport of postconsumer material.
- **Energy of material resource (EMR)** is not an expended energy but the energy value of resources removed from nature and used as material inputs for the product systems. For plastic resins, the EMR is associated with fossil resources (crude oil, natural gas) that are predominantly used as fuel resources. For paperboard and PLA, the EMR reflects the energy content of harvested trees and corn. These biomass materials are normally used as materials or food but can be used as a source of energy. In this study, EMR for biomass materials is shown separately from fossil EMR for plastics. As shown in Figures ES-1 through ES-4, the decision whether or not to include biomass EMR (the green segment in the figures) has a large influence on total energy results and conclusions.
- **End of life energy credit** is based on the amount of useful energy recovered from end-of-life management of the containers, based on the U.S. average municipal solid waste disposition for materials that are not recovered for recycling. The energy credit includes energy recovered from waste-to-energy combustion of 20 percent of the postconsumer products and from combustion of landfill gas recovered from decomposition of landfilled paperboard products.

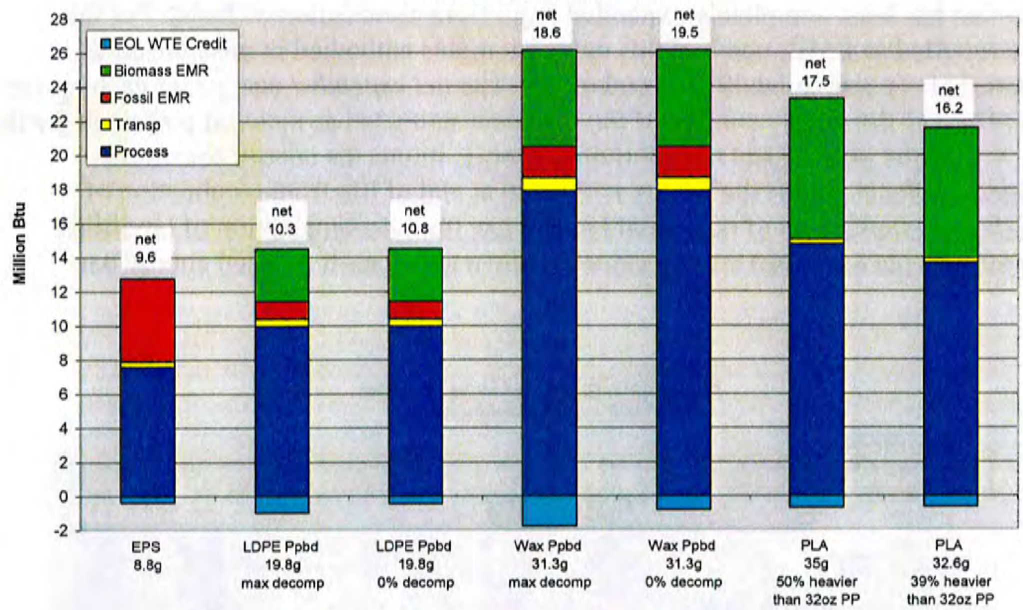
The process and transportation energy segments shown in the figures represent energy that has been completely expended (e.g., from combustion of fuels). For the energy reported as EMR, much of this energy remains embodied in postconsumer products that are sent to landfills at end of life. The *net expended* energy for each system is calculated as the energy content of the resources extracted as material feedstock for the product, plus the process and transportation energy, minus the energy content in landfilled products, minus the energy recovered at end of life from combustion of products and combustion of recovered landfill gas from decomposition of landfilled products. The net expended energy value is shown above each detailed energy bar.

Figure ES-1. Energy for 16-oz Hot Cups (10,000 average weight cups)



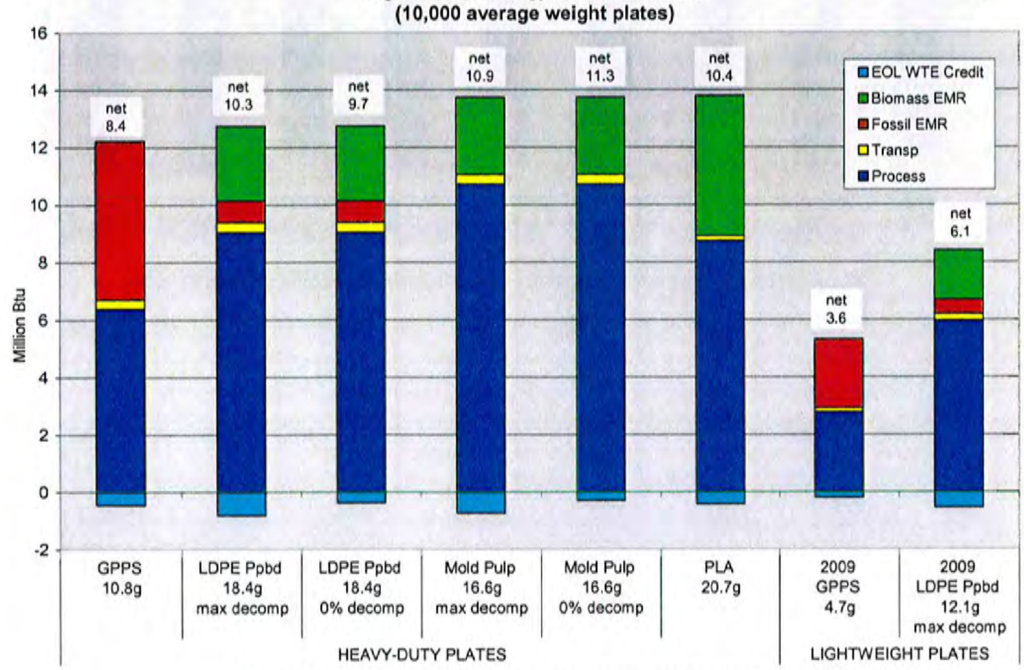
Net expended energy = total energy requirements - energy recovery - energy content of landfilled material

Figure ES-2. Energy for 32-oz Cold Cups (10,000 average weight cups)



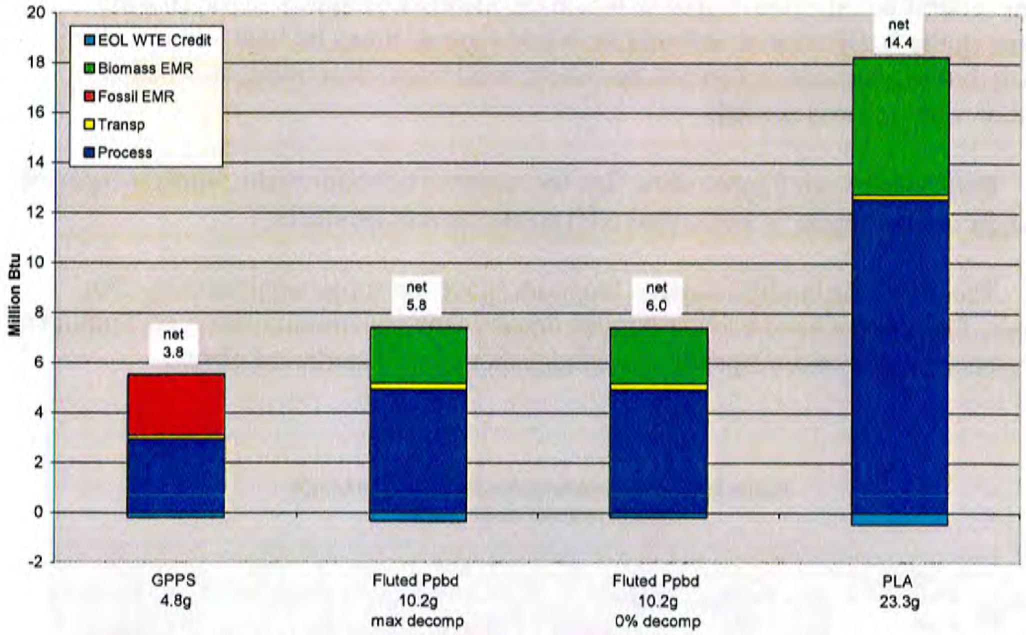
Net expended energy = total energy requirements - energy recovery - energy content of landfilled material

Figure ES-3. Energy for 9-inch Plates (10,000 average weight plates)



Net expended energy = total energy requirements - energy recovery - energy content of landfilled material

Figure ES-4. Energy for Sandwich-size Clamshells
(10,000 average weight clamshells)



Net expended energy = total energy requirements - energy recovery - energy content of landfilled material

Solid Waste Results

Solid waste results are shown in two sets of figures. Figures ES-5 through ES-8 show the total weight of solid waste separated into the following 3 categories:

- **Process wastes** are the solid wastes generated by the various processes from raw material acquisition through production of foodservice products.
- **Fuel-related wastes** are the wastes from the production and combustion of fuels used for process energy and transportation energy.
- **Postconsumer wastes** are the foodservice products that are landfilled at end of life, plus any ash resulting from waste-to-energy combustion of disposed products.

Figures ES-9 through ES-12 show the same results converted to a volume basis using landfill densities that take into account not only the density of the material as put into the landfill but also the degree to which the material compacts in the landfill. Comparing the weight-based and volume-based figures, it can be seen that different comparative conclusions can be reached about solid waste depending on whether a weight or volume basis is used.

Both solid waste figures show that the majority of solid waste, whether reported by weight or by volume, is associated with postconsumer products.

The lower the landfill density, the more space the component takes up. For example, foam plates have a lower landfill density than paperboard plates, so a pound of foam plates takes up more landfill space than a pound of paperboard plates.

Figure ES-5. Weight of Solid Waste for 16-oz Hot Cups (10,000 average weight cups)

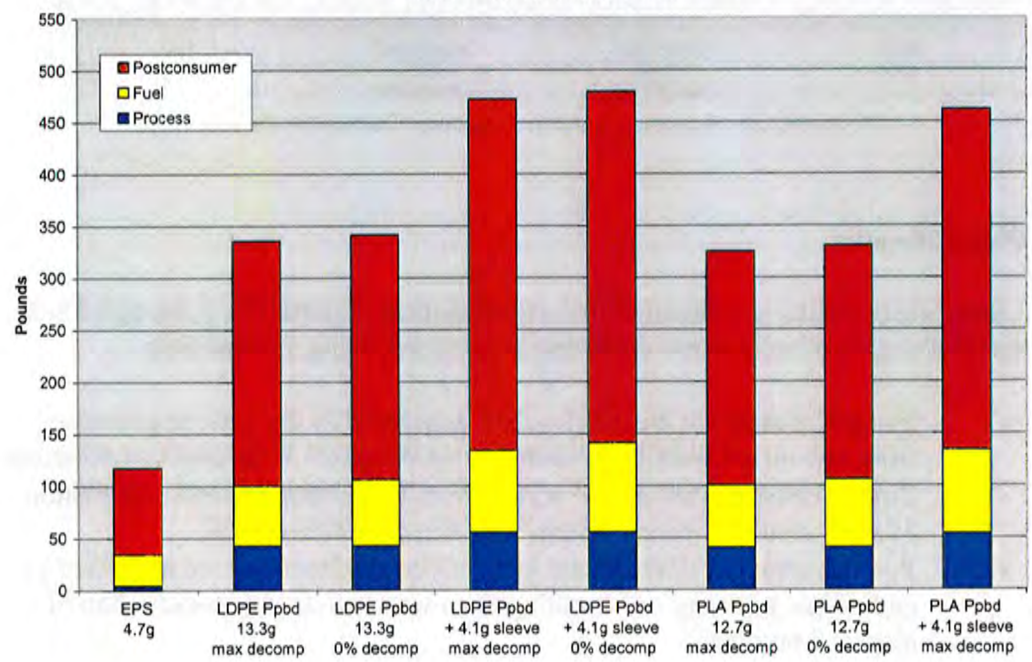


Figure ES-6. Weight of Solid Waste for 32-oz Cold Cups (10,000 average weight cups)

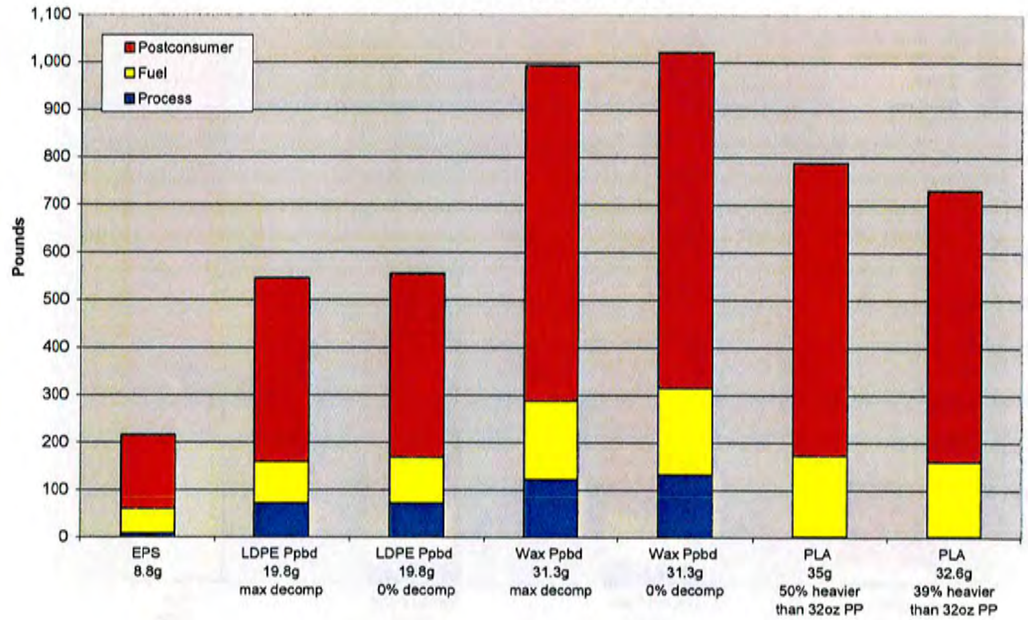


Figure ES-7. Weight of Solid Waste for 9-inch Plates (10,000 average weight plates)

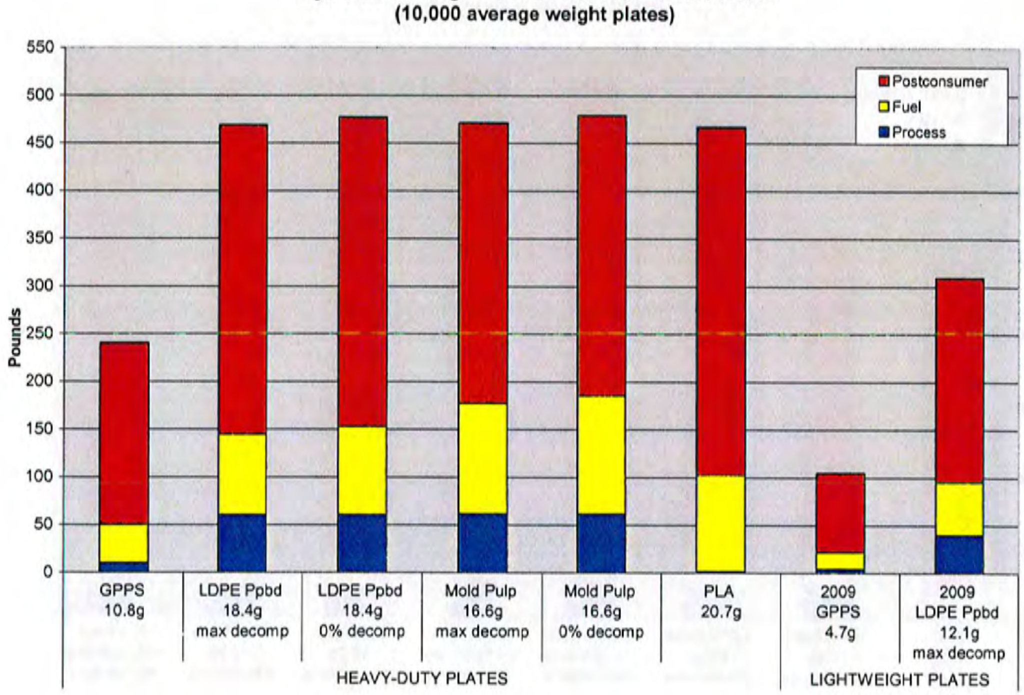


Figure ES-8. Weight of Solid Waste for Sandwich-size Clamshells (10,000 average weight clamshells)

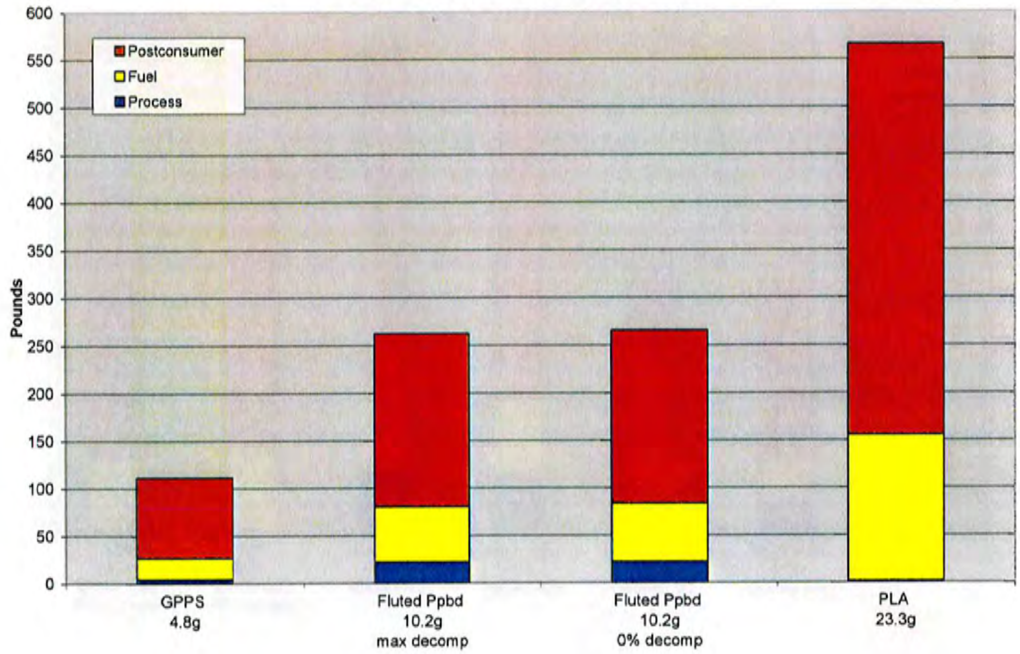


Figure ES-9. Volume of Solid Waste for 16-oz Hot Cups (10,000 average weight cups)

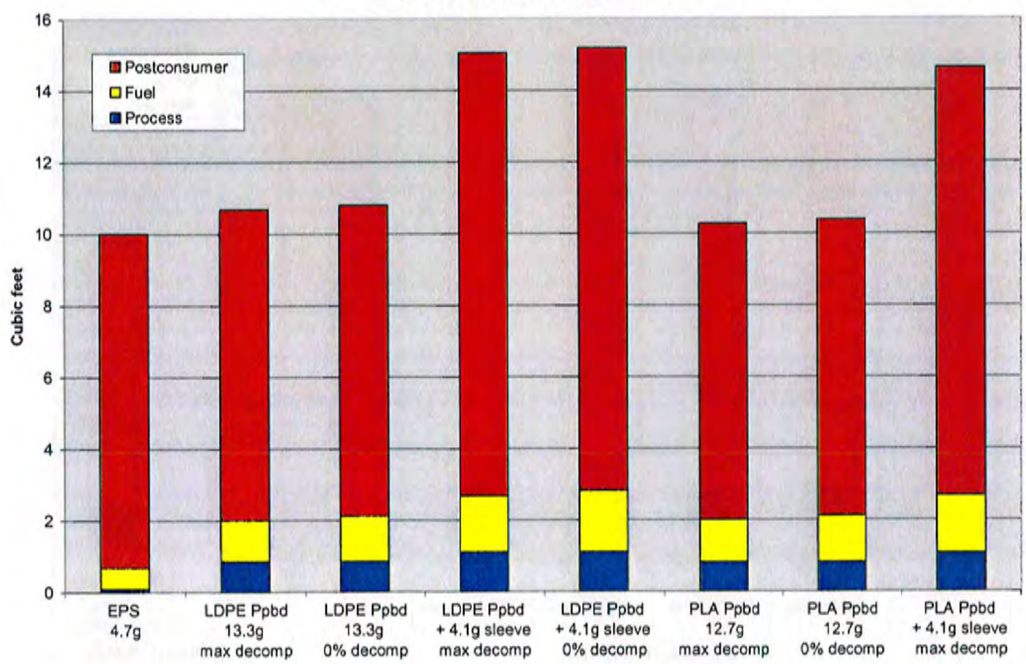


Figure ES-10. Volume of Solid Waste for 32-oz Cold Cups (10,000 average weight cups)

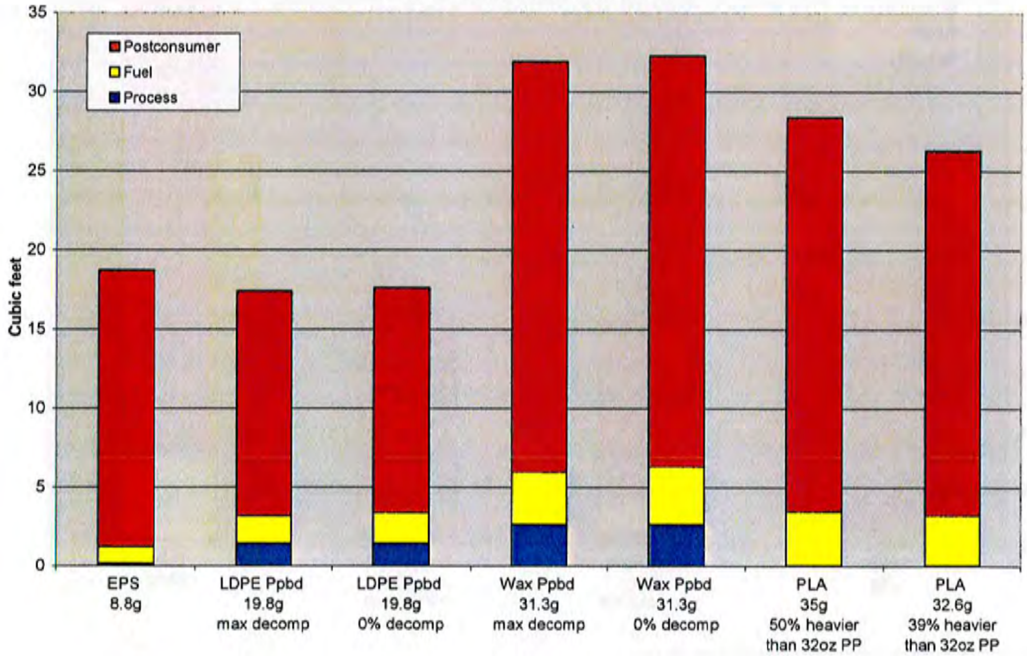


Figure ES-11. Volume of Solid Waste for 9-inch Plates (10,000 average weight plates)

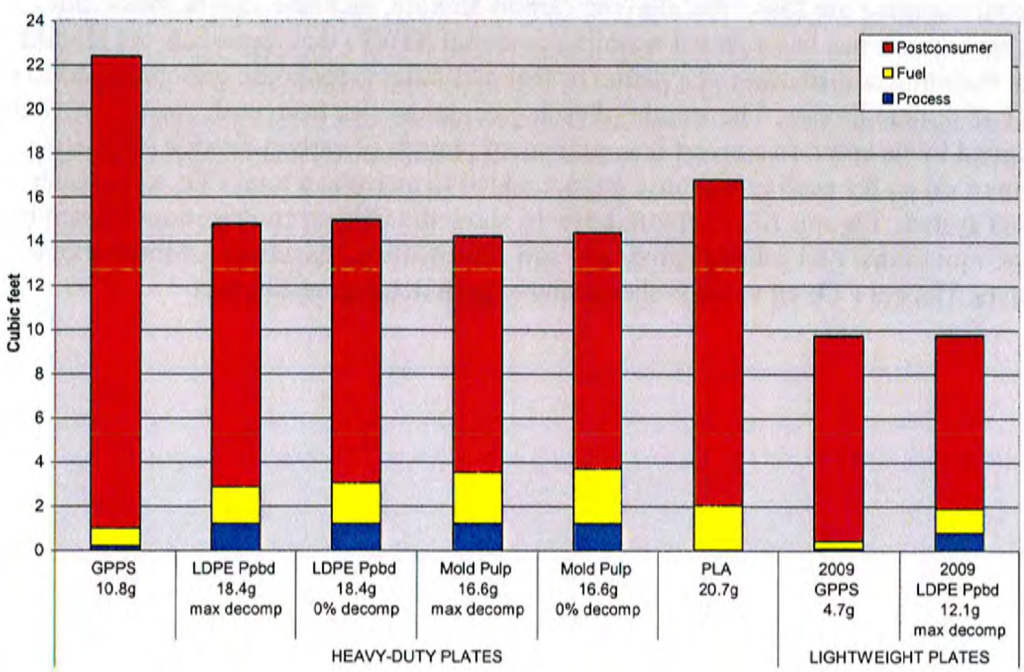
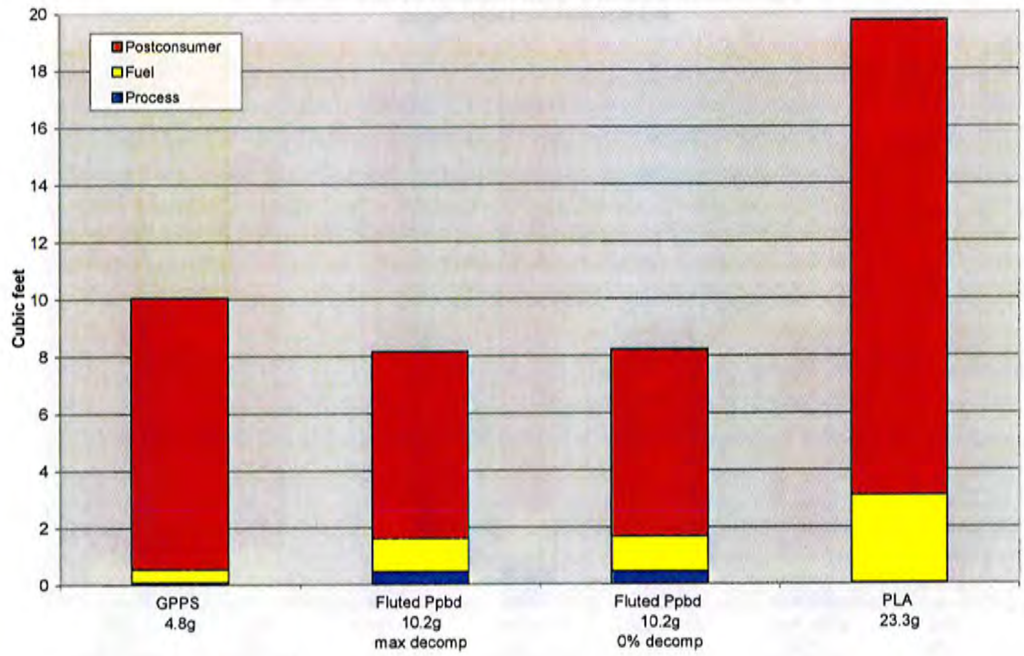


Figure ES-12. Volume of Solid Waste for Sandwich-size Clamshells (10,000 average weight clamshells)

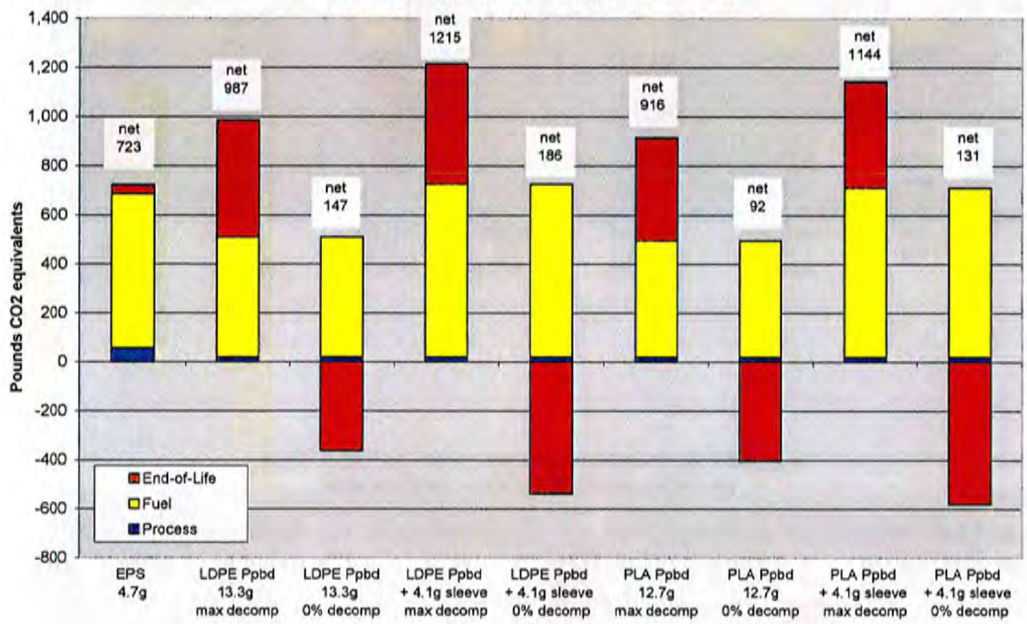


Greenhouse Gas Results

The primary three atmospheric emissions reported in this analysis that contribute to global warming are fossil fuel-derived carbon dioxide, methane, and nitrous oxide. Each greenhouse gas has a global warming potential (GWP) that represents the relative global warming contribution of a pound of that particular greenhouse gas compared to a pound of carbon dioxide. The weight of each greenhouse gas from each product system is multiplied by its GWP to convert it to equivalent pounds of carbon dioxide (CO_2 eq), then the CO_2 eq for each greenhouse gas are added to arrive at a total CO_2 eq for each product system. Figures ES-13 through ES-16 show the CO_2 eq contributions related to process emissions, fuel-related emissions, and end-of-life management of foodservice products. The net CO_2 eq value is shown above each detailed results bar.

All CO_2 calculations, including CO_2 eq calculations for the aggregated methane releases from decomposition of landfilled paper products, are based on 100-year GWP factors published in the IPCC Second Assessment report (SAR), published in 1996.[7] Although two subsequent updates of the IPCC report with slightly different GWPs have been published since the SAR, the GWPs from the SAR are used for consistency with international reporting standards.[8] The IPCC SAR 100-year global warming potentials (GWP) are 21 for methane and 310 for nitrous oxide.

Figure ES-13. Greenhouse Gas Emissions for 16-oz Hot Cups (lb CO2 eq per 10,000 average weight cups)



7 **Climate Change 1995: The Science of Climate Change.** Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change. IPCC 1996. GWP factors are shown in Table 4.

8 The United Nations Framework Convention on Climate Change reporting guidelines for national inventories continue to use GWPs from the IPPC Second Assessment Report (SAR). For this reason, the U.S. EPA also uses GWPs from the IPCC SAR, as described on page ES-1 of EPA 430-R-08-005 **Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006** (April 15, 2008).

Figure ES-14. Greenhouse Gas Emissions for 32-oz Cold Cups (lb CO2 eq per 10,000 average weight cups)

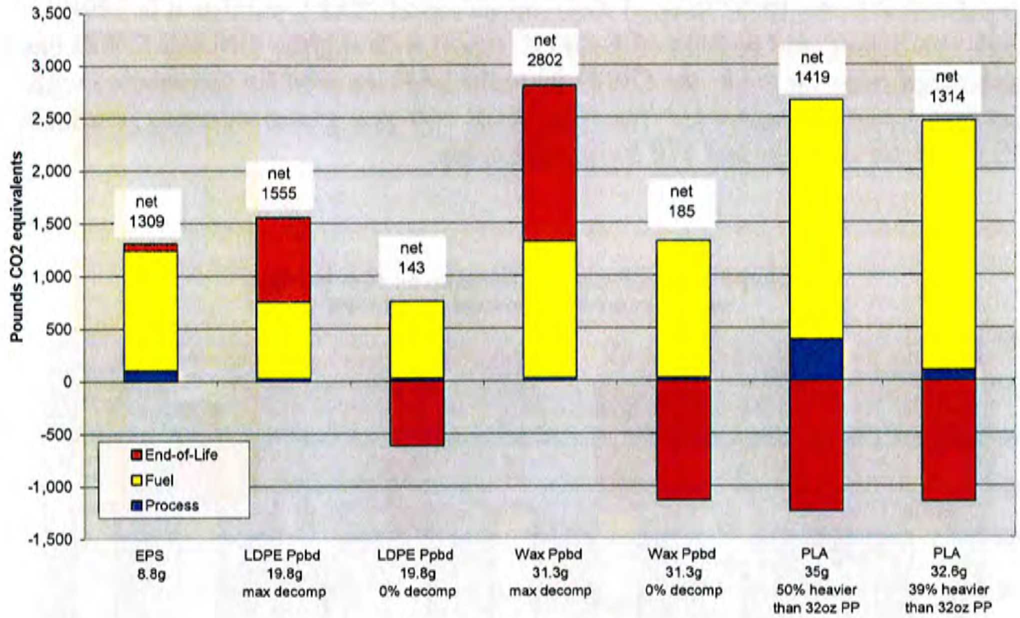


Figure ES-15. Greenhouse Gas Emissions for 9-inch Plates (lb CO2 eq per 10,000 average weight plates)

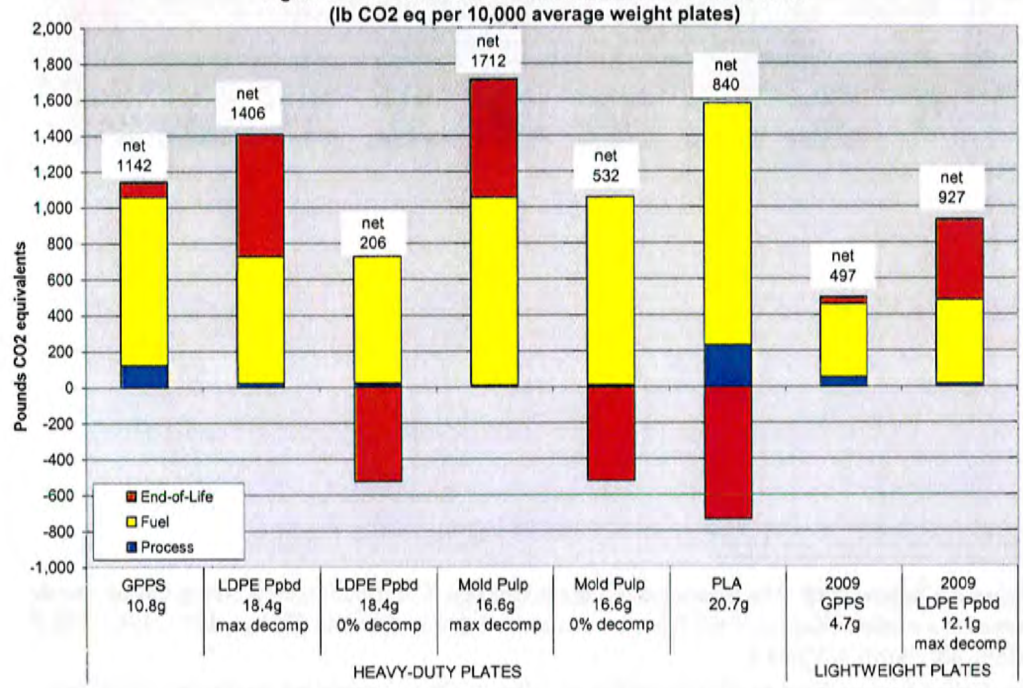
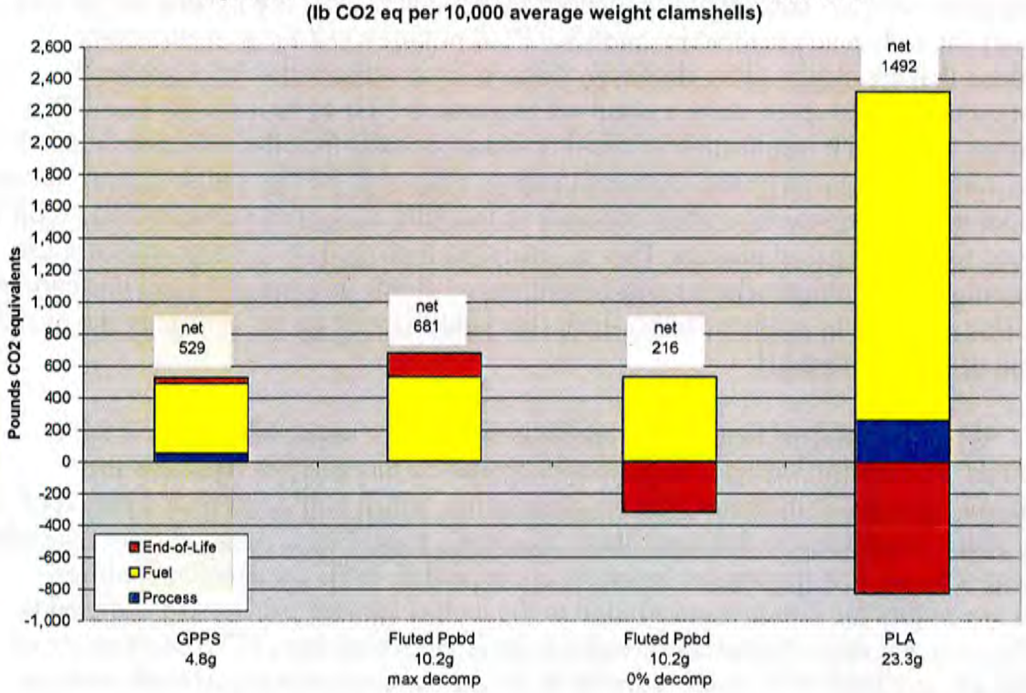


Figure ES-16. Greenhouse Gas Emissions for Sandwich-size Clamshells (lb CO2 eq per 10,000 average weight clamshells)



The "Net End of Life" segment in Figures ES-13 through ES-16 includes estimates for the greenhouse gas effects of end-of-life management of foodservice products, including energy credits for useful energy that is recovered from waste-to-energy combustion of postconsumer items and from waste-to-energy combustion of recovered landfill gas. The methodology and data sources for these calculations are described in detail in the End-of-Life Management section of Chapter 1. The end-of-life GHG results should be considered to have a higher uncertainty than the process and fuel-related GHG results. For paperboard items, the end-of-life GHG results are strongly dependent on assumptions about decomposition in landfills and the fate of methane produced from decomposition. However, some general observations can be made.

Neither PS nor PLA decomposes to produce methane in landfills.[9,10] For the biomass-derived PLA content of the foodservice products, there is a net end-of-life CO_2 eq credit for carbon sequestered in landfilled PLA products and for grid electricity emissions that are displaced by electricity from WTE combustion of PLA products. Polystyrene foam products show a small net increase in CO_2 eq because the fossil CO_2 emissions from WTE combustion of fossil resins are greater than the emission credits for grid electricity displaced by the recovered energy. Although PS has a high carbon content and does not decompose to produce methane in landfills, no carbon sequestration credit is assigned to fossil-derived plastics. This is consistent with the U.S. EPA greenhouse gas accounting methodology, which treats landfilling of plastic as a transfer from one carbon stock (the oil field) to another carbon stock (the landfill) with no net change in the overall amount of carbon stored.[11]

When paperboard foodservice products decompose anaerobically, methane is generated. The landfill methane emissions estimated in this analysis represent the *cumulative* releases of methane from decomposition, which will occur over a period of many years. In addition to decomposition emissions, fossil CO_2 is released from the resin coatings when coated paperboard products are burned in WTE combustion facilities. There are credits for carbon sequestration in the undecomposed paperboard and credits for displacement of grid electricity when energy is recovered from WTE combustion of landfill gas and from WTE combustion of disposed postconsumer paperboard products.

When paperboard foodservice products are modeled at maximum experimental decomposition levels, the overall effect of end-of-life management activities for these products is a net increase in CO_2 eq, because the CO_2 eq for the cumulative fugitive methane emissions is much greater than the CO_2 eq credits for WTE combustion and sequestration in landfilled material that does not decompose.

When paperboard products are modeled at 0 percent decomposition, however, the net end-of-life results are very different. At 0 percent decomposition, no methane is produced and all the carbon content of the paperboard is sequestered in the landfilled products, so that there is a large net CO_2 eq credit for paperboard products.

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9 U.S. EPA. **Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks.** Third Edition. September 2006. Page 79 of Chapter 6 Landfilling states "Plastics, carpet, PCs, clay bricks, concrete, fly ash, and tires do not biodegrade measurably in anaerobic conditions, and therefore do not generate any CH4."

10 NatureWorks LLC website, "Fact or Fiction?" section.

11 U.S. EPA. **Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks.** Third Edition. September 2006. Page 6.

Water Use

Water use data were not available for many of the unit processes associated with the production of the foodservice products in this analysis, resulting in data gaps when attempting to construct models for product systems on a unit process basis. Therefore, it was necessary to use aggregated cradle-to-material data sets for most of the materials modeled. Furthermore, data sources did not distinguish between consumptive use of cooling water and recirculating use of cooling water. Since it was not possible to differentiate between consumptive and non-consumptive use of water, the water results shown throughout this report are referred to as water *use* rather than water *consumption*. Because of the use of aggregated cradle-to-material water use data, and the inability to clearly differentiate between consumptive and non-consumptive uses of water, the water use results presented here should be considered to have a high degree of uncertainty. Total water use for each foodservice product system shown in Figures ES-17 through ES-20 includes process water use and cooling water use, including cooling water associated with electricity generation.

Polystyrene resin products requires very little process water compared to paperboard and PLA products. Process water use for paperboard and PLA includes water used in pulping operations, corn irrigation, corn wet mills, and other processes used to convert corn to PLA. Cooling water use per pound is higher for production of PS foam products and PLA products compared to paperboard products, since molding and thermoforming of resins requires more electricity compared to the processes used to convert paperboard into cups, plates, and clamshells.

Figure ES-17. Gallons of Water Used for 16-oz Hot Cups (10,000 average weight cups)

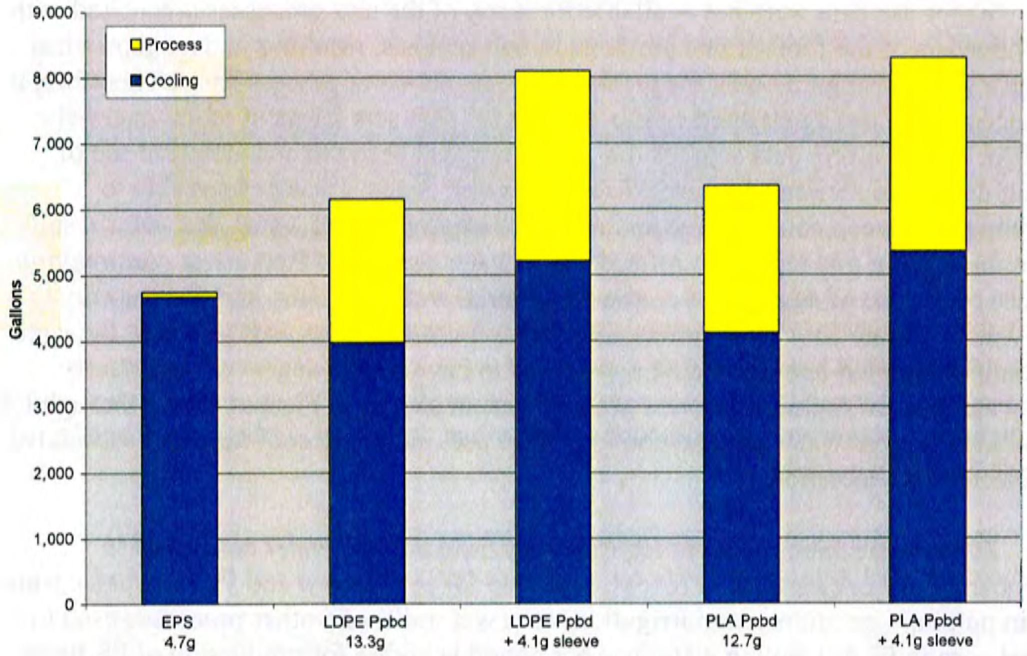


Figure ES-18. Gallons of Water Used for 32-oz Cold Cups (10,000 average weight cups)

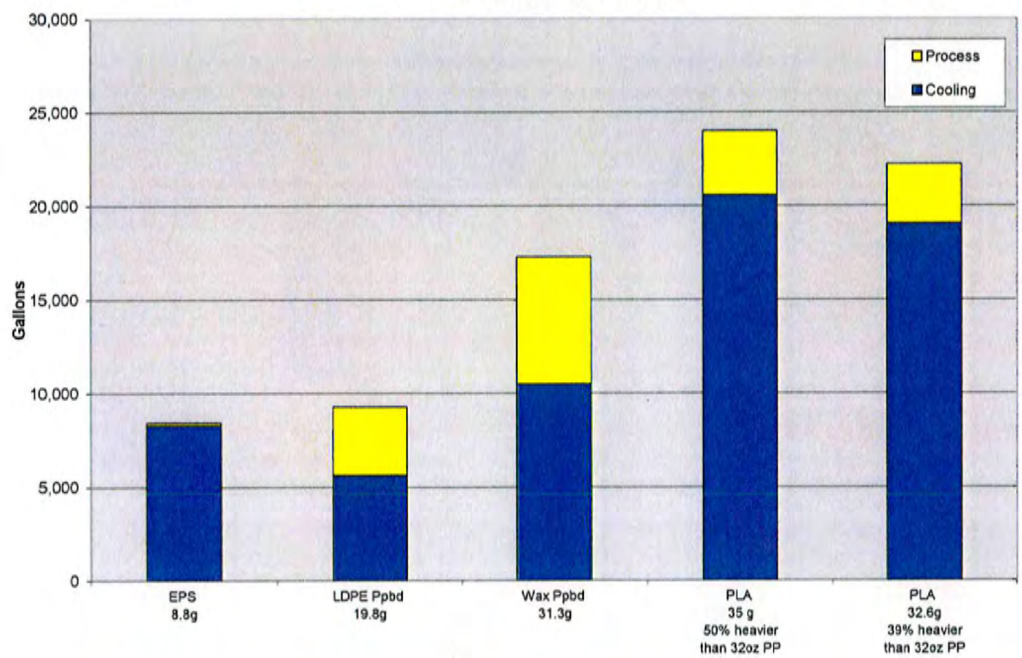


Figure ES-19 Gallons of Water Used for 9-inch Plates (10,000 average weight plates)

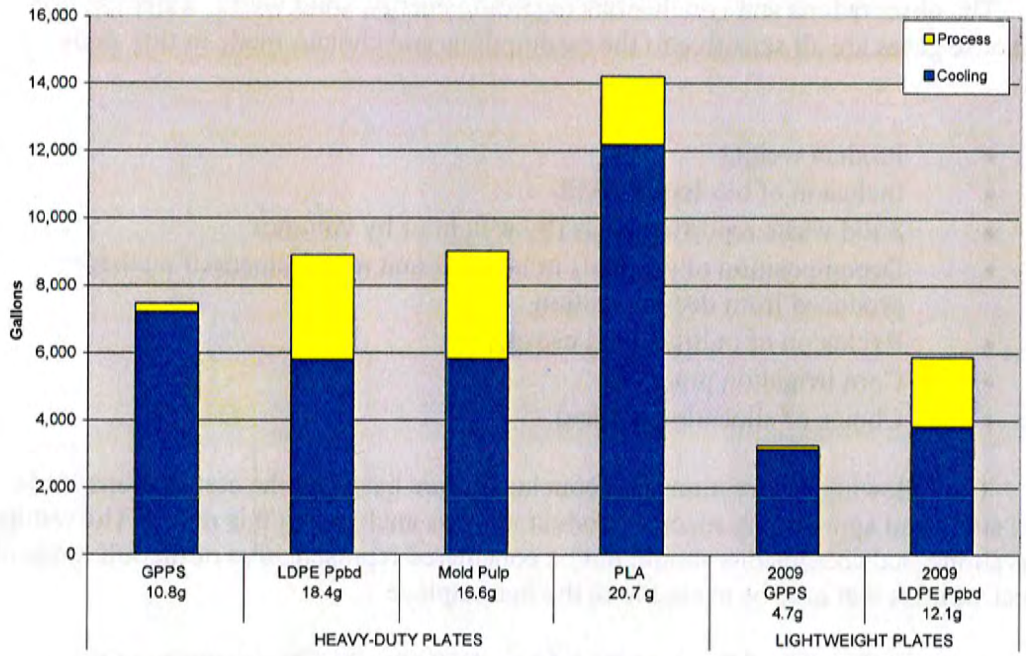
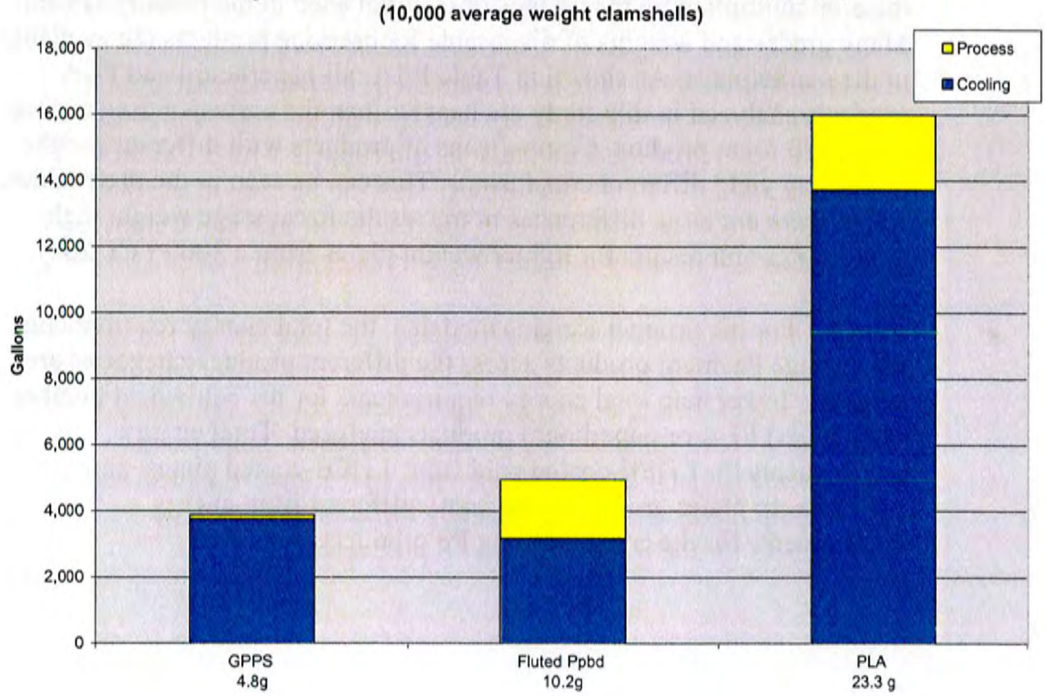


Figure ES-20. Gallons of Water Used for Sandwich-size Clamshells (10,000 average weight clamshells)



KEY OBSERVATIONS AND CONCLUSIONS

The observations and conclusions regarding energy, solid waste, water use and greenhouse gases are all sensitive to the assumptions and choices made in this study about

- Product weight
- Inclusion of bio-based EMR
- Solid waste reporting basis (by weight or by volume)
- Decomposition of products in landfills and management of methane produced from decomposition
- Exclusion of indirect land use change
- Corn irrigation practices
- Choice of allocation method.

The following observations and conclusions are based on the assumptions made in this study and apply to the specific product weights analyzed in this report. The results, observations, and conclusions should not be considered representative of the full range of product weights that may be available in the marketplace.

- **Influence of Product Weight on LCI Results:** The majority of the environmental burdens for producing each type of foodservice item is from the production of the materials used. Material production burdens for a product are calculated as the product of the burdens per pound of material multiplied by the pounds of material used in the product system. Many grades and weights of disposable foodservice products are available in the marketplace. As shown in Table ES-1, all paperboard and PLA products analyzed in this study are heavier than the corresponding average weight PS foam product. Comparisons of products with different weight ratios may yield different conclusions. This can be seen in the plate tables, where there are large differences in the results for average weight high-grade plates and results for lighter weight plates from a 2009 LCI study.

- **Energy:** For the product weights modeled, the total energy requirements for average PS foam products across the different product categories are generally lower than total energy requirements for the equivalent number of (heavier) PLA or paperboard products analyzed. Total energy requirements for LDPE-coated cold cups, LDPE-coated plates, and molded pulp plates are not significantly different from energy requirements for the corresponding PS products.

- **Net Energy Consumption:** A significant portion of the total energy requirements for each product is energy of material resource. Some of the EMR remains embodied in the postconsumer products that are sent to landfills at end of life. Some energy is also recovered from postconsumer materials that are managed by WTE combustion, as well as from WTE combustion of landfill gas produced from paperboard decomposition.

- **Solid Waste:** Comparative conclusions about solid waste differ depending whether the results are expressed in terms of weight or volume of waste. Postconsumer products account for the largest share of solid waste for each system. The plastic foam systems produce less *weight* of solid waste compared to heavier paperboard and PLA products. However, because of the low density of foam products, the differences in solid waste *volume* of postconsumer foam products and corresponding paperboard or solid resin products become relatively small for most product categories. For plates, heavy-duty PS foam plates produce a greater volume of solid waste than other types of heavy-duty plates; however, for the 2009 equivalent strength plate comparison, the PS foam and paperboard plates have very similar solid waste volumes.

- **Greenhouse Gas Results:** The majority of GHG emissions for most systems studied are associated with combustion of fossil fuels for process and transportation energy. For the PLA system, there are also significant process GHG emissions associated with nitrous oxide emissions from fertilizer use for corn. The **end-of-life** greenhouse gas results presented here should be considered more uncertain than other emissions data. End-of-life management results in a small net increase in GHG for PS foam products and a net GHG credit for PLA products. End-of-life results for paperboard products vary considerably depending on assumptions about decomposition. At maximum experimental decomposition levels, the overall effect of the estimated GHG additions and credits from end-of-life management is a large net increase in GHG for paperboard products. At lower decomposition rates, the net end-of-life GHG for paperboard products is much smaller, since less methane is released and more carbon is sequestered in undecomposed material. If the paperboard does not decompose, no methane is produced and all the biomass carbon in the paperboard product is sequestered, resulting in a large carbon sequestration credit.

- **Limitations of Water Use Data:** Because of a lack of unit process-level data on water use, the water use results in this analysis are largely based on aggregated cradle-to-material data sets and estimates based on literature. In addition, data sources did not distinguish between consumptive use of cooling water and recirculating use of cooling water. Every effort was made to provide corresponding coverage of water use for each product system; however, without access to the supporting unit process data, and lacking distinction between consumptive and non-consumptive uses of water, it was not possible to ensure that different cradle-to-material data sets were derived using consistent methodologies. Therefore, the comparative water use results in this report have a high degree of uncertainty.
- **Water Use Results:** Across the different product categories, water use for the average weight paperboard product in each category is 20 to 30 percent higher than for the corresponding average weight PS foam product, and water use for the solid PLA product is 2 to 4 times as high as for the corresponding PS foam product. The differences in the weights of the solid PLA and PS foam products are a significant driver for the comparative water use results.

Environmental Resources Planning, LLC

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LITTER STUDIES FIND THAT FOAM FOOD SERVICE MAKES UP 1.5 PERCENT OF LITTER

Commonly used polystyrene foam food service products (typically referred to as STYROFOAM™) make up 1.5 percent of litter, according to a new report that surveys recent studies on litter.

The May 2012 report by environmental consulting firm Environmental Resources Planning of Gaithersburg, MD, "examined a variety of litter surveys to determine the extent to which polystyrene foam food service products contribute to litter."

ER Planning compiled information from nineteen litter surveys conducted in the U.S. and Canada from 1994 to 2009, including a 2008 national survey of 240 sites. The firm reviewed surveys that used statistically valid quantification and characterization methodologies.

The report finds that polystyrene foam food service products "consistently constitute a small portion of litter (1.5 percent). Evaluating just the surveys conducted since 2000 yields an even lower median value of 1.1 percent."

Survey	Year	Percent
San Jose	2009	2.3%
Alberta	2009	0.7%
San Jose	2008	0.8%
National	2008	1.7%
San Francisco	2008	1.1%
San Francisco	2007	1.7%
Alberta	2007	1.1%
Toronto	2006	1.1%
Toronto	2004	1.0%
Region of Peel	2003	0.5%
Region of Durham	2003	0.6%
Region of York	2003	0.3%
Toronto	2002	1.5%
Florida	2002	2.3%
Florida	2001	2.2%
Florida	1997	3.1%
Florida	1996	3.6%
Florida	1995	3.3%
Florida	1994	3.9%
Median Value		**1.5%**

The complete report ("The Contribution of Polystyrene Foam Food Service Products to Litter") is available on ER Planning's web site.

The report's project manager Steven R. Stein is a subject matter expert on litter, recycling and environmental issues. His work studying litter and its impacts on our communities has been featured in *The New York Times* and *National Geographic*, as well as on NPR and Good Morning America. Field crews under his direction have physically surveyed litter along more than 15.5 million square feet of roadways and recreational areas.

He led the 2009 KAB National Litter Survey, the most comprehensive study of its kind and sponsored the 2011 National Litter Forum, which focused on restoring our nation's communities. Mr. Stein has taught Environmental Science and Ethics in Management at the university level. He was invited as a subject matter expert on environmental issues and community dynamics to participate in a study commissioned by the President and in a Sustainable Consumption Roundtable convened by the Johnson Foundation.

Mr. Stein may be reached at 240 631-6532 or sstein@erplanning.com.

The report was underwritten by the American Chemistry Council's Plastics Foodservice Packaging Group.

ER PLANNING

Fiscal Impacts of Prohibiting Expanded Polystyrene Food Service Products in Maryland

SB 186 & HB 229

Preliminary Estimates

January 2017

Prepared By:

mb PUBLIC AFFAIRS, INC.

Table of Contents

Fiscal Impacts of Prohibiting Expanded Polystyrene Food Service Products in Maryland, Preliminary Estimates: SB 186 & HB 229

Summary, January 2017

This study has been conducted to quantify the potential effects of restrictions on expanded polystyrene food service products in Maryland. As specified in the proposed legislation, the restrictions would apply to use by food service businesses and others as well as to the retail sale of these products, while exempting certain food trays. The proposed legislation would also apply to sales of loose fill expanded polystyrene packaging, but only the food service applications are addressed in this report.

Expanded Polystyrene Food Service Products, Estimated Purchases & Cost Impacts by End Users Subject to Proposed Restrictions ($ million)

	Limited-Service Restaurants	Full-Service Restaurants	Convenience Stores	Grocery Stores/ Wholesalers	Non-Commercial	Total
Estimated Purchases, 2015	$17.5	$5.4	$2.6	$6.6	$8.9	$41.0
Estimated Cost Impacts	$16.3	$5.4	$2.8	$2.2	$8.3	$34.9

As shown in the table above, 2015 sales in Maryland (other than Montgomery and Prince George's Counties) of expanded polystyrene food service ware is estimated at $41.0 million. The additional cost impacts from the proposed expanded polystyrene restrictions:

- More restrictive regulation would result in the affected businesses, organizations, and consumers spending an additional $34.9 million annually to replace the restricted products.
- Based on the numbers in the table, for every $1 now spent on expanded polystyrene food service products, replacement alternatives on average would cost $1.85.
- In all cases, these cost premiums are conservative estimates based on the lowest cost pricing for both expanded polystyrene and complying alternative materials. In practice, the cost premiums are likely to be higher, due to the high variability in the cost, supply availability, and performance characteristics required in individual applications.

As shown in the table, the cost impacts vary by end user, with the largest share likely affecting restaurants. New restrictions on disposable food service ware would add further cost pressures at a time the state restaurant industry is already coping with rising costs, and consumers are pulling back in the face of the compensating rising prices.

As shown by state sales tax data, the Maryland restaurant industry has experienced significant sales recovery from the recession in only the last two years, but with growth in the number of establishments in the limited-service component essentially tapering off beginning in 2013.

As shown in regional price data, the ability of the local restaurant industry—as in the rest of the US—to absorb further price increases is limited. Existing cost pressures have already seen prices rise 3.3% over the past year, while prices for competing food at home have dropped by 1.8%.

Additional indirect impacts are likely to occur. Because of their characteristics, expanded polystyrene products are produced near their end user markets, while contracting information from the states of Pennsylvania and Oregon show that most of the alternatives are produced generally elsewhere in the US and overseas.

Shifts in local spending associated with the higher prices will also result in some level of a substation effect. While a detailed analysis was not performed, rough estimates using factors from earlier studies suggests just over 800 jobs could be loss when including the direct, indirect, and induced effects.

State fiscal impacts will come from two sources. Based on preliminary estimates, state agencies and schools spent an estimated $3.0 million on expanded polystyrene products in 2016. Their associated disposable food service ware costs will also rise if expanded polystyrene is restricted. In addition, state tax revenues will change, although the actual effect will vary depending on how the affected businesses respond to these higher regulatory costs, due to local business tax structure. The combined effect of these two factors is summarized in the following table.

	Costs Absorbed	Price Increases
State Revenues	-$1.6	$1.3
State Costs	-0.9	-0.9
Total	-$2.5	$0.4

The potential state fiscal impacts range from a revenue gain of $0.4 million if affected businesses are able to pass on the full cost of compliance to consumers in the form of higher prices, to an annual loss of $2.5 million if the affected businesses find they are limited in passing on further costs in the current price environment. Note that under the Price Increases scenario, however, the potential gain to state revenues comes from higher sales and use tax receipts. While this component would be an addition to state revenues, this also represents an additional cost increase of $1.3 million to consumers, which likely will offset other purchases rather than providing an actual gain to the state.

Background

Study Scope and Purpose

Beginning with Berkeley, California in 1988, a number of local governments and states have considered restrictions and outright bans on the use of expanded polystyrene (EPS) food service ware. As compiled from various websites,[1] at least 128 cities and counties, but no states, have adopted some form of ordinance, ranging widely from restrictions only on local government purchases, to limits on the types of takeout food containers food vendors may use, to broader prohibitions on individual consumer purchases as well. Of these 128 measures, 99 have been adopted by local governments in California, primarily in the San Francisco Bay Area and other coastal areas.

Two bills have been introduced for this purpose in the Maryland General Assembly. Senate Bill 186 and House Bill 229 would enact the following provisions:

- By January 1, 2018, food service businesses would be prohibited from providing food in an expanded polystyrene food service product.
- Sales of expanded food service products and expanded polystyrene loose fill packaging would be prohibited after the same date.
- These prohibitions would not apply to prepackaged foods sourced by a food service business from other vendors or from outside the state, and to packaging for raw, uncooked, or butchered meat, fish, poultry, or seafood.

This study measures the direct impacts of restricting expanded polystyrene food service products and thereby requiring their replacement with generally more costly alternatives. Costs from the proposed ban on loose fill packaging are not addressed, and would be in addition to the impacts identified in this report.

The analysis considers the following factors:

- Fiscal impacts are estimated from: (1) the additional costs from replacing expanded polystyrene food service product purchases by state agencies and by local programs funded by state subventions and pass-through federal subventions and (2) effects on state revenues from restricting purchase and use of these food service ware items by commercial vendors and consumers as well.

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[1] (1) Groundswell, Map: Which Cities Have Banned Plastic Foam? (http://groundswell.org/map-which-cities-have-banned-plastic-foam/); (2) California Restaurant Association, Local Polystyrene Bans, http://www.calrest.org/uploads/2/6/1/5/26153474/list_of_polystyrene_ordinances_master_020812.pdf; (3) Californians Against Waste, Polystyrene: Local Ordinances (http://www.cawrecycles.org/polystyrene-local-ordinances/?rq=polystyrene).

- Direct economic impacts are estimated from the cost differences facing consumers and businesses from requiring replacement alternatives to existing expanded polystyrene food service product purchases. These economic impacts are used to estimate the revenue fiscal impacts above.

The distribution of these cost increases--which would be assumed by the affected businesses through lower profits or passed on to consumers as higher costs--are shown by affected end user sector using available public data from US Bureau of Labor Statistics and US Bureau of the Census.

The estimates contained in this report focus on the direct impacts in order to provide more easily replicable numbers. The intent is to provide more transparent calculations to help inform the policy debates over this issue. While this study does not estimate the additional indirect and induced economic impacts through modeling, the potential scale of these effects are addressed through a review of earlier studies conducted on this issue for other states.

All of the analysis is done from a lowest-cost perspective in order to provide conservative estimates of current product use and the impacts of placing restrictions on these products. Existing purchases by end user are estimated based on the lowest cost prices as determined from a survey of current pricing. Cost impacts from any potential restrictions similarly are calculated from the lowest cost, allowable alternatives.

As such, the conclusions of the analysis should be considered in terms of "at least" amounts. The actual cost impacts are likely to be higher for a number of reasons. Not all end users will make purchases at the lowest cost prices used in the analysis. Many of the alternatives, especially compostable and recyclable products, are produced by smaller companies with less capacity, and prices are likely to fluctuate in face of significantly expanded demand. Many end users are likely to be forced to use higher cost alternatives in order to secure specific performance characteristics required by their offerings that are now available more cost effectively through EPS products (e.g., insulation, sanitary requirements).

On an individual purchase level, the impacts of any proposed restrictions are likely to be experienced as a matter of a few cents. Considered from a broader geographic area such as Maryland as a whole and from the cumulative purchases of an individual or a local business over the course of a year, these added costs will sum up to a more significant level with defined impacts on jobs, incomes, spending, and public revenues.

Note that throughout this study, data sources and reports cited with a date refer to the references listed in the Bibliography.

Expanded Polystyrene Food Service Products

EPS applications for food containers and other disposable food service ware have been in widespread use for more than five decades. Their selection as a preferred food service ware option is driven in many cases by a combination of factors including low cost, availability, and a range of performance characteristics that generally are more costly to duplicate. These features have led to use in a number of situations, as summarized in an earlier study (Keybridge Research, 2009):

PS [polystyrene] foam cups are significantly sturdier and more heat-resistant than either paper or hard plastic alternatives, and they do not conduct heat or lose their shape when holding hot beverages. This prevents the need to "double-cup" or use paperboard or corrugated sleeves, reducing waste and reducing costs.

Food trays made from foam are light but sufficiently sturdy to hold heavy and even oily food products without tearing or leaking.

Prepared hot and cold foods for sale by many food vendors are stored and sold in lidded foam containers that insure insulation and block air exposure, prolonging the life of foods and eliminating spoilage and waste.

PS foam is inert and very stable, which are critical requirements in sanitary applications. Also, PS foam's chemical composition is not conducive to bacterial growth, which provides hygienic benefits to perishable foods stored in PS foam containers. These benefits are a major reason why PS foam food service products are so frequently used in hospitals, schools, nursing homes, cafeterias and restaurants where it is critical that the food service ware in contact with food be clean and hygienic.

Polystyrene foam products are more affordable than both competing disposable food packaging materials and reusable dishes. Polystyrene foam cuts costs and increases operating efficiency when factoring in the additional resources required by "permanent ware", including equipment, labor, detergents, water and electricity resources to run dishwashers, and wastewater management.

Keybridge Research, Quantifying the Potential Economic Impacts of a Ban on Polystyrene Foam Food service Products in California, November 18, 2009, p. 4

Beginning with the Maryland Recycling Act and Pennsylvania's Act 101 in 1988, the states have adopted a range of other methods for waste management in conjunction with traditional practices such as landfills and incineration. With this increased focus, the same characteristics that have made expanded polystyrene food service products the preferred and most cost-effective product in numerous applications have also made them the target of regulatory proposals in some areas. The durability of the products produces a visual impact in the environment when released as litter. Differences among municipal recycling capabilities along with historically limited but now growing markets for recycled plastics have made these products more challenging for waste diversion programs in the past.

At the same time, there are no current perfect replacements because of the unique properties found only in expanded polystyrene food service products. Food service wares from various other materials are currently available in the market, but differ widely in providing comparable product characteristics, generally are available at higher cost and for some biodegradables in more limited supply, and often present their own challenges to litter abatement and to existing and future waste diversion efforts.

There is little data on the contribution of expanded polystyrene food service products to Maryland's total solid waste stream or on the amounts of polystyrene foam that are currently recycled. However, previous local studies indicate that these products comprise about 1% of the total solid waste stream, with the products covered by the proposed bill making up some subset of that amount.

- A recent waste characterization study for Prince George's County Brown Station Road Sanitary Landfill (SCS Engineers, 2016) estimated all polystyrene (both expanded and other forms) materials at 1.9% of both residential and commercial waste streams and 2.4% for public schools.

- An earlier study of the Montgomery County Transfer Station (SCS Engineers, 2013) estimated similar results: expanded polystyrene products were 1.1% of the overall waste stream, ranging from 0.9% to 1.1% for residential and 1.2% for nonresidential.

Current recycling rates remain very low, as local programs generally do not accept these materials for curbside recycling. Existing polystyrene foam recycling within Maryland focuses more on packaging materials, although the Earth911 website indicates at least one recycler within the state accepting food service products.[2]

Definitions Used in the Analysis

The products and affected end users addressed in the analysis are those defined in the proposed legislation:

- The affected end user groups are: (1) Food Service Businesses, including restaurants, fast food style restaurants, cafes, delicatessens, coffee shops, supermarkets or grocery stores, vending trucks or carts, food trucks, movie theater, dinner theaters, and business or institutional cafeterias, including those operated by or on behalf of the state; and (2) others purchasing these products for personal or incidental use. For the purposes of the analysis, the assumption is that all such purchases by this second category would be affected by the legislation, although many would have readily available out-of-state options.

- The affected products would be food service ware used for selling or providing food, including food containers, plates, hot and cold beverage cups, meat and vegetable trays, and egg cartons. As defined in the bills, not included are: "prepackaged soup or other food that a food service business sells or otherwise provides to its customers in expanded polystyrene containers that have been filled and sealed before receipt by the food service business; food or beverages that have been filled and sealed in expanded polystyrene containers outside the state before receipt by the food service business; and materials used to package raw, uncooked, or butchered meat, fish, poultry, or seafood for off-premises consumption."

Analysis Framework

The basic approach to the analysis is to estimate existing expenditures for EPS food service products that would be affected by the proposed legislation, and compare to the costs for businesses and consumers to buy alternative replacements. The calculations are done through the following steps.

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[2] http://search.earth911.com/?utm_source=earth911-header&utm_medium=top-navigation-menu&utm_campaign=top-nav-recycle-search-button&what=%236+Plastic+-+Expanded.

- Base Case. Existing costs for end user sectors are first estimated assuming no further state-level regulation of food service products. The Base Case is used to compare the cost of requiring a switch to alternative products, and to estimate the potential direct impacts of the proposed legislative restrictions.

  Note that even under this case, the relative market share of expanded polystyrene food service products is expected to decline as a result of current market trends. While the overall market projections used for the analysis in this report (Freedonia Group, 2015) show some continued growth in total expanded polystyrene applications, the growth rates for most expanded polystyrene product categories are lower—up to one-half to one-third lower—than for other material types. The Freedonia market projections show absolute growth for expanded polystyrene food service products over the next 10 years, but their relative share is expected to decline as the use of other materials grows faster.

  This market share slowing is likely the result of two general trends. First, material substitution is already occurring within some end user sectors, particularly those dealing with higher end consumers and larger chains more able to accommodate the added costs through higher prices or by having available a broader range of potential offsetting cost savings such as greater use of automation to reduce labor costs. Second, other end users have already made changes in their product offerings (e.g., menu changes or serving size reductions) to minimize the cost impact from using alternative food container products.

  The key example in this second regard from our surveys of government procurement was the finding that school districts in general have reduced their purchases of expanded polystyrene trays in recent years. Some have moved away from only offering hot entrées requiring rigid trays, to more limited menus or periodic menu replacements with sandwiches and single-item servings such as chicken that can be served in paper boat trays. Others have moved entirely to other alternatives while absorbing the additional costs. For example, Montgomery County Public Schools has shifted to paperboard trays[3] at—based on purchasing data obtained from Montgomery and from other school agencies—an additional cost of about $135,000 annually.

- Lowest Cost Alternatives Case. Costs to end user sectors are then estimated based on the restrictions in the proposed legislation. This case assumes restrictions prohibiting the use of expanded polystyrene food service products but without provisions requiring specific alternatives such containers made from biodegradable/compostable or recyclable materials. Polystyrene foam products would be restricted under this option, but end users would be allowed to use any alternative available in the market. To develop a conservative estimate of the potential direct impacts, this scenario assumes that the lowest cost alternative will be used regardless of whether it is recyclable or biodegradable/compostable.

- Sectors Affected. Both the Base Case and Alternatives Case contain estimates broken down by the core end user sectors, defined as follows:

[3] Montgomery Schools Ending the Era of the Foam Lunch Tray, Washington Post, May 18, 2014.

- ✓ Limited-Service Restaurants includes NAICS 7223 (Special Food Services), 722513 (Limited-Service Restaurants), 722514 (Cafeterias, Grill Buffets, and Buffets), and 722515 (Snack and Nonalcoholic Beverage Bars).
- ✓ Full-Service Restaurants includes NAICS 722511 (Full-service Restaurants).
- ✓ Convenience Stores includes NAICS 44512 (Convenience Stores) and 44711 (Gasoline Stations with Convenience Stores).
- ✓ Grocery Stores/Wholesalers includes NAICS 4244 (Grocery Product Merchant Wholesalers), 4452 (Specialty Food Stores), 44511 (Supermarkets and Other Grocery Stores), and 45291 (Warehouse Clubs and Superstores).
- ✓ Non-Commercial includes consumers, government agencies, institutions, non-profits, and others purchasing containers for personal, organizational, or incidental use and not as a component of retail sales.

Existing Sales & Cost of Complying Alternatives

The general approach to this study is: (1) identify existing uses of expanded polystyrene food service products by state agencies, businesses, and the public within Maryland; (2) estimate the cost to replace these items with the lowest cost alternative for a low impact case; and (3) estimate the cost to replace these items with the lowest cost, fully compostable/recyclable alternative for a high impact case. The steps and data used in this approach are described in this section.

Current Expanded Polystyrene Food Service Products Market

Table 1: Base Case: Expanded Polystyrene Food Service Products, Estimated Purchases by End Users Subject to Proposed Restrictions in 2015 ($ million)

Limited-Service Restaurants	Full-Service Restaurants	Convenience Stores	Grocery Stores/ Wholesalers	Non-Commercial	Total
$17.5	$5.4	$2.6	$6.6	$8.9	$41.0

Existing purchases of expanded polystyrene food service products within Maryland were estimated as follows:

- Core data was taken from national sales estimates and projections (Freedonia Group, 2015), which are broken out by product class and material.
- The national figures were then distributed by region using confidential industry market data, broken down by product class and end user sector. This data allowed for taking into account regional differences in consumption patterns and cost structure differences among the core end user sectors.
- The regional estimates for the Middle Atlantic States were then used to develop the Maryland estimates, apportioned by an appropriate proxy which in general was population for non-commercial sales and employment or wages for business sales.
- Prices by product class were estimated from surveys of current price information and government sourcing to determine the cost differences for alternative products. The specifics of this data step are detailed further below.
- The Maryland estimates were adjusted to account for local restrictions previously adopted in Montgomery and Prince George's Counties. The results in Table 1 incorporate these measures as if they were in effect in 2015, in order to provide a consistent base option for development of the impact estimates. These adjustments assume these local measures are fully effective with minimal nonconforming purchases from outside the localities. Similarly,

the state estimates assume full effectiveness of the proposed restrictions, with minimal nonconforming purchases from outside the state.

The results of this analysis are summarized in Table 1. Total Maryland sales in 2015 are estimated to be at least $41.0 million, but likely somewhat higher given that the estimates are based on lowest unit cost, generally government prices. This monetary total is down from a comparable estimate for 2011. Although the estimated number of units sold in Maryland in 2015 was higher than in 2011, lower prices in some of the product classes and shifts between product classes produced the total dollar decline.

Range of Disposable Food Container Alternatives

The potential universe of food service alternatives falls within the following general categories:

- Paperboard is a readily available alternative, but for almost all food service applications, paper products include some form of lining such as wax or PE (polyethylene). These linings can present challenges to recycling and composting of these materials. Bioplastic lined products such as PLA are available which can be handled in industrial but generally not home composting facilities, and these products generally carry a considerably higher cost.

- Molded pulp is used for several food service items such as plates, bowls, trays, and clamshells. These products may or may not include a lining, and generally are made from paper. The lined products present the same recycling and composting challenges of lined paperboard, but items with more costly bioplastic linings are also available.

- Bagasse products are made from a sugarcane by-product that is pulped and then pressure formed into the final product. These items are generally made abroad (typically in Asia) and must be shipped to the US. Often marketed as fully compostable, a number of applications include a bioplastic lining or layer which will pose problems for all but industrial composting operations. Similar products are also produced from bamboo and wheat straw.

- Other plastic materials such as non-bottle thermoformed PET (polyethylene terephthalate), OPS (oriented polystyrene), and polypropylene are used in food service applications. Their use as an acceptable alternative will be limited in those cases where insulation is not one of the required product characteristics.

- Most existing plant-based bioplastic alternatives rely on PLA (polylactic acid). PLA can be made from a variety of plant starches, but in the US is made primarily from corn. PLA is biodegradable over different periods depending on the additives used. Its main disadvantage is that it is designed to begin to biodegrade under the same temperature and moisture conditions associated with hot food and liquids. Many suppliers also provide warnings about the temperature and moisture conditions under which these products must be stored, making their use more problematic for smaller operations especially small restaurants, trucks, and carts with limited storage space.

- Aluminum products are available for some applications, such as replacements for some trays, clamshells, and other food containers. The high cost relative to polystyrene foam, paper, and other plastics will limit the use of aluminum in other applications. Aluminum containers also require an associated lid made of a different materials—generally clear polystyrene or a lined paperboard—which must be handled differently if recycling is the waste management option. Although it is already used within the food service industries, broader use is limited by cost.

Because the proposed legislation is modeled more on the Prince George's County provisions, there are no further restrictions proposed on what type of alternatives may be used, such as Montgomery County's requirements to use recyclable or compostable products. Consequently, the impact calculations focus on the lowest cost alternatives regardless of their other attributes and marketing claims.

Cost of Disposable Food Container Alternatives

Cost factors for the base case and the cost impact options were determined from the following sources:

- Core unit costs were taken from current low-cost bid contracts issued by various government agencies, using as a base current pricing contained in the current applicable blanket purchase orders (BPO) under the Maryland Department of General Services (DGS): BPO 001B5400500 (Statewide Contract for Disposable and Compostable Food Service Products), BPO 001B5400501 (Statewide Contract for Disposable and Compostable Food Service Products), and BPO 001B64007-1 (Statewide Contract for Disposable and Replacement Food Service Products for Insulated Meal Tray Systems). These contracts cover most product classes with polystyrene foam items, along with pricing for a number of product alternatives as well.

- Additional core unit costs for alternatives were taken from another recently issued contract by the Oregon Department of Administrative Services, Procurement Services, specifically for compostable food service ware (Contract No. 6443, Revision No. 1.1, Food Service Products: Grocery-Disposable, June 27, 2016).

- These prices were then compared to procurement data obtained under the Maryland Public Information Act (PIA) requests to various state and school agencies along with comparable requests to public agencies in other states. Responses were received from over 40 agencies providing detailed procurement data along with current low-bid pricing. Most responders provided data from both FY15 and FY16 to enable the analysis to determine any significant price movements.

- Some local governments which have adopted restrictions on expanded polystyrene food service products also compile information on available sources of complying alternatives. San Jose, CA and Montgomery County, MD include some pricing information which was used to check the price comparisons developed as above. The San Jose data includes pricing both for bulk and retail purchases. Not all items listed in these two information sources, however, are currently available.

- Finally, costs were reviewed on various restaurant supply and other internet sources.

The base pricing in most cases is taken from the public agency procurement document. The result of low bid pricing, this data comes from a market test of generally available low prices in the region. Where the products offered are also generally available on similar terms in the Maryland region, appropriate adjustments are made from the other sources listed above.

For all products, only the main item is considered and not lids. Most of the local ordinances adopted to date do not cover lid materials, and while some of the expanded polystyrene alternatives require same-manufacture lids, the most commonly used items such as hot and cold cups generally accommodate standard sizes.

Alternative costs are determined based on how they are used in practice. For example, stand-alone paper cups are one of the more cost-effective alternatives, but in practice, this cost level applies only to cold cups. Their use as hot cups involves some sort of protection and stabilization such as double cupping or sleeves. Their cost as an alternative is adjusted accordingly and compared to other options that incorporate these features into their design or apply other components such as built-in handles. While the use of sleeves is more common, double cupping produces a more conservative replacement cost estimate for most cup sizes, and consequently is used as the basis for the analysis.

Table 2 summarizes the low cost unit prices identified from the data sources, both for expanded polystyrene products and those made from alternative materials. In Table 2, "Fiber" products include paper, molded pulp, bagasse, and similar materials.

The unit prices of Table 2 were then used to determine the lowest cost alternative product under each of the product categories. The results are contained in Table 3. The average cost premium for each product class was then weighted by total estimated sales to determine the overall average cost premium under each scenario.

Food tray use is analyzed separately. Comparable cost premiums were taken from previous impact studies that conducted a more detailed review of this component of the market, showing the cost premiums ranged from 19% for coated paper to just over 200% for PLA. These factors were adjusted to current pricing through the data analysis described above.

As shown in Tables 2 and 3:

- <u>Base Case</u>: Table 2, Polystyrene Foam column was applied to estimated unit volumes to calculate the estimated sales values in Table 1. For comparison, a 2011 sales estimate was calculated from a comparable price survey conducted in 2012.

- <u>Lowest Cost Alternatives Case</u>: The averages in Table 3 were used to estimate cost impacts from the proposed restrictions where general rather than detailed procurement data is available, including where applicable the product class averages and the overall weighted average.

In all cases, these cost premiums are conservative estimates based on the lowest cost pricing for both polystyrene foam and complying alternative materials. In practice, the cost premiums are likely to be higher, due to the high variability in the cost, supply availability, and performance characteristics required in individual applications. As an indication of the potential range, a number of the public records responses also provided the related MSRP pricing for most items. Based on this data, the actual impacts could be as much as 20% higher than the conservative, low cost estimates on which the analysis is based.

While the analysis is based on current cost differentials, a frequent assumption in government regulations mandating specific material replacements, in particular with "green" materials, is that over time as use increases, economies of scale will produce cheaper prices. For example:

> **What is the price difference between compostable products and traditional ones? Depending on the product, compostables can be two to four times more expensive than traditional products. The price difference has the potential to decrease over time through economies of scale and increased petroleum-plastic prices.**
>
> *BSI Biodegradable Solutions, http://www.biodegradablesolutions.com/faqs.php*

> **Restaurants also have a concern/perception that switching to compostables will cost more money. This concern may prove to be short-lived if more local distributors participate and the cost of compostables drops.**
>
> *Seattle Public Utilities (2008), Vol. I, p. 3-11*

This assumption requires at least two underlying conditions. First, that there are significant economies of scale that can be achieved. While no means a definitive analysis of the full trends, prices for many of the alternatives considered in this report have not changed significantly over the past 5 years. For example, a similar survey of government procurement in 2010 found the lowest cost for a 12 oz. PLA-lined compostable hot cup at 7.0 cents. Applying the same government discount rates offered in 2010, the same cup from the same source would be priced at 7.8 cents today. In this same period, the lowest cost paper/PLA-lined alternative identified through surveys of government sources was unchanged at 5.5 cents each. Prices for some other alternatives have moderated to some degree since our surveys began in 2005, but not enough to narrow significantly the large price gap that remains for these products.

Second, this assumption also assumes that all other technology will stand still, and that there are no further economies to be achieved in the production of existing products. As indicated above, total dollar sales for Maryland are estimated to be lower than they were in 2011 while sales measured by unit volume have increased. This result is due in part to price decreases for some product classes while prices in others have remained the same, an outcome coming largely from the significant drop in oil and natural gas prices during this period.

Table 2: Unit Cost for Expanded Polystyrene Food Service Products & Low Cost Alternatives by Material Type ($)

	Expanded Polystyrene	Fiber	With Sleeve/ Double	Fiber/ compostable	With Sleeve/ Double	Plastic (PS, PET, PP)	PLA
Clamshell - 6" 1 compartment	$0.037	$0.176		$0.087		$0.059	$0.206
Clamshell - 8" 1 compartment	0.069			0.150		0.121	0.379
Clamshell -8" 3 compartment	0.067			0.150		0.178	
Clamshell - 9" 1 compartment	0.064	0.281		0.159		0.163	
Clamshell - 9" 3 compartment	0.064			0.162		0.178	
Average, Clamshells	$0.060	$0.228		$0.141		$0.140	$0.293
Cold Cup - 8 oz	0.017	0.030		0.058		0.019	0.053
Cold Cup - 12 oz	0.021	0.028		0.069		0.025	0.069
Cold Cup - 16 oz	0.037	0.043		0.075		0.046	0.075
Average, Cold Cups	$0.025	$0.033		$0.067		$0.030	$0.066
Hot Cup - 8 oz	0.017	0.024	0.048	0.051	0.099		
Hot Cup - 12 oz	0.021	0.032	0.063	0.042	0.090		
Hot Cup - 16 oz	0.037	0.037	0.075	0.050	0.098		
Average, Hot Cups	$0.025	$0.031	$0.062	$0.048	$0.096		
Plate - 7 inch	0.013	0.044		0.027		0.127	
Plate - 9 inch	0.019	0.054		0.054		0.240	
Bowl - 8 oz	0.014	0.029		0.029		0.108	
Bowl - 12 oz	0.013	0.036		0.028		0.099	
Average, Plates & Bowls	$0.015	$0.041		$0.035		$0.144	
Serving Tray - 5 compartment	0.032	0.046					
Serving Tray - 6 compartment	0.043	0.095					
Average, Serving Tray	$0.038	$0.071					

PLA lining

PE lining

Table 3: Cost Premium for Expanded Polystyrene Food Service Alternatives ($ per unit)

	Lowest Cost Alternatives	
	Difference ($)	*% Increase*
Clamshell - 6" 1 compartment	0.022	61%
Clamshell - 8" 1 compartment	0.052	75%
Clamshell -8" 3 compartment	0.083	123%
Clamshell - 9" 1 compartment	0.095	148%
Clamshell - 9" 3 compartment	0.098	154%
Average, Clamshells	0.070	112%
Cold Cup - 8 oz	0.002	12%
Cold Cup - 12 oz	0.004	19%
Cold Cup - 16 oz	0.006	16%
Average, Cold Cups	0.004	16%
Hot Cup - 8 oz	0.031	182%
Hot Cup - 12 oz	0.042	201%
Hot Cup - 16 oz	0.038	102%
Average, Hot Cups	0.037	162%
Plate - 7 inch	0.014	108%
Plate - 9 inch	0.035	184%
Bowl - 8 oz	0.016	114%
Bowl - 12 oz	0.015	115%
Average, Plates & Bowls	0.020	130%
Serving Tray - 5 compartment	0.014	44%
Serving Tray - 6 compartment	0.052	121%
Average, Serving Tray	0.033	82%
Weighted Average		95%

Economic Impacts

Total Cost Impacts

Table 4: Summary Cost Impacts ($ million) to End Users Subject to Proposed Restrictions

Limited-Service Restaurants	Full-Service Restaurants	Convenience Stores	Grocery Stores/ Wholesalers	Non-Commercial	Total
$16.3	$5.4	$2.8	$2.2	$8.3	$34.9

Note: Columns may not sum due to rounding

Using the existing sales and cost premium estimates developed in the previous sections, the total additional costs stemming from potential restrictions are summarized in Table 4. Again, these are conservative estimates based on the lowest unit costs, and likely would be larger in actual practice.

The consequences of these cost impacts will vary by individual business and economic conditions existing at the time any restrictions would become effective. Grocery stores have more control over immediate price changes, but also operate within an industry that currently is increasingly constrained by price competition. Restaurants tend to restrict price changes to their schedules for printing new menus. The other end users range somewhere in between.

Table 4 also does not incorporate any assumptions about the price elasticities of demand. In the short term as price increases are introduced, there likely will be at least some reduced demand for the affected businesses at the margin. Over the longer term, any such effects are likely to be reduced as consumers adjust to any higher prices. The end result, however, will in essence be an "environmental tax" of at least $34.9 million on the affected food sales that will first be imposed on local businesses, but eventually is likely to be transferred to consumers through price increases.

Indirect Impacts

The analysis of this study relies on the direct cost changes as estimated above, and does not include a detailed consideration of indirect and induced impacts as would be done in full economic analysis. However, these further impacts are likely to occur.

First, the immediate adjustments in response to any restrictions on food service ware are likely to see at least some level of substitution. The affected businesses, especially small businesses, are likely to first seek compensating cost savings in other areas such as ingredient use, portion size, or paid labor and the associated labor costs. Consumers faced with higher costs will at least at the margin continue to reduce related food expenditures or substitute other personal cost savings depending on their demand elasticities. These changes in purchases and consumption will be felt in different areas of the regional economy.

Second, because it is relatively light-weight (95% air) product, expanded polystyrene food service products and other expanded applications tend to be manufactured near the end user markets in order to reduce transportation and warehousing costs. Most of the alternative products available to replace expanded polystyrene tend to be produced in more centralized US facilities due to their manufacturing profile, or are imported due to their raw materials source.

Table 5: Food service Ware Manufacturer Locations

Product	Material	Reference	Manufacturing
Clamshell - 6" 1 compartment	bagasse	OR DAS	China, Thailand
Clamshell - 8" 1 compartment	bagasse	OR DAS	China, Thailand
Clamshell - 9" 1 compartment	bagasse	OR DAS	China, Thailand
Clamshell - 9" 3 compartment	bagasse	OR DAS	China, Thailand
Clamshell - 9" 3 compartment	foam	PA DGS	NY, IL
Cold Cup - 7 oz	paper/waxed	PA DGS	PA, MD, MI
Cold Cup - 7 oz	pla	OR DAS	PA, MI, SC, ID
Cold Cup - 7 oz	ps	PA DGS	PA, MD, MI
Cold Cup - 16 oz	pla	OR DAS	PA, MI, SC, ID
Hot Cup - 8 oz	foam	PA DGS	PA, MD, MI
Hot Cup - 8 oz	paper/pe	PA DGS	PA, TN
Hot Cup - 12 oz	foam	PA DGS	PA, MD, MI
Hot Cup - 16 oz	foam	PA DGS	PA, MD, MI
Plate - 7 inch	bagasse	OR DAS	China, Thailand
Plate - 9 inch	bagasse	PA DGS	China, IL
Plate - 9 inch	bagasse	OR DAS	China, Thailand
Plate - 9 inch	foam	PA DGS	NY, IL
Plate - 9 inch	paper	OR DAS	US
Bowl - 8 oz	foam	PA DGS	PA, MD, MI
Bowl - 12 oz	bagasse	OR DAS	China, Thailand
Bowl - 12 oz	bagasse/bamboo	PA DGS	NY, IL
Bowl - 12 oz	foam	PA DGS	PA, MD, MI
Serving Tray - 5 compartment	foam	PA DGS	NY, IL
Serving Tray - 6 compartment	foam	PA DGS	NY, IL

Source: Pennsylvania Department of General Services, Contract No. 4400015922, Disposable Food Service Products Lot 1, August 29, 2016;
Contract No. 4400015923, Disposable Food Service Products Lot 2, August 29, 2016;
Oregon Department of Administrative Services, Contract No. 6443, Revision No. 1.1,
Food Service Products: Grocery-Disposable, June 27, 2016

To illustrate this point, both the Pennsylvania Department of General Services (PA DGS) and Oregon Department of Administrative Services (OR DAS) procurement contracts used in the cost data survey also include identification of the manufacturing location for many of the expanded polystyrene and alternative material products available through these general contracts. As summarized in Table 5, of the core food service products used in this analysis, expanded polystyrene and some alternative products are manufactured in Maryland or in neighboring/nearby states. PLA is more dispersed. The generally less costly bagasse alternatives are manufactured in Asia, although some domestic production in the Midwest is beginning to develop similar products from wheat straw.

Similarly, Biodegradable Products Institute maintains a list of alternative disposable food service ware producers with products that have been certified as biodegradable or compostable in accordance with ASTM D6400 or D6868.[4] Of the 88 providers listed, 47 are located in other countries, and none are in Maryland. Even for some the US providers such as World Centric, the US location shown on the Institute list serves primarily as a distribution operation, with the company's manufacturing currently located in Asia.[5]

Expanded polystyrene, however, is produced regionally, and a primary source of indirect/induced impacts will be from reduced sales/employment/income from the existing regional sources for the Maryland market. Within Maryland in 2015, there were 3 establishments classified under NAICS 32614 (Polystyrene Foam Product Manufacturing) with an estimated more than 200 employees and paying an average annual salary of over $50,000 (based on comparable regional data). Within the broader region of the Middle Atlantic States (Census Bureau definition), there were a total of 66 establishments with an average employment of 50 and average annual salary of $47,000. Expanded polystyrene products sold into the Maryland market will generally come from a subset of these facilities.

Proponents for restrictions on food service ware also often maintain that some of the polystyrene jobs lost will be replaced by jobs manufacturing new products from recycling the alternative materials. First, this claim assumes the alternatives are amenable to recycling when, as discussed later in this report, many of these materials will become contaminated with food residue and therefore ineligible for recycling.

Second, even under current recycling programs, a significant portion of the materials collected are exported for recycling overseas, further reducing potential indirect benefits within the region. For example, studies by the California Department of Resources Recycling and Recovery (February 2016; November 2016) show that over one-fifth of recycled materials collected in that state were shipped by sea to Asia in 2015, with just under another 1% shipped out of the state by rail and truck. Such shipments were higher in previous years but have softened as a result of slowing in the China economy and low oil prices (and therefore low prices for recycled plastic resin).

Table 6: Estimates of Direct & Indirect Impacts from Potential Restrictions on Expanded Polystyrene Food Service Products (dollars in millions)

	Lowest Cost Alternatives	
	Output	*Employment*
Negative impacts associated with decreased final demand for expanded polystyrene food service products	-$119.6	-554
Positive impacts associated with increased final demand for expanded polystyrene food service products substitutes	$26.8	125
Negative impacts associated with increased cost of disposal food service ware	-$55.5	-405
Net impacts	-$148.3	-834

[4] http://products.bpiworld.org/companies/category/food service.
[5] http://worldcentric.org/about-us/faq#general10.

An indication of the potential indirect and induced impacts can be shown through the detailed input-output modeling done by Keybridge Research (2009) for California. Scaling the Keybridge multipliers and applying the estimated direct impacts from Table 5 results in the estimates shown in Table 6. Incorporating direct, indirect, and induced effects, Table 7 indicates total regional economic output would be reduced roughly by $148 million and employment by over 800.

Note that Table 7 only gives rough estimates of the likely direct and indirect impacts for the Maryland region, as the input/output coefficients and inputs would differ from those used in the Keybridge model and would depend on the extent of the region being modeled. However, the important conclusion from this analysis is that the overall net impact is negative due to the fact that expanded polystyrene food service products are produced within the region, and the available substitutes primarily would be imported from other regions and countries.

Restaurants

Table 7: Full-Service Restaurants Subject to Proposed Restrictions

	Establishments	Employment	Ave. Annual Wage
2007	2,135	60,308	$16,493
2015	2,531	68,762	$19,530
Change	18.5%	14.0%	18.4%

Source: US Bureau of Labor Statistics

Table 8: Limited-Service Restaurants Subject to Proposed Restrictions

	Establishments	Employment	Ave. Annual Wage
2007	4,512	63,215	$14,912
2015	4,951	70,657	$16,615
Change	9.7%	11.8%	11.4%

Source: US Bureau of Labor Statistics

While the restaurant industry has recovered and grown beyond its pre-recession levels, the proposed restrictions would have the greatest effect on that portion of the industry—limited-service restaurants—where growth has already tapered off. Tables 7 and 8 contain baseline data on Maryland restaurants potentially subject to the proposed restrictions, those located in the state other than in Montgomery and Prince George's Counties. Full-service restaurants have shown significant growth, with the number of establishments expanding by 18.5% compared to the pre-recession levels in 2007, and total employment growing by 14.0%. Limited-service restaurants have grown at about half this rate, but still with significant employment growth at 11.8%. However, after experiencing most of this growth between 2010 and 2012, the number of limited-service restaurants essentially remained level between 2013 and 2015.

Note that in the tables, average annual wages is a composite statistic that reflects both hourly wages and average number of hours worked. As such, the data shown here and in the following tables do not necessarily indicate the average salary for a full-time worker, but instead address both general wage levels and splits between full-time and part-time workers in each industry.

Sales tax data indicates that the bulk of financial strengthening for the industry has come primarily in the last two years. For Maryland as a whole, sales tax revenue data from the Maryland Comptroller can be used as a proxy measure of overall sales trends, although the Food and Beverage Group data may be affected in specific years by shifts between purchases of food and of alcoholic beverages, which are currently taxed at different rates. As taken from the Sales and Use Tax Industry Tables, taxable sales for Restaurants, Lunchrooms, Delicatessens and for Restaurants and Nightclubs grew at an average combined rate of 3.9% from FY 2012 to FY 2016, with most of the growth occurring only in the last two years consistent with projections from National Restaurant Association for Maryland.

One of the significant effects of the proposed restrictions would be on self-employed and unpaid family workers, especially in smaller restaurants where family income is derived from profits rather than wages. The employment numbers in Tables 8 and 9 cover only wage and salary workers. Not included are self-employed workers and non-wage family workers who derive their incomes from the available profits. In 2015, the American Community Survey shows that self-employed and unpaid family workers in the Maryland Accommodation & Food Services industry were equivalent to 4% of total wage and salary workers. The true scale of restaurant employment would be shown by adding this factor to the employment numbers shown below, or roughly another 5,200 self-employed and unpaid family workers whose income relies on the available profits from their businesses.

Restaurant profit margins are already low, with little room to absorb additional costs. Restaurant profit margin estimates vary by year, but generally average around 4-5% of sales. Analysis of privately held restaurant financial statements by Sageworks show national margins going from a low of 0.4% in 2008 to 4.6% in 2015. National Restaurant Association (2010) broke out the estimates at 5.9% for Limited-Service Restaurants to 2.8% for Full-Service Restaurants.

Doubling the costs of disposable food service products used by restaurants likely will have a low effect on total costs, but will result in a significant reduction on already low profit margins. Previous analysis by Economic & Planning Systems (2012) pegged the cost of "to go" service ware at 1.57% of sales for Limited-Service Restaurants and 0.34% for Full-Service Restaurants. These items cover the same disposable service ware products analyzed in this report. Viewed from this perspective, relatively large movements in the cost of food service ware can have a significant impact on already low profit margins. While the absolute cost of food service ware alternatives may affect the equivalent of only about 1% of total sales, this cost factor represents 27% of Limited-Service profit and 12% of Full-Service profit. Significant increases in the costs of these service ware products—if not passed on directly to consumers in the form of higher costs—thereby can have significant effects on the profitability and continued operations of these businesses, along with related fiscal impacts to state tax revenues.

Restaurants are already having to absorb other major cost increases from government requirements, especially for the labor costs that account for about a third of their total expenses. In general, restaurant prices have already been increasing in response to cost rises faced in several prime components of their cost structures, including labor, rent, and energy. For example, labor costs have been rising with the tightening labor markets, regulatory requirements such as insurance coverage under the federal Affordable Care Act for full-time employees in firms with over 50 employees, and Maryland's action to raise minimum wage from $7.25 an hour at the beginning of 2015 to $10.10 by 2018. Cost increases as contained in the proposed legislation will not be felt in isolation, but would come at a time when these low margin businesses are already coping with significant increases in their other major costs.

Restaurants have already been forced to make significant price increases in recent years, and may be limited in their ability to pursue this strategy further without reducing market share. The extent of these existing price changes locally are reflected in Table 9, which compares growth in the latest data for the Washington-Baltimore, DC-MD-VA-WV CPI for food away from home (restaurant purchases) vs. food at home (grocery store purchases), along with the comparable US data. Looking at these components shows that while basic food costs are in decline, other growing costs have seen restaurants react with higher prices. This trend is even more pronounced looking at a longer time frame. Looking at the comparable data since 2011, Maryland prices for food consumed at home have increased only 1.2%, while prices for food consumed away from home have leapt 13.9%.

Table 9: Change in Food Prices, November 2016 vs. November 2015

	Maryland	US
Food at Home	-1.8%	-2.2%
Food away from Home	3.3%	2.3%

Source: US Bureau of Labor Statistics,
Consumer Price Index, not seasonally adjusted

The latest Food Price Outlook issued by the US Department of Agriculture expects these trends to continue:

> **Food-away-from-home prices have been rising consistently month-over-month due, in part, to differences in the cost structure of restaurants versus supermarkets or grocery stores. Restaurant prices primarily comprise labor and rental costs with only a small portion going toward food. For this reason, decreasing farm-level and wholesale food prices have had less of an impact on restaurant menu prices. . . In 2016, ERS predicts food-at-home (supermarket) prices to decrease between 1.25 and 0.25 percent, marking the first year since 1967 that retail food prices could reflect annual deflation.**
>
> *USDA (2016)*

This growing disparity between restaurant and grocery store prices, however, has already had an impact on restaurant traffic and revenues. The latest reports from NPD Group show that nationally, total restaurant visits were flat in both the first and second quarters of 2016, and declined 1% in the third quarter. Quick service restaurant traffic—accounting for 80% of total restaurant visits—declined for the first time in 5 years.[6]

Under these conditions, new restrictions on disposable food service ware would add further cost pressures at a time the local restaurant industry is already coping with rising costs, and consumers are pulling back in the face of the compensating rising prices.

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[6] NPD Group, After Two Consecutive Quarters of Stalled Traffic Growth, Restaurant Visits Decline in Third Quarter, December 6, 2016; Dining Out Falls Victim to Economy, *Wall Street Journal*, June 26, 2016.

Grocery Stores/Wholesalers

Table 10: Estimated Grocery Stores/Wholesalers Subject to Proposed Restrictions

	Establishments	Employment	Ave. Annual Wage
2007	1,671	47,855	$28,964
2015	1,756	50,678	$31,127
Change	5.1%	5.9%	7.5%

Source: US Bureau of Labor Statistics

As shown in Table 10, the Maryland grocery industry (outside Montgomery and Prince George's Counties) has seen some growth compared to conditions prior to the recession. The number of establishments has grown 5.9%, and employment nearly kept pace at 5.1%. Note that in Table 10, employment and wage data was estimated for NAICS 45291 from available Middle Atlantic state averages due to non-disclosure limitations. Table 10 also incorporates only the portions of NAICS 45291 related to food sales, as estimated from confidential industry data.

Sales tax data indicates that sales for the state as a whole have largely been flat in recent years. As with restaurants, sales tax revenue data from the Maryland Comptroller can be used as a proxy measure of overall sales trends. As taken from the Sales and Use Tax Industry Tables, taxable sales for Supermarkets and for Independent Grocery grew at an average combined rate of only 0.8% from FY 2012 to FY 2016, with most of the growth occurring only in 2014 and the other years showing lower or negative growth.

Operating data for this industry is more variable given the wide range of enterprise types, but is generally lower for operations more likely to use expanded polystyrene products. Independent Grocers Association (2015) reports the average profit margin for independent grocers ranged between 0.9% to 1.9% between 2007 and 2014. Ahold Delhaize (Giant Food) reported operating earnings of 3.4% and net earnings of 2.2% in 2015. For examples of nontraditional chains, Whole Foods recently has averaged 4.0% and Wal-Mart 3.4%.

These profit margins particularly for independent grocers leave little room for additional cost increases, especially at a time many also are experiencing downward pressure on revenues and profits as core food prices decline. As reported recently in the *Wall Street Journal*:

> **At least six national food retailers, including Costco Wholesale Corp. and Whole Foods Market Inc., and four of the five largest publicly traded food distributors, including Sysco Corp. and US Foods Holding Corp., have reported that their margins suffered in the last quarter because of food deflation, the first time analysts can recall so many grocers singling out deflation as a big problem.**
>
> **. . . Grocers such as Supervalu Inc. and Smart & Final Stores Inc. have been hit particularly hard. Even when the volume of products increased, profits have decreased in some categories because the price declines were so steep. Smart & Final's division catering to restaurants sold 42% more packages of eggs during its most recent quarter but recorded a 34% drop in egg revenue because of the lower prices, Chief Executive David Hirz told investors.**

Food Price Deflation Cheers Consumers, Hurts Farmers, Grocers and Restaurants, Wall Street Journal, August 29, 2016

The extent of competitive pressures on grocery stores is reflected in the discussion of this issue for restaurants above. As indicated in Table 9, the price component of the regional CPI for Food Away from Home has dropped 1.8% in the last year. Since 2011, this price component has increased a total of only 1.2%, a deflationary situation that has already made many traditional grocery outlets vulnerable to lower cost competition.

Similarly, the grocery industry faces many of the same general cost increases affecting restaurants. Labor costs have been rising with the tightening labor markets and regulatory requirements such as insurance coverage under the federal Affordable Care Act for full-time employees in firms with over 50 employees. With relatively fewer minimum wage employees, this industry will not be as immediately affected by Maryland's action to raise minimum wage are restaurants, but will be as the rate reaches $10.10 in 2018 both directly and indirectly as wage compaction forces wage increases in other classifications.

Convenience Stores

Table 11: Convenience Stores Subject to Proposed Restrictions

	Establishments	Employment	Ave. Annual Wage
2007	1,432	11,297	$17,810
2015	1,579	13,453	$18,686
Change	10.3%	19.1%	4.9%

Source: US Bureau of Labor Statistics

Convenience stores outside Montgomery and Prince George's Counties have expanded 10.3% compared to pre-recession levels in 2007, but employment has grown almost twice as fast. The data in Table 11 covers both stand-alone stores and gasoline stations with convenience stores. For the gasoline station segment, fuel constitutes about 75% of sales, with the remainder consisting of groceries, cigarettes, alcoholic beverages, prepared foods, and other items (First Research 2012). Convenience stores with no fuel sales generate about 35% of sales from groceries, 25% from tobacco products, and the remainder from other items including prepared foods and lottery tickets. Nationally, the industry is split between larger operations, and single-store operators that comprise over 60% of the total stores. Similar to independent grocery stores, profit margins are fairly low, in the 1.5% range.

Overall, potential cost impacts to this industry are about 30% higher than the broader grocery industry, and average costs will be higher given the smaller number of affected establishments.

Although convenience stores concentrate more on a smaller number of higher volume products, they still face many of the same price and cost factors currently impacting the restaurant and grocery industries. The high incidence of single-store operators, however, suggests that impacts to net incomes will likely be higher in an industry that has less room for price increases that would increase their competitive disadvantages with the previous industries.

Non-Commercial

The primary components of this sector that would be affected include local government agencies, nonprofit organizations, retail sales of the affected products, and various institutions such as hospitals, colleges and universities, and churches. City agencies are described in detail in the following Fiscal Impact section.

Fiscal Impacts

Fiscal Impacts: State Tax Revenues

Table 12: Summary Fiscal Impacts: Annual State Revenues ($ million)

	Costs Absorbed	Price Increases
Changes in revenues	-$1.6	$1.3

The primary Maryland business taxes cover the following items:

- 6% sales and use tax.
- 9% alcohol tax.
- 8.25% corporation income tax rate.
- Personal income tax rate of 2% to 5.75% for pass-through business types taxed at personal rates.

The exact effect on local revenues will depend on how the affected businesses react to the higher costs. Initially, businesses may be forced to absorb some or all of the costs, especially restaurants who have already gone through a period of price increases and grocery stores facing increasing price competition from low-cost operators in a period of food price deflation. The affected businesses may also seek offsetting costs savings, such as reduced labor costs through additional automation or in the case of family-owned firms, reduction of paid labor and greater use of owner and unpaid family worker labor. Other cost reduction strategies may include reducing menu or product offerings, portion reduction, ingredient substitution, or shifting business models (e.g., replacing table service with counter service operation). However, cost reduction strategies are likely to be limited as most of the affected businesses have likely already adopted most of these strategies in response to other rising costs, especially federal health care insurance requirements and Maryland's increasing minimum wage. Over time, the costs are likely to be shifted to consumers in the form of higher prices, although as indicated in the previous section, most of the affected end users have already gone through a period of price increases or have limited competitive options for pursuing this approach.

The effects of these strategies are summarized in Table 12. In each instance, the revenue effects shown are only those directly related to the increased service ware product costs. Changes in tax revenues due to reduced sales as a result of demand elasticities as prices rise are likely, but are not incorporated into the calculations.

- In the case of Cost Absorbed, state revenues would decline at least $1.6 million through lower corporate and personal income tax receipts (from pass through entities) but somewhat higher sales and use tax from retail sales of the alternative products. As with the previous cost impact analysis, this estimate assumes one-for-one replacement of current expanded polystyrene product use with alternatives, although the significantly higher costs are also likely to result in fewer purchases. In addition, the full effects that would be triggered by these additional costs in concert with other cost pressures on these industries likely would larger. As discussed previously, the analysis is based on businesses and consumers purchasing the lowest cost alternative, while higher priced substitutes are likely in many cases for a variety of reasons.

- In the case that prices are raised to match the additional costs, state revenues would rise by at least $1.3 million as a result of additional sales and use tax charged on the higher prices. Again, this amount is likely to be larger as product substitution will not always be at the lowest cost alternative. More importantly, while this amount would represent an increase to state revenues, it would fall as an additional cost of the proposed restrictions on the public and businesses.

- The case where state businesses are able to obtain other cost reductions is not analyzed in the table, as cost savings would be expected to net out the additional cost for alternative products. The primary effect would be an increase of sales tax from retail sales of the alternative products of $100,000 or less. However, additional effects are possible. Once a decision is made to put cost strategies into effect, some may lead to additional economic changes. For example, to the extent these costs combined with other pending costs increases lead to greater automation by the affected businesses, a greater number of existing jobs would be affected given the required investment levels to achieve an efficient level of automation. Such changes would have a broader effect on the cost structure of the affected businesses, along with additional but unknown changes on state revenues from both business taxes and a drop in income from the jobs affected by such a move.

- Indirect effects, such as those suggested by the rough estimates in Table 7, will also affect state revenues, although these factors are not incorporated into the estimates above.

As shown in Table 12, the potential fiscal impacts on local revenues range from a loss of $1.6 million if the affected businesses absorb the costs, to a gain of $1.3 million annually if the costs are fully passed on to consumers. These additional tax payments of $1.3 million—stemming primarily from the local sales and gross receipts taxes—would also likely be shifted to consumers.

Fiscal Impacts: State Costs

As providers of meals under various programs, state agencies would face additional costs similar to those imposed on other food providers subject to the proposed restrictions. Fiscal impacts from state costs are estimated based on FY 2016 expenditure and cost data. We have requested purchasing data from the relevant agencies under the Maryland Public Information Act, and a number have already provided usable data. However, given the legislative deadlines, the following section contains preliminary estimates of the full state purchases based on the responses received to date, previous information on Maryland purchases obtained for a prior study of similar proposals, comparable data obtained from agencies in other states, and state budget data. The information presented below, however, consists of preliminary estimates and will be updated as additional procurement data is received.

The primary state-funded food programs potentially affected by expanded polystyrene food service product restrictions are summarized in Table 13. Where available, the total cost figures cover food, personnel, and other expenses from the FY 2016 appropriations. In addition to these budgeted programs, various agencies may also purchase disposable food service ware for incidental use or other program purposes.

Table 13: Primary State Food Provider Programs ($ million)

Agency	Program	Total Cost, FY 16
Aging	Older Americans Act Nutrition Services	$ 11.0
Education	Food Services Program	354.9
Health & Mental Hygiene	Various	n/a
Higher Education Institutions	Student meal plans	n/a
Juvenile Justice	Food services	n/a
Hospitals	Meals Program, children of parents w/ illnesses/diseases	n/a
Maryland School for the Deaf	Food services	n/a
Public Safety & Correctional Services	Food services	n/a

Source: State of Maryland Budget Documents

Table 14: Estimated Expanded Polystyrene Food Service Products Purchases ($)

	FY 16 Purchases
State Agencies	$ 429,000
Schools	2,587,000
Total	$3,016,000

Current use by these programs was estimated from the following factors:

- Data for Public Safety, Juvenile Justice, and School for the Deaf was estimated based on their reported purchases from the DGS blanket purchase orders. The reported figures cover all material types, however. The expanded polystyrene component was estimated using average factors obtained from comparable agencies in other states.

- Data for Education was based on the current procurement data responses provided by Montgomery County Schools and Anne Arundel County Schools, applied to K-12 public enrollment numbers. The major component, trays, was estimated based on the unit data provided in these responses rather than the general factors of Table 3. Although we have not yet received their MPIA response, the estimates assume that Prince George's County Schools use the same alternative material trays as Montgomery County Schools.

- Data for Aging and Hospitals was estimated using average factors obtained from comparable agencies in other states.

- Data was not estimated for Higher Education as student meals are mixed as to whether they are provided by outside contractors or the school operations. Some data is being obtained from contractors in both Maryland and other states that will be used in the update to address this component.

In Table 14, because the information is primarily estimated at this point, the numbers given should be considered as reasonable upper bounds, and could range to over $3 million depending on the delivery methods, selected vendors, and foods served in any given year.

Applying the cost premiums developed in Table 3 (applied by product class for the schools), the additional costs to state costs are summarized in Table 15. The overall impact ratio is smaller than for the broader economic impacts developed previously as the costs are dominated by estimated tray purchases by the schools.

Table 15: Summary Fiscal Impacts: Annual Procurement Costs ($ million)

	FY 16
State Agencies	$408,000
Schools	488,000
Total	$896,000

Combining Tables 14 and 15, total annual Fiscal Impacts to the state are summarized in Table 16. As indicated, total state fiscal costs could range from a net cost of $2.5 million to a gain of $400,000 depending on how businesses react to these additional costs. However, the potential gain incorporates the additional sales tax cost of $1.3 million to consumers, which likely will offset other purchases rather than providing an actual gain to the state.

Table 17: Summary Fiscal Impacts: Total Annual Local Costs ($ million)

	Costs Absorbed	Price Increases
State Revenues	-$1.6	$1.3
State Costs	-0.9	-0.9
Total	-$2.5	$0.4

Fiscal Impacts: Local Costs

While local fiscal impacts are not included in the analysis of this report, a frequent claim of restrictions such as those proposed in the legislation is that local solid waste management programs will be able to obtain cost savings as one component of the solid waste stream—expanded polystyrene—that has challenges for diversion purposes will be replaced with materials more amenable to recycling and composting. Strictly applied, however, the end result is generally more likely to be the replacement of one form of lighter weight solid waste with another heavier one. This outcome is even more likely to occur in the absence of companion efforts—and substantial additional public and consumer costs—to develop local capabilities to divert either the existing waste stream through more recycling or a new stream through changes to local recycling and composting infrastructure.

Many of the product alternatives are promoted as recyclable, and in their original or cleaned state many technically are. But in practical applications, the least costly alternative in most cases is a paper, pulp, or paperboard application. Most local recycling programs do not accept these materials if they become contaminated with food or grease, making them unacceptable for recycling but more critically potentially contaminating other larger amounts of otherwise recyclable paper products. In addition, most local programs allow containers to be recycled only if they have been rinsed or cleaned, meaning a recycling requirement for disposable food containers can be effective only if the public is willing to take the time to clean more of their garbage.

The effectiveness of recycling attributes also assumes the public is willing to recycle more, while the most recent data shows the opposite is happening. Even incorporating the source reduction credit, data from Maryland Department of the Environment shows the state waste diversion rate went from a high of 48.9% in 2011 and 2012, to 47.6% in 2014.[7] Several other states have experienced similar or steeper downturns in recent years.[8]

Similarly, a number of food service product alternatives are marketed as "compostable" or "biodegradable," but many also contain limitations in this regard. Disposable food containers designed for hot food and liquids necessarily are designed to withstand the conditions found in many composting operations. Others such as paper or molded pulp may contain a PE, wax, PLA, or other lining that can complicate or contaminate the compost process. Many of these products are also designed for industrial compost facilities, and not home composting operations, with many including warning labels such as the following:

- **In order for solid products to biodegrade, they must be broken into small pieces and left uncovered in the sunlight. Disposing of a biodegradable product in your normal trash, where it will eventually be disposed of in a landfill, will not allow the product to biodegrade.**

- **Due to the variability in conditions, we do not recommend Greenware® products for use in home composting. Greenware® products are certified by the Biodegradable Products Institute (BPI) to meet international standard ASTM 6400 for compostability in industrial compost facilities, which carefully regulate temperature, moisture and turning.**

- **Our PLA products are compostable in commercial compost facilities, but unfortunately not in your home compost.**

- **Our sugarcane products are compostable in commercial compost facilities, but unfortunately not in your home compost.**

The desirability of compostable products also relies heavily on the availability of appropriate composting facilities. Few localities have invested in this required infrastructure. For example, Montgomery County adopted a ban on expanded polystyrene food service products but also incorporated a requirement that replacements be recyclable or compostable. Yet, their information materials on the ban include the following warning:

> **Compostable means the material will break down into, or otherwise become part of usable compost soil-conditioning material in a safe and timely manner in an appropriate composting program or facility. *Currently, there is a very limited number of compost facilities***

[7] Maryland Department of the Environment, Maryland State, County and City Recycling, http://mde.maryland.gov/programs/Land/RecyclingandOperationsprogram/StateCountyandCityContactInfo/Pages/programs/landprograms/recycling/local/recylingrates.aspx.

[8] Washington Post, American Recycling is Stalling, and the Big Blue Bin is One Reason Why, June 20, 2015.

accepting food scraps and compostable food service ware in their composting operations in existence serving the region.[9] *[emphasis in original]*

These same characteristics also limit the applicability of many disposable food container alternatives as a litter solution. Degradability within the natural environment occurs only when the necessary moisture, temperature, and microbial conditions are met, and several studies (California Integrated Waste Management Board, 2007; Innocenti, 2005; Nolan-ITU, 2002) have identified and measured the persistence of these materials when littered.

The promotion of biodegradable attributes to the public may also run counter to anti-litter efforts, by fostering the mistaken belief that the products will degrade naturally if discarded. For example, prior to its most recent action, San Francisco enacted a requirement in 2007 that food vendors use compostable or recyclable rather than expanded polystyrene food service products. Litter audits conducted before the restrictions and for two years after, however, showed (Table 17) that while the incidence of polystyrene in litter dropped 41% overall, the relative share represented by the categories containing food service ware for all materials generally increased (except for boxes).

Table 17: Percent of Total Large Litter from Food service Ware Categories, San Francisco Litter Audits

	2007	2008	2009
Cups	6.4%	6.4%	8.9%
Take-Out Extras	3.0%	3.8%	4.1%
Wraps	1.8%	3.6%	3.4%
Boxes	1.2%	3.4%	1.9%
Trays	0.2%	0.1%	0.5%
Total	*12.6%*	*17.3%*	*18.8%*

Source: San Francisco Environment Department,
The City of San Francisco Streets Litter Re-Audit, 2009

Consequently, simply replacing one component of the solid waste stream has yet to demonstrate actual savings on the local level, taking into account costs saved from handling expanded polystyrene, the extent to which to alternatives can be properly recycled or composted, and the comparative costs of local investments/local rate increases required for facilities to divert either the existing materials or their eventual replacements.

[9] Montgomery County, Department of Environmental Protection, Q&A: Ban on the Use and Sale of Expanded Polystyrene Food Service Ware in Montgomery County, Maryland.

About the Author

This report was prepared by Michael Kahoe, who serves as a strategic partner at MB Public Affairs, Inc. Founded in 1997, MB Public Affairs, Inc. provides clients a unique combination of research capabilities, public policy issue expertise, strategic analysis, and communications skills. MB Public Affairs, Inc. provides research consulting services to trade associations, private business interests, non-profits, and government organizations. With offices in Sacramento, CA and Austin, TX, the firm has worked for clients across the country on federal, state, and local issues.

The principals at MB Public Affairs, Inc. have worked in the public policy arena for decades. Mr. Kahoe is a recognized public policy expert who specializes in state and national regulatory matters and government relations. He has nearly 40 years of experience working on environmental, regulatory, and natural resource issues in California and other states, including Assistant Secretary of the former Environmental Affairs Agency, Deputy Secretary and part of the original team that created the California Environmental Protection Agency, and Deputy Cabinet Secretary over the State's environmental, energy, natural resources, regulatory, and agricultural agencies.

Prior to service with the State of California, Mr. Kahoe was an environmental consultant with Bay Area consulting firms and worked for the Fresno County-City Economic Development Program. He holds an MBA in Finance from University of California, Berkeley, MA in Economics from University of California, Santa Barbara, and BA in Social Relations from Immaculate Heart College.

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Modern polystyrene packaging has long been a preferred material of the foodservice industry because it **insulates better, keeps food fresher longer, costs less** than alternative coated paperboard products and **uses less resources.**

With today's growing concerns about the environment and climate change, polystyrene packaging solutions are becoming more recognized as **environmentally-preferable** for a host of reasons including their lightweight properties. Polystyrene packaging makes sense for business, consumers, and our planet.

Polystyrene Packaging – Environmentally Preferable

Consider The Whole Package

All packaging leaves an environmental footprint regardless of material type. It takes energy and raw materials to produce, transport, and recover or dispose of all materials. So it is important to measure all of these impacts throughout the entire lifecycle of the product. Polystyrene foodservice packaging uses less energy and resources to manufacture than comparable paper or coated paperboard products.

A Lighter Footprint

- Foam polystyrene cups weigh between two to five times less than comparable paper packaging products. This means fewer air emissions when transporting products.

An Energy Saver

- A polystyrene hot beverage cup requires about 50 percent less energy to produce than a similar coated paperboard cup with a corrugated cup sleeve. Decreasing energy usage is considered one effective way to slow global warming.

A Smart Choice for Recycling

- Recycled polystyrene represents an emerging market. A number of municipalities are instituting effective programs to reclaim this valuable resource. Post-consumer recycled polystyrene in some cases becomes "green building" construction products. Most single use, coated paperboard foodservice packaging materials are not recycled because the coating and paper cannot be separated economically.

Polystyrene Plastic – Designed with Food Safety in Mind

50 Years of Safety

The food safety benefits of polystyrene foodservice packaging are undisputed. The United States Food and Drug Administration regulates the safety of food-contact packaging and has approved the use of polystyrene since 1958, so too have governments around the world.

Clean, Sanitary and Non-Porous

- Polystyrene foodservice products can help in providing sanitary foodservice and preventing the spread of disease. Reusables need washing and drying – the plate and utensils you are using now have been used by someone else.

Saves Resources

- Reusables require water and energy to clean. Using polystyrene foodservice packaging conserves these important resources.

Provides Peace of Mind

- Parents, teachers, hospital patients and their loved ones are assured about the safety of prepared foods that are served on the sanitary surfaces of disposable polystyrene foodservice packaging.

Peak Performance at any Temperature

- Hot foods stay hot. Cold foods stay cold. Fresh foods stay fresh. From organic salads to spicy chili, polystyrene packaging offers more convenience and dining enjoyment for people on the go.

Polystyrene Food Packaging Delivers for Business

Focus on Fresh Ingredients, Not Packaging

Foodservice is a highly competitive industry. Choosing polystyrene packaging allows everyone from mom-and-pop restaurant owners to directors of large school districts to help keep costs low and menus affordable for customers. Less money spent on packaging also means greater resources available to expand business and hire new employees.

Greater Convenience for Customers

- Consumers enjoy the benefits of sturdy and strong polystyrene foodservice containers. And polystyrene packaging insulates extremely well to maintain food temperature, which can reduce food waste due to spoilage or damaged packaging and leakage.

Better Packaging Equals Less Packaging

- Because polystyrene foodservice products provide outstanding insulation and strength, such wasteful practices as double-cupping are not needed. This significantly reduces the number of containers and the natural resources used to make them.

Polystyrene – The Smart, Sustainable Solution

Makes Environmental Sense

All things considered, polystyrene foodservice makes good environmental sense. It generally uses fewer resources to manufacture, and weighs half as much as comparable coated paperboard products, resulting in a tangible reduction in air emissions during transport.

An Emerging Market: Polystyrene Recycling

- The second largest city in the United States, Los Angeles, has implemented a curbside program for recycling clean polystyrene products, including foam cups. No such program exists for coated paperboard products.

The Landfill Myth

- Polystyrene is not "filling up" landfills. In fact, polystyrene foodservice packaging currently accounts for less than 1 percent by weight and volume of land-filled materials.

An Excellent Energy Source

- High-energy content materials like polystyrene provide heat and light for neighboring communities. At over 16,000 BTUs per pound, polystyrene contains twice the energy of coal and burns cleanly.

Contributes LESS Greenhouse Gases

- Coffee lovers may be surprised to learn that one average weight polystyrene foam cup produces significantly less greenhouse gas emissions than two average weight coated paperboard cups or one average weight coated paperboard cup with a sleeve.

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