Flexible Packaging Industry Segment Profile Analysis

A Flexible Packaging Association Report

Prepared for FPA by PTIS, a Division of Havi Global Solutions Direct, LLC

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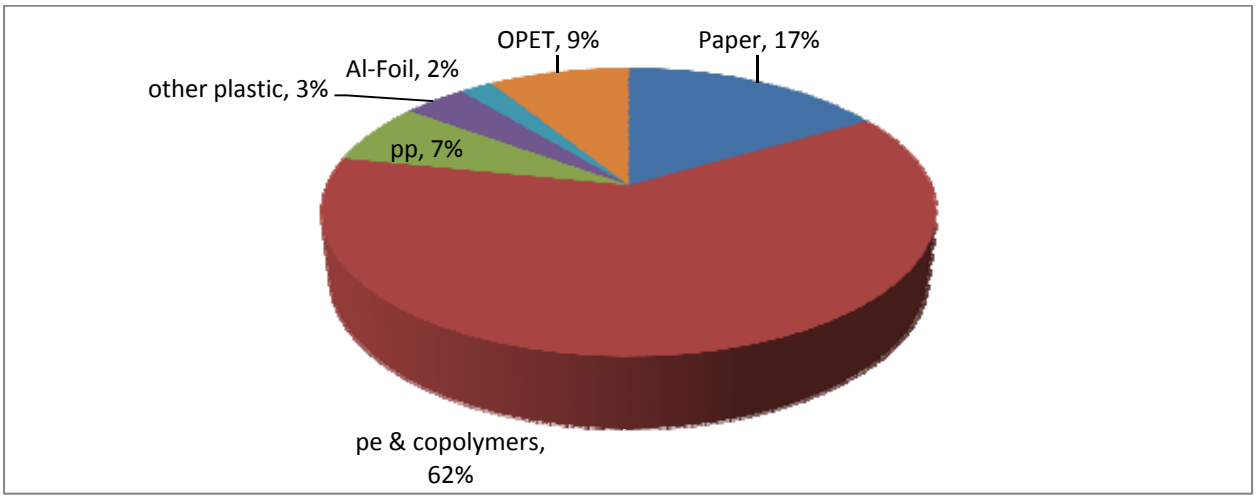
Executive Summary

This Industry Segment Profile of Flexible Packaging Formats in the United States by volume, revenue and substrates was developed by Packaging Technology Integrated Solutions, a division of HAVI Global Solutions, LLC.

The objective of the report is to provide the association and its members with a profile of the US flexible packaging market size (volumes and revenue) and composition by material for the various packaging formats (i.e. product packaging including bags, wrappers, lay flat pouches, standup pouches, retort pouches, lidding, shrink sleeves, shrink wrap, and stretch films; and retail carry bags, storage and trash bags).

The methodology for compiling the profile involved interviews with multiple industry experts across the segments researched for the 2012 estimates. Market studies of both packaging and packaged products from the period provided baseline data from 2002. Where conflicting estimates were encountered, the estimates for the source most closely aligned to that segment were used, rather than ones from a less focused source. Future projections are based on 2002-2012 trends, growth estimates for end use markets, and current industry dynamics as indicated by interviews. Specific sources for each segment are described in the segment summaries.

Figure 1: 2012 US Flexible Packaging Material Composition



The report estimates the size of the US Flexible Packaging Market as 17.3 Billion lbs. worth 26.7 Billion US$ with raw material composition as shown in Figure 1. In the aggregate, the value of the US flexible packaging market grew at a compound (2002-2012) annual growth rate of 3.0%. Segments currently enjoying high growth rates are standup pouches, flow wraps, and retort pouches. The advantages these segments demonstrate over alternative packaging formats provide opportunities for flexible packaging users, for example:

- Improved retail display (multi-color graphics and total billboard area)
- Extended shelf life (hermetic seals impermeable to environmental odors)
- Processing and packaging efficiencies (less package volume to process; less packaging volume to store..retort pouches in particular)
- Enhanced safety (tamper evidence)
- Distribution savings (lower weight packaging materials)

The conversion of alternate packaging formats to flexible ones (e.g. juice bottles to juice pouches, bag-in-folding carton crackers to stand up pouches, restaurant wine in bottles to barrier bag-in -box, etc.) continues to drive growth. To a lesser extent, new food processing technologies also add to flexible packaging opportunities. *Packaging Strategies* indicated in 2003 that 25% of flexible packaging's sales growth in the previous five years had come at the expense of other packaging formats[1] The same organization in its annual summary 6 years later claimed: :"The flexible packaging market continues to offer fantastic growth opportunities, particularly as a replacement package for rigid packaging"[2]. Very large growth in dollar/tonnage volumes may represent numerically small percentage growth because of the large total size of the US flexible packaging market.

Recycle *content* in flexible packaging is minimal. Food contact safety concerns hinder growth in recycle content in flexible packaging in the important (50-60 %) food packaging portion of the industry. Quality and consistency for thin films manufactured with recycled resin present difficulties for thin-film nonfood uses. Cut/wrap packages for sanitary paper products evaluated hdpe resin recycled from blow-molded dairy bottles, but the residual sour milk odor made even this use unacceptable.

Pilot programs both to *recover* used flexible packaging and to *recycle* it back to appropriate uses are well established. The American Chemistry Council commissions an annual survey of plastic bag and film recycling. The latest report indicates that almost 1 billion pounds of plastic bag and film material was recovered in 2010.[3] Most of this (58%) was from commercial sources, primarily stretch films. This suggests that over half of the estimated 928 million pounds of stretch film (See Segment No. 10) is recovered for reuse. About one-third of the plastic used in retail shopping nags is recovered for reuse. The same report estimates that "plastic lumber" uses about 42% of all the recovered films and bags, while one-fifth is returned to film and sheet uses. About 37% of this plastic is reused for garden products, crates, buckets, pallets, piping, and other miscellaneous applications.

Public-private initiatives in several jurisdictions[4] demonstrate to effectiveness of collecting consumer retail bags at retail outlets and keeping them separate from other plastic waste. The price paid for clean, uniform plastic can be 50% more than mixed plastic bag and film material receives.

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[1] W.E. Lewis, *Packaging Strategies 2003 Packaging Outlook* p. 11.
[2] Danny Beard; *Packaging Strategies 2006 Packaging Outlook* p. 4.
[3] 2010 National Postconsumer Plastic Bag & Film Recycling Report; Moore Recycling Associates for the American Chemistry Council, January, 2012, 11 pp.
[4] See for example, Minnesota Waste Wise *ANNUAL REPORT 2011-2012*; St. Paul, MN; 11 pp. and *Report to the Illinois General Assembly* Plastic Bag Recycling Task Force; Solid Waste Agency of Lake County, Illinois, 2010, 93 pp.

Estimates for the various segments of the US Flexible Packaging Market in 2012 follow in Table 1:

Table 1: 2012 US Flexible Packaging Market: Revenue- Volume

FORMAT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	2002–2012 CAGR based on $ MM	Est. Annual Volume – 2002	Est. Annual Volume – 2012	2002–2012 CAGR based on MM lbs	Percent Total based on $ MM	Percent Total based on MM lbs
Bags (excludes retail, storage and trash bags)	$5,566	$7,072	2.4%	5,169	4,796	-0.7%	26.4%	27.7%
Cut/wrap	$404	$573	3.6%	231	254	1.0%	2.1%	1.5%
Flow Wrap	$34	$76	8.4%	32	53	5.2%	0.3%	0.3%
Wraps	$2,260	$1,967	-1.4%	1572	1365	-3.7%	7.4%	7.9%
Lay flat/Pillow pouches	$3,892	$5,151	2.8%	2,992	3,321	1.0%	19.3%	19.2%
Standup pouches	$564	$1,560	10.7%	465	946	7.4%	5.8%	5.5%
Retort pouches	$40	$78	6.9%	10	16	4.8%	0.3%	0.1%
Lidding	$11	$30	10.6%	6	11	6.2%	0.1%	0.1%
Sleeve labels	$1,408	$2,070	3.9%	670	817	2.0%	7.7%	4.7%
Shrink bundling	$775	$993	2.5%	745	866	1.5%	3.7%	5.0%
Stretch films	$1,047	$1,219	1.5%	910	938	0.3%	4.6%	5.4%
Retail carry bags	$1,569	$2,750	5.8%	1,582	2,212	3.4%	10.3%	12.8%
Storage bags	$673	$950	3.5%	660	612	-0.8%	3.6%	3.5%
Trash bags	$1,601	$2,258	3.5%	801	1,129	3.5%	8.4%	6.5%
Overall	$19,844	$26,747	3.0%	15,845	17,336	0.8%	100.0%	100.0%

Composition (% by wgt):[5]	
SEGMENT	**Substrates***
Bags	Paper(37); ldpe(61); hdpe (2); nylon & Barrier <1%
Cut/wrap	OPP(22); WOPP(16); ldpe (46); paper (5); hdpe (11)
Flow Wrap	OPP(8); WOPP(92)
Wraps	ldpe (72), foil (18), paper (10)
Lay flat/pillow pouches	OPP(30); ldpe(40);OPET(29);foil(1)
Standup pouches	ldpe(32);OPET(60);foil(8)
Retort pouches	OPET(18); foil(40); pp(42)
Lidding	OPET(40); foil(30); paper(20); OPP (10)
Sleeve labels	PVC(54); PETG(21); OPP(5); OPS(9); ldpe(11)
Shrink bundling	ldpe (100)
Stretch films	ldpe (100)
Retail carry bags	ldpe(19) hdpe(38),paper(43)
Storage bags	ldpe (100)
Trash bags	ldpe (100)

[5] Raw material abbreviations are described in the Annex I. In general, upper case letters (OPP) refer to raw materials used only in extruded film form; lower case letters (ldpe) to those used in either resin or extruded film form. Other abbreviations are defined in the text.

Figure 2: Composition of U.S. Flexible Packaging Industry 2012 ($ mm)

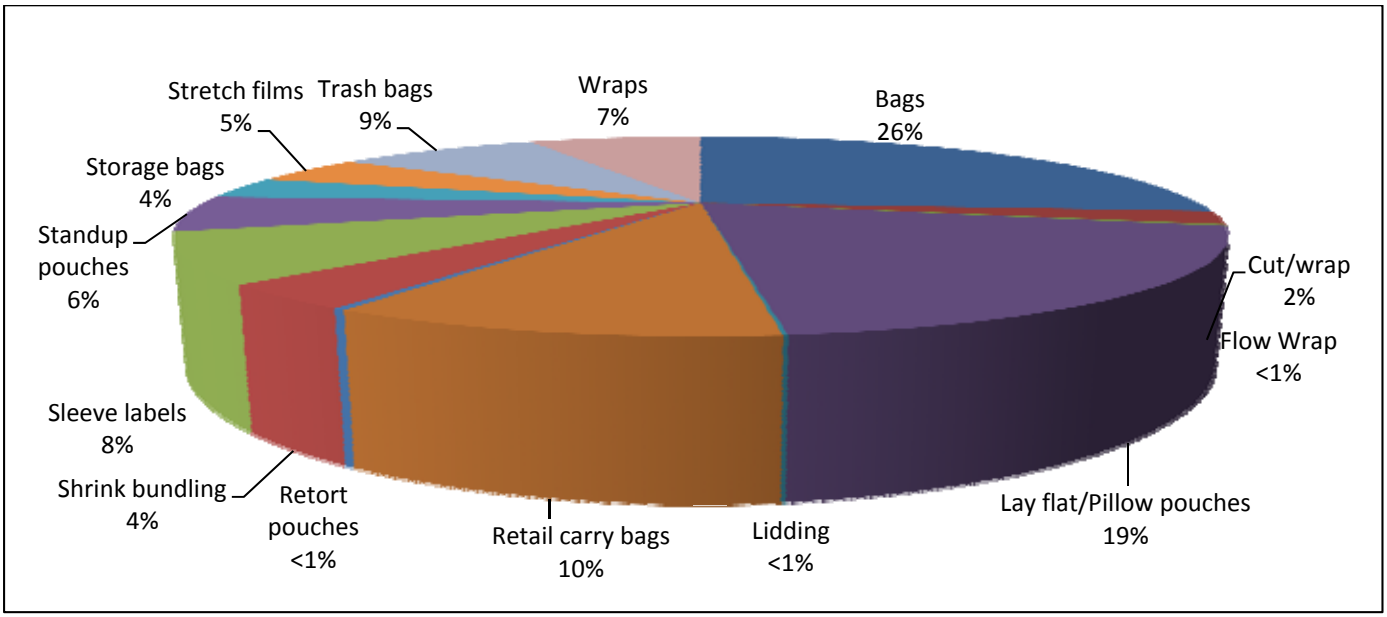
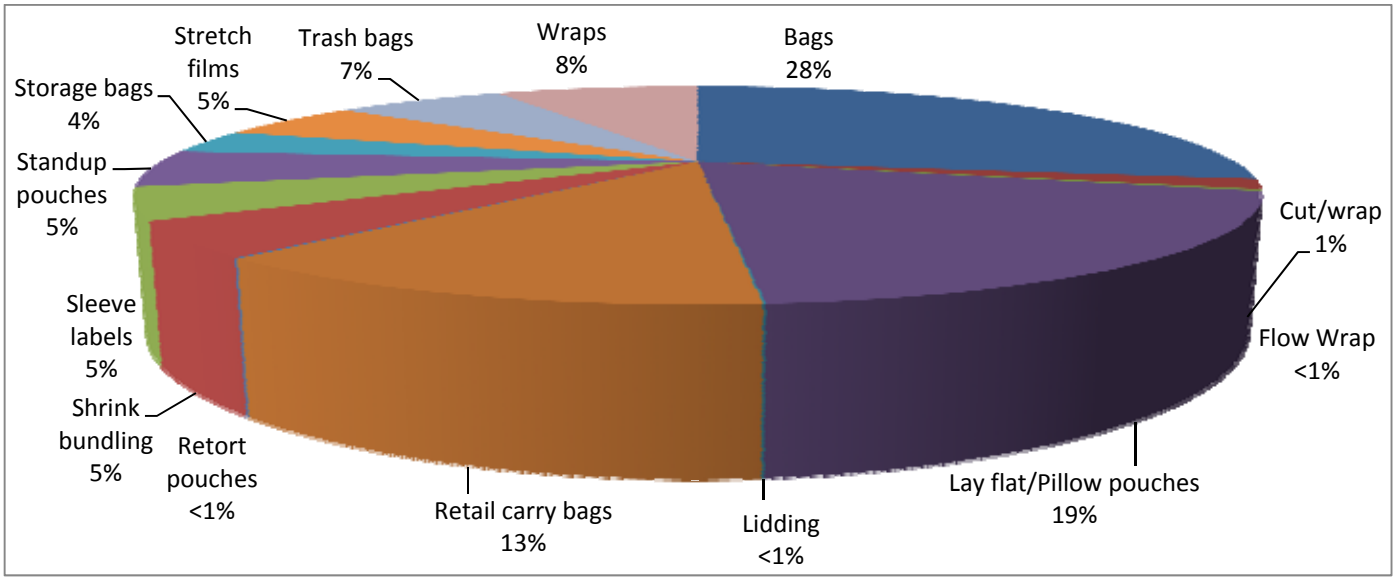


Figure 3: Composition of U.S. Flexible Packaging Industry 2012 (mm lbs)



Overall, the US flexible packaging industry, with a few notable exceptions, has experienced slow growth over the past decade due in large part to continued global manufacturing capacity expansion and recessionary economy in the US. Importantly, (1) the industry is still growing… both sales value and volume; (2) alternate packaging formats do not threaten existing applications, and, (3) unlike other packaging formats, the diversity of flexible packaging segments, markets, and raw materials buffer the industry from major swings in demand, costs, and availability. In many cases, new flexible packaging demand, including conversion from other packaging formats are initially small in size, and slow to take hold, but over time these can amount to tens of millions of additional sales and volumes.

Over the 2002-2011 period, gross domestic product rose at an annual compounded rate of 4% and the producer price index for Plastics material and resins manufacturing (NAICS 325211) rose at an annual compounded rate of 6.7% from 2011 to 2012. The 3.1% compounded growth rate for industry sales over the period (less than both of the others) suggests new forces at play: pricing pressure from users and/or increasing imported products.

Overview

Assumptions relevant to specific sections are listed in those sections. However, several general underlying standards were used across all segments:

- The *State of the U.S. Flexible Packaging Industry Report (2012)*[i] value of direct raw materials costs as 56% of net sales allowed conversion of market sales to raw material demand by weight. This portion certainly varies across the range of flexible packaging formats, the wide range of converting value adding operations, from film extruding, to printing and laminating, to bag making, etc. suggests that the number serves as an appropriate average. It was also assumed constant over the 2002-2012 period considered by the report.
- Differences in the cost of raw materials between 2002 and 2012 were estimated using to industry commodity indices as well as lower dollar values.

Marketplace priority on sustainable packaging works to the advantage of the industry as a whole. New technology continues to support "source reduction". Such advances as stronger metallocene-catalyzed polyethylene allowing down gauging; durable surface protection from energy-cured (UV and EB) coatings eliminating laminated layers; and barrier resins coextruded with sealing ones providing integrated converting films to eliminate some coatings and laminations.

The flexible packaging industry continues to develop flexible packages that are sustainable and safe for the environment. Biopolymers play an increasing role in the industry. FPA has taken a leadership position to research the lifecycle impact of flexible packaging and provide education on its uses, benefits, and end of life collection and repurposing.

1. Bags (excludes retail, storage, trash)

Scope.....

This segment includes a very wide range of product containers sold business to business. It excludes retail carry out, storage and trash bags which are all covered in sections 12-14 of this report. Many products in this category are fabricated from a monolayer of film. This monolayer is some grade of polyethylene (ldpe, lldpe, blends, etc.) with the exception of "Coex film" bags. The latter category includes barrier structures for specialty applications. "Single film bags" include bread bags, diaper bags, produce bags, textile bags, dry cleaning bags and other non-food bags used to collate and merchandise multiple items. They are typically made using the side weld process, in which a web is folded side to side; seals are made in the folded web in a cross-machine direction; while fold in the center of the web becomes the bottom of the bag. In a few cases (e.g. heavy-duty shipping sacks), form-fill-seal processes can replace the pre-made bag fill-seal process.

The segment is primarily made of polyethylene, but other segments include significant volumes, (by sales value and weight) of similar flexible packages: By definition, the segment excludes lay-flat, stand-up and retort *pouches* (quantified in their respective segments). It excludes the retail carry *bags*, consumer storage *bags*, and trash *bags* included each in its own specific section.

The segment includes some premade bags packed with a fill-seal process as well as roll stock filled in a vertical form-fill seal process. Its distinguishing feature is "depth" achieved from one or more longitudinal seals in a single web of material such that the package includes a front, a back, and 2-side panels. General use of the term limits its use to containers holding multiple items (e.g. cookie bag), or numerous small product units (e.g. rice bag). The "Methodology" section below provides detail on packaging formats used to estimate this segment's size.

Summary.....

Table 2: Volume, Revenue and Substrates - Bags

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Single film bags	$591	$645	0.90%	603	481	-2.20%
Coex film bags	$993	$1,400	3.40%	0.5	0.6	9.40%
Heavy Duty Shipping Sacks	$1,923	$2,649	3.30%	1,881	1,709	-1.00%
Multiwall Bags	$1,129	$1,097	-0.30%	1,775	1,778	0.10%
Box Liners	$930	$1,281	3.30%	909	827	-1.00%
Bags total	$5,566	$7,072	2.4%	5,169	4,796	-0.7%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Single film bags	ldpe (100)	Print/Bag Making
Coex film bags	ldpe (50); Nylon(30);Barrier (20)	(Print)/Bag Making
Heavy Duty Shipping Sacks	ldpe (100)	Print/(Bag Making)
Multiwall Bags	paper (100) (many have plastic film liner)	Print/Bag Making
Box Liners	hdpe (90); ldpe (10)	Blown Film
Bags overall	Paper(37); ldpe(61); hdpe (2); nylon & Barrier<<1%	

Background .....

The flexible Packaging segment “Bags” evolved from basic paper converting.[6] The mechanical process for bag making depended on the sort of folding, gluing and stapling steps used to fabricate paper bags. Patents for transparent bags made of cellophane appeared in the late 1920’s. Initial applications were driven by a sense that transparent packaging would be desirable for retail merchandising of various products. By 1935, a patent was issued for a form-fill-seal bag making machine relying on heat-sealed cellophane to contain a product.

Despite the lack of firm definition, the flexible packaging "bag” segment" represents the largest and most versatile format in the industry. From heavy duty shipping sacks, holding scores of pounds of granular products, to simple polyethylene parts bags, holding an ounce or two of product, the format continues to be an effective, efficient, and cost-effective packaging option.

Flexible bags for consumer and industrial products use less material than competing formats to contain a given amount of product, and present a minimum volume of waste for disposal. The flexibility and light weight of bags combines well with rigid transport packaging for energy and materials efficient logistics. Multiple layers in many bag materials often limit or restrict recycling of that material.

Potential compositions of bags are almost limitless. The simplest bag structures are mono-layered or coextruded ldpe films that can be sealed with “impulse sealing” methods.[7] More involved structures require a heat resistant substrate (often paper, OPP or OPET) coated with or laminated/coextruded to a layer with less heat resistance. “Constant temperature sealing” methods[8] make seals for bags made of these types materials

[6] See for example, Francis Wolle, *MACHINE FOR MAKING BAGS OF PAPER* US Patent No. 9,355, Oct 26, 1852

[7] “Impulse seals” are accomplished by opposing surfaces from at least two film panels and holding them in place while an “impulse” of electric current passes through at least one side of the holding arms. The current melts the plastic surfaces while the pressure comingles the molten material. This comingled area, limited to the thickness of the holding arm seals the two sheets together. If the pressure is sufficiently great and the impulse sufficiently strong, the sealing process may split the film at the sealed area.

[8] “Constant pressure seals” are accomplished by opposing surfaces from at least two panels of the packaging film and holding them in place with a pair of “seal jaws”, at least one of which is heated (to a “constant” temperature). The hot jaw heats the material from the outside to the inner sealing surfaces. The surfaces begin to soften and the pressure comingles the molten material. This comingled area, matching to the width of the seal jaw, seals the two sheets together. If bags are to be separated at the seal areas, separate, but coordinated cutting is necessary

Methodology.....

Primary Source:		
	Single film bags	Freedonia "Plastic Film to 2012"[xii] US Census of manufacturing; 2007 Economic Census and 2011Annual Survey of Manufacturing NAICS category 322224 and subcategories
	Coex film bags	Freedonia "Plastic Film to 2012"[xii] US Census of manufacturing; 2007 Economic Census and 2011Annual Survey of Manufacturing NAICS category 322224 and subcategories
	Heavy duty shipping sacks-HDSS	2012 Standard Report on Plastics Bag & Pouch Manufacturing; Anything Research; Plastics Bag & Pouch Manufacturing; US Census Bureau[ii]
	Multiwall Bags-MWB	2012 Standard Report on Uncoated Paper & Multiwall Bag Manufacturing; Anything Research; Uncoated Paper & Multiwall Bag Manufacturing; US Census Bureau[iii]
	Liners	Plastics Bag & Pouch Manufacturing; US Census Bureau[iv]
Critical Assumptions:		
	Single film bags	Annual bag consumption extended with standard film and dimensions; nominal yields, and assumed prices
	Coex film bags	Annual bag consumption extended with standard film and dimensions; nominal yields, and assumed prices and assumed prices
	Heavy Duty Shipping Sacks	2007 US Census percentage of HDSS (25.9%) applied to annual totals for plastic bag manufacturing (NAICS 326111). This value for HDSS extended with standard film and dimensions; nominal yields, and assumed prices
	Multiwall Bags	2007 US Census percentage of 3 ply+ MWB (41.4%) applied to annual totals for Paper & Multiwall Bag Manufacturing (NAICS 322224). This value for MWB extended with standard film and dimensions; nominal yields, and assumed prices
	Liners	2007 US Census percentage of Other, liners (12.5%) applied to annual totals for Other, liners manufacturing (NAICS 326111). This value for HDSS extended with standard film and dimensions; nominal yields, and assumed prices

Opportunities.....

Specific areas with recent vitality account for much of the growth in the mature flexible bag segment:

- Plastic HDSS continue to take share from former MWB applications. The Paper Shipping Sack Manufacturers Association reports that July, 2011 to July, 2012 decreased 4.5% compared to the same period a year previous.[9] Some of this share is also taken by laminated woven polypropylene (LWP) bags, but this product line's rate of growth has decreased. HDSS are increasing share in food--particularly industrial and institutional—and nonfood (e.g. chemical) markets.
- Pillow packs, typically produced on vertical form-fill-seal equipment represent a relatively accessible and inexpensive package. A growing number of easy-open and reclose options keep the format popular and an option to replace rigid packages.
- The Liner category includes a variety of applications from retail food (bag-in-box) to bulk commodity shipping. In the latter category, reseable rigid metal or plastic supports hold disposable flexible liners and provide economical, sanitary, often transparent, and easily disposed packaging systems.

[9] PSSMA report for the IOPP Technical Bag Committee; September 2012

2. Cut/Wrap

Scope.....

This segment includes wrap-around labels and product wrappers sold business to business. The common feature of this segment involves cutting a length of material from a roll and then automatically wrapping the cut piece around another object. The material takes on the form of the object that it wraps..

These applications require an image sensing mechanism to determine where to "cut" one label or wrappers from the roll. Various means then affix that material to or around the object(s) being wrapped. Bottle labels and some ream wraps require hot melt adhesives to hold them around their products. Film-based ream wrap and towel/tissue overwrap are sealed inside surfaces to outside surfaces of the folded ends of the over wrap that enclose the product. The "Methodology" section below provides detail on packaging formats used to estimate this segment's size.

Summary .....

Table 3: Volume, Revenue and Substrates - Cut/wrap

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (%:$)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (%: lb)
Wrap-around Label	$210	$280	2.9%	84	84	0.0%
Ream wrap	&22	$21	-0.7%	18	13	-3.2%
Towel-tissue overwrap	$172	$272	4.7%	129	157	2.0%
Cut/wrap total	$404	$573	3.6%	231	254	1.0%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Wrap-around Label	OPP(60); WOPP(40)	Print/(Laminate)
Ream wrap	Paper(68);ldpe(16);OPP(16)	(Extrusion coat)/Print/(Laminate)
Towel-tissue overwrap	ldpe(80);hdpe(20)	Print
Cut/wrap overall	OPP (22); WOPP(16); Paper(5); ldpe(46); hdpe (11)	

Background .....

Cut/wrap flexible packaging applications represent some of the most basic packaging operations. At its simplest, ream wrap and towel and tissue overwrap packages are form around their contents by progressive folds that are held in place by heat seals or glue. Wrap around labels evolved from pre-cut spot labels where additional efficiencies and display areas were desirable.

These packaging materials provide little utility beyond unitizing and labeling, but in doing so significantly enhance the distribution and merchandising options for their products.

OPP is the material of choice for wrap around labels, either in single layer, or laminations of clear OPP to WOPP. Towel and tissue overwrap is typically HDPE film, providing sufficient stiffness to wrap and hold multiple units of the paper products. Ream wrap, since the advent of electrostatic copiers has used ldpe-coated paper, which limits moisture changes in the cut-sized paper, and reduces paper jams in the copiers. With increasing "home office" use of cut paper, LDPE-coated paper has been supplemented with clear OPP printed with retail branding copy that permits direct consumer inspection of the wrapped paper.

Methodology.....

Primary Source:		
	Wrap-around Label	Freedonia *Labels to 2015"*[v]
	Ream wrap	Paper Age *Shrinking Uncoated Freesheet Demand Continues To Pose a Key Challenge; Mar-Apr, 2012*[vi]
	Towel-tissue overwrap	Paper Age *Made in North America – Tissue; Nov-Dec,2010*[vii]
Critical Assumptions:		
	Wrap-around Label	Freedonia Label value extended with standard film and dimensions; nominal yields, and assumed prices
	Ream wrap	Annual industry production converted to packages This number of packages extended with standard film and dimensions; nominal yields, and assumed prices.
	Towel-tissue overwrap	Annual industry production converted to packages (80% coated paper; 20% OPP split assumed) This number of packages extended with standard film and dimensions; nominal yields, and assumed prices.

Opportunities.....

The industry searches for a recyclable moisture barrier/water soluble coating as an alternative to the LDPE coating of paper ream wrap material. The existing composite does not recycle as easily as office paper.

PET bottle recycling processes can accommodate the wrap-around labels in this segment by separating the bottle PET and label OPP on the basis of their densities relative to water baths used in the processes.

The current cut/wrap format for towel/tissue products has captured essentially the entire market from folding carton alternatives. If efficient, affordable equipment wrapping equipment were dedicated to diaper-type products, the format could take share from the bag and carton formats used there.

3. Flow Wrap

Scope.....

This segment includes a particular kind of product container sold business to business

Flow wrapped packages, as estimated here, include products typically wrapped using a "horizontal form-fill-seal" process. In this, material from a roll is unwound and extended in a horizontal plane. Opposing edges of the material are sealed longitudinally inside-to- inside (called a "fin seal") to make a flexible tubular shape. Before fin sealing, an object (or sometimes several objects) is placed over (or under) the flat material so as to be surrounded by the tube as the fin seal is made. Such objects are articles with a well defined three dimensional shape. They may be individual pieces (e.g. candy) or containers with multiple pieces (e.gf. cookie tray). The packaging process recognizes the trailing edge of the object and makes a cross-web inside-to inside seal to close that end of the tube. At the same time, the leading edge of the package for the next article is made. The process is relatively quick and with electronic controls can essentially run continuously with minimal excess material needed for the 'end seals" between articles. The "Methodology" section below provides detail on packaging formats used to estimate this segment's size.

Summary .....

Table 4: Volume, Revenue and Substrates - Flow wrap

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Bar Wrap	$30	$71	9.0%	27	49	6.1%
Tray Wrap	$4	$5	2.3%	5	4	-2.2%
Flow wrap total	$34	$76	8.5%	32	53	5.1%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Bar Wrap	WOPP (100)	Print/Liquid coat
Tray Wrap	OPP (100) ~50% metallized	Print/Laminate
Flow wrap overall	OPP (8); WOPP (92)	

Background .....

The Hudson-Sharp Machine Company takes credit for the original horizontal flow wrapper in the U.S., the "Campbell Wrapper"(US Patent 2, 546,721) It was developed and introduced in the late 40's and was used throughout the world in the wrapping of candy, cheese, bakery and various other products.[10].

Temperature, pressure and dwell time are the three variables typically available to adjust packaging speeds for form-fill-seal operations. To increase speeds, longer dwell time is counterproductive and seal pressure is often dependent on package geometry for flow wrap equipment. Increasing sealing temperatures is effective if the product can tolerate the added heat. Because chocolate bars are heat sensitive, an ambient temperature, cohesive seal technique was developed to wrap them quickly. A pattern coating in the seal areas of the packaging material releases from the opposite side of the material in roll form. However, it makes tight seals when matched with a like coating on an opposing face in seal areas.

[10] http://www.campbellwrapper.com

A variety of equipment developers have refined the basic concept to incorporate electronic timing and controls to the form/fill/seal process so that flow wrap processes are some of the fastest of flexible packaging formats.

Flow-wrap materials for non heat-sensitive products use much the same materials as do bags. But as with cold seal material, dwell time and seal pressure adjustments are not available to increase packaging speeds or seal strengths. This fact favors thin materials with low temperature sealing surfaces.

Methodology.....

Primary Source:		
	Bars	Manufacturing Confectioner; US Confectionery Sales, 2012[viii]
	Tray cookies	Manufacturing Confectioner; US U.S. Cookie and Snack Sales, 2012[ix]
Critical Assumptions:		
	Bars	Manufacturing Confectioner data adjusted for 25% Grocery sales from Wal-Mart. Annual wrappers used calculated using 2012 retail prices. This number of wrappers extended with standard film and dimensions; nominal yields, and assumed prices.
	Tray cookies	Manufacturing Confectioner data adjusted for 25% Grocery sales from Wal-Mart. Annual wrappers used calculated using 2012 retail prices. This number of wrappers extended with standard film and dimensions; nominal yields, and assumed prices

Opportunities.....

The bar sub-segment has captured essentially the entire market from a cut and fold format, but 10 of the top twenty cookie items (more than 75% of sales) are sold in bags, folding cartons, or plastic clam-shells, suggesting a growth opportunity for over-wrapped trays (at the expense of the other formats).

The bar product format addresses compelling consumer drivers for product convenience and portability. Much of the growth in this segment over the study period resulted from the appearance and market acceptance of the “health bar” food category. Still considered a “nutraceutical”, the category has evolved from a niche segment for high performance athletes to a main stream one serving broader diet, meal replacement and meals-on-the go purposes. Consumer friendly package features for easy-opening and clean one-hand consumption of bar products help increase consumer product satisfaction with added convenience and portability.

Consumer convenience increased greatly for trays-packed cookies in flow wrap with the introduction of the patented *Snack ’n Seal* technology.[11] The concept integrates a pre-weakened score line on the top of the package with a pressure sensitive frame allowing a hinged panel (defined by the score lines) to open and then adhere to a pressure-sensitive adhesive coated thin flange (revealed as the panel is opened) when reclosed. The basic components (pre-weakened score line; hinged panel; pressure sensitive frame; and flange) are utilized in other formats,, but the patent status of the Kraft technology may limit its growth in this flow wrapped cookie tray format in the near future.

[11] *Kraft's Chips Ahoy! launches in resealable packaging*; Jim Butschli; *Packaging World*; Sep., 30,2005

4. Wraps

Scope.....

This segment includes a range of product covering s sold business to consumer as well as business to business for temporary containment and protection of food products, primarily.

Wrap products, paper, aluminum foil, and plastic films are sold in roll form and sheet form. Both Institutional and household products are included in the category.

Table 5: Volume, Revenue and Substrates - Wraps

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Wraps	$2,260	$1.967	-1.4%	1,572	1,365	1.4%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Plastic wrap	ldpe (100%)	Blown Film; Cast Film
Foil wrap	Al (100%)	Rolling
Paper wrap	Paper (100)	Coated paper
Wraps overall	Ldpe(72), Al (18).Paper(10)	

Background .....

Wraps, as historically included in the flexible packaging industry, represent product coverings offering minor protection (mostly from dust, dirt, cross-contamination, etc) for short periods of time…hours to days. The business-to-business products have given way to other flexible packaging formats as processing techniques expanded and distributions systems grew. Storage bags and rigid disposable containers have replaced many uses of business-to-consumer wraps, but some specialty wrap products (e.g. cling film, parchment paper, and aluminum foil) have niche uses beyond containing and protecting functions. For example, parchment paper and foil have specific applications in various cooking applications.

Methodology.....

The complexity and imprecise scope of this category precluded an in-depth investigation of the category for this study. The US Census Annual Survey of Manufacturing provided a basis for comparing total paper, foil and film production to total FPA industry numbers in estimating the size of this segment. Two of the three major suppliers of paper, plastic and foil wraps (household and institutional) are private companies who do not provide regular data on this segment of their operations.

Primary Source:	
	REYNOLDS GROUP HOLDINGS LIMITED Annual Report[x]
Critical Assumptions:	
	No significant change in product mix or raw material as percent of sales over the 10 year period.

5. Lay Flat and Pillow Pouches

Scope.....

This segment includes a very wide range of product containers sold business to business.

The segment includes conventional 3- and 4- side seal pouches formed with neither side nor bottom gussets. As estimated here, the pouches may be premade for fill-seal loading or formed/filled/and sealed from roll stock in integrated operations. The pouches have two panels, a front and back (or top and bottom). These panels may originate from one roll of material (i.e. folded over and sealed on 3 sides) or two rolls (i.e. sealed on 4 sides). The "Methodology" section below provides detail on packaging formats used to estimate this segment's size.

"Pillow pouches" in this category represent bags made from one web, formed into a tube-shape; sealed edge to edge (i.e. machine direction) to preserve the tube form; and then sealed in the cross web direction for top and bottom seals. These packages are most often fabricated in a form-fill-seal process.

"Stand-up *bags*", both pre-made and vertical form-fill-seal, represent a hybrid format. They are distinguished from stand up pouches in having a three dimensional cross section comprised of separate front, back and (2) side panels rather than simply a front and back panel. In form-fill-seal versions, extra longitudinal seals define the side panels, forming a bag "bottom" that stands up, at least while product remains in it(so called quad-seal bags). Pre-made bag versions are fabricated on horizontal flat bed machinery and provide better-defined flat bottoms than the form-fill-seal configurations because extra folds and gussets can be sealed into place during bag fabrication.

Summary .....

Table 6: Volume, Revenue and Substrates - Lay flat pouch

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Lay Flat Pouches	$1,354	$1,879	3.3%	1,198	1,080	-1.0%
Pillow Pouches	$2,538	$3,272	2.6%	1,794	2,241	2.2%
Lay Flat/Pillow Pouches	$3,892	$5,151	2.8%	2,992	3,321	1.0%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Lay Flat Pouches	OPP(10); ldpe(24);OPET(64);foil(2)	Print/Laminate
Pillow Pouches	OPP (39); ldpe (47); OPET (14)	print/(Laminate)
Lay Flat Overall	OPP(30); ldpe(40);OPET(29);foil(1)	

Background .....

The segment includes "packets" of various liquids, usually filled in multi-lane form-fill-seal equipment. This estimate also includes "thermo-form-fill-seal" packages including a "forming" web (which is not flat)

and a flat non-forming web. This non-forming web is functionally very similar to "lidding ", but is distinguished from estimates in that section by the flexible nature of the material to which it is sealed.

Materials used are similar to those in the Bag segment. Barrier materials, including foil and evoh are used for products sensitive to oxygen and/or changes in moisture content. For liquid and vacuum packaging applications, very strong, hermetic seals are necessary. Thick ldpe-based sealants are normally used. Heat resistant OPET or Nylon layers on the outside permit the use of high temperature sealing temperatures that provide reasonably fast packaging speeds.

Methodology.....

Primary Source:	
	Pillow Pouches, Pillow pouch segment of Flat Pouch category in Freedonia Pouch[xi] Freedonia "*Pouches to 2016*"[xii]
Critical Assumptions:	
	Pillow Pouches, Freedonia food segments extended with segment-standard structures; nominal yields, and assumed prices Freedonia food and nonfood segments for 3-side and 4-side seal pouches, reduced by retort pouch figures, extended with segment-standard structures; nominal yields, and assumed prices

Opportunities.....

Lay-flat pouches represent another mature format for which appropriate equipment represents a relatively accessible and inexpensive packaging option. New equipment provides high-speed filling options, usually accomplished with parallel filling lanes or multiple filling stations in a rotary configuration. The format generally accommodates a press to close plastic profile reclose option, for larger multiple serving packages.

New control systems for 4-side seal pouches allow use of more extensible all-plastic structures where dimensional stability (from paper and/or foil structures) was previously required.

"Condiment packet" products in this lay flat pouch segment face a challenge in the fast food industry from small thermo-formed rigid plastic containers with flexible lidding. This alternative is already standard for specialty sauces and some jams and preserves in that industry. The lidded rigid container has recently been introduced for ketchup.

Vertical form-fill-seal "stand-up *bags*", suffer from relatively slow speeds and high waste (e.g. variability in making the extra longitudinal seals). Pre-made stand-up bags are costly and form-seal operations slow. Both pre-made and form-fill-seal, offer consumer appeal and a logistics-friendly square shape. The logical evolution of the form involves in line integration of the flat-bed pre-made forma into a fill seal operation. The efficiency, consumer and logistics preferences will combine to grow demand for the format, and investment to resolve existing issues.

Thermo form-fill-seal technology has evolved with films to provide a roll stock (forming and non-forming webs) solution where previous only pre-made bags were an option. In the future, capital cost of the packaging equipment may provide sufficient materials consumables cost savings.[12] An easy-open, reclose technology similar to the flow wrap/cookie tray system has been adapted to this format[13]

[12] *DuPont Awards—celebrating innovation and collaboration*; *Packaging World Magazine;* May 17, 2012
[13] *Printpack Inc.: All in the family*; *Flexible Packaging Magazine*; May 21, 2008.

6. Standup Pouches

Scope.....

This segment consists of a particular kind of flexible product containers sold business to business.

This segment consists of a particular kind of flexible product containers sold business to business. "Standup pouches" have a front panel and a back panel sealed to each other to define vertical sides of the package. A bottom gusset (comprised of font and/or back panel material or a separate web) is sealed into the sides to form the bottom of the package. "Standup bags" have multiple longitudinal seals to define two side panels in addition to the from ant back ones. The "Methodology" section below provides detail on packaging formats used to estimate this segment's size.

Summary.....

Table 7: Volume, Revenue and Substrates - Standup pouch

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Standup Pouches	$564	$1,560	10.7%	465	946	7.4%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Standup Pouches	ldpe(32);OPET(60);foil(8); ~30% of OPET metallized	Print/Laminate

Background.....

Materials for standup pouches are very similar to those used for lay flat pouches. Where the pouch's stand up nature is important for merchandising, transparent barrier materials, rather than foil or metallized films are used.

The format initially appeared as a patented single serve fruit-juice package. With the expiration of the patent, uses expanded into dry foods for which folding cartons were previously used. The standup pouch continues to take share from various rigid packaging formats and represents one of the fasting growing flexible packaging segments around the world.[14]

Pouch structures tend toward thick and stiff laminations. The standup ability is accomplished with an extra panel of material at pouch bottom that bridges front and back panels of the pouch. The panel may represent a gusset fold either between front and back, or with a folded, individual web. While various mechanisms and fabricating sequences are used, all require at two points along the sides of the pouch that the two layer (front and back) thickness of the side seals expand to a four layer thickness (the two sides of the folded bottom. Thick sealant layers, typically LDPE, allow air-tight calking of these transition areas. This thickness and the calking requirement make heat resistant OPET the material of choice for the outside layer of standup pouches.

[14] Anton Steeman provides a comprehensive review of "The Evolution of the Stand-Up Pouch" on line at
1.http://bestinpackaging.com/2009/10/06/the-evolution-of-the-stand-up-pouch/
2. http://bestinpackaging.com/2009/10/26/the-evolution-of-the-stand-up-pouch-part-2/
3. http://www.packagingdigest.com/blog/Excellence_in_Packaging/23255-From_Doy_Pack_to_S_Pouch.php
All retrieved 8/31/2012.

Methodology.....

Primary Source:	
	Freedonia "*Pouches to 2016*"
Critical Assumptions:	
	Freedonia food and nonfood segments for standup pouches, reduced by retort pouch figures, extended with segment-standard structures; nominal yields, and assumed prices

Opportunities.....

The stand-up pouch has been the consummate symbol of the energy, inventiveness, and utility of the Flexible Packaging industry for over twenty years, and continues to lead industry growth. Around The world, various consumer goods companies have already developed many applications yet to be adopted in the US market. Many of these involve adding easy-open and reclose features to pouches with rigid plastic "fitments" welded into the pouch material. Adapting the format for "self-feeding" packages of pureed "juniors" food generated a market reportedly using over 800 million pouches annually in just 1 year.[15]

"Sustainable packaging" initiatives favor Stand up pouches over rigid alternatives. "Refill" quantities of retail liquid non food products (e.g. health and beauty aids; cleaning products) offer consumers economy and materials efficiency while retaining the ease-of-use of an original rigid container/dispenser.

The "Retail-Ready Packaging (RRP)" model[16] favors adoption of stand up pouches for all variety of products. The concept requires packaging that is fit for purpose throughout the supply chain. In essence, RRP seeks to minimize costs (e.g. energy, labor, storage) for a retail product from the time it leaves its manufacturer/packager until a consumer pays for it. Toward the end of this logistics continuum is the "shelf stocking" effort. Traditionally, this has involved package-by-package removal of retail items from corrugated shipping cases and placement individually on store shelves. At this stage, RRP suggests intermediate-sized "packages" (less than shipping cases but more than a single retail items) for stocking shelves more efficiently. Such "shippers" with 10-20 retail units have long been used for retail stand up pouch display. RRP recognizes this intermediate package format as not just an extra cost for product display but a cost-savings throughout the distribution system.

[15] *Sprout's new spout supports self-feeding of 'older infants';* Anne Marie Mohan; *Packaging World Magazine;* October 10, 2012; Pouch usage estimate from 2012 *Packaging Strategies* Global Pouch Forum presentation by Jessica Rolph, HappyFamily Brands

[16] *RRP still growing, but hurdles do exist*; Pat Reynolds, *Packaging World*; Apr.30, 2012

7. Retort Pouches

Scope.....

This segment consists of a particular kind of flexible product containers sold business to business.

It includes primarily lay-flat and some stand up pouches filled with products for which thermal sterilization (retorting) is necessary in order to stop pathogens growth in vulnerable products (e.g. low acid, high water activity foods) during subsequent distribution and merchandising. Non-thermal sterilization is the subject of current research but has not yet proven commercially viable for shelf stable handling of vulnerable products.

Summary.....

Table 8: Volume, Revenue and Substrates - Retort pouch

Volumes	Million US$*		2002-2012	Million pounds		2002-2012
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Retort Pouches	$40	$78	3.9%	10	16	5.0%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Retort Pouches	OPET(18); foil(40); pp(42) ~6% of OPET is transparent barrier coated	(Print)/Laminate

Background.....

Following the Vietnam conflict, The United States Army Natick R&D Command initiated research on a flexible pouch format capable of replacing the rigid tin-plate cans used as “C-rations” for troops in Southeast Asia. By 1980, initial government procurement of food packaged in retort packages began as a central element of its “Meals-Ready-to-Eat” (MRE) combat rations system. Commercial use of the technology followed quickly with a Smoked salmon retort pouch product. The pouch, produced by the Reynolds Metals Company, was awarded the 1979 Chairman’s Award in FPAs annual packaging competition.

The next 20 years witnessed refinement of pouch components, particularly inks/adhesives , plastic profile zippers, and transparent high barrier plastic films (as aluminum foil replacements), but the few commercial products offered in the US market during this period experienced very short life cycles.

The retort pouch sustainably penetrated the US pet food market in May 1999 with Mars Inc.’s launch of “Kal-Kan's Whiskas” cat food in the format. A 2002 overview of retort pouches suggested that “[perhaps the greatest impediment to the wholesale and rapid adoption of retort packaging in North America is the well established can-making and can-filling infrastructure.”[17] A year earlier in the same periodical, a columnist commented that “Last May (2000), Star-Kist introduced a 2 lb. 11 oz. package of tuna for foodservice distribution“[18]

That institutional package was followed a month later (15 June 2000) when StarKist announced they would launch “StarKist Tuna” in a “No-Drain” 2.6 ounce consumer pouch (Retort pouches require less

[17] *RETORT FLEXIBLE PACKAGING: The Revolution Has Begun”; FLEXIBLE PACKAGING Magazine, November 2002, pp19-25*
[18] *Targeting New Markets: Retort Pouches”; FLEXIBLE PACKAGING Magazine*, November, 2001

liquid (oil or brine) than does a rigid container for reliable, uniform sterilization).[19] Unmentioned in the announcement was the history that starting in the 1970s, the United States tuna canning industry faced "low-cost competition from Thailand and other Asian countries. As a result, the bulk of its production was moved either to its territories (American Samoa or Puerto Rico), where minimum wages were lower than on the mainland, or to Southeast Asian countries.[20] Between 1979 and 2007, 11 canneries based in the United States and its overseas possessions closed, greatly devaluing the "well established can-making and can-filling infrastructure".

Retort pouch growth momentum faces competitive pressure from retortable plastic trays, cups and bowls with flexible lidding. The Pack Expo 2006 "most innovative packaging of the year" winner was Nestlé Purina's *Beneful®* Prepared Meals Dog Food packaged in such a format. The impact in North America was estimated to be a -1.2 % decline in retort pouches for pet food over the years 2005-2010.[xiii] (In the same the years, North American retort pouch consumption for human food grew 9.8%).[21] Overall industry's demand for flexible retortable material is only partially impacted by this substitution as the lidding on the rigid plastic containers is essentially the pouch lamination sealed to the container.

The drivers in the retort market today are quality, convenience, efficiency, and sustainability. Certainly consumer familiarity with barrier pouches (flat and standup) help make "flexible can" formats for shelf stable foods more acceptable

Typical structures for retort pouches are:

12 μ (0.48 mil) oriented polyester		12 μ (0.48 mil) oriented polyester
12 μ (0.5 mil) aluminum foil	*or:*	12 μ (0.48 mil) transparent barrier-coated oriented polyester
50 μ (2 mil) cast polypropylene		50 μ (2 mil) cast polypropylene

Methodology.....

Primary Source:	
	Allied Development "*Retort Pouches*; 2011-2015"
Critical Assumptions:	
	"North American" volumes (Canada, Mexico, USA) were distributed among the three using weighted average GDP of the countries. Implied US volume extended with segment-standard structures; nominal yields, and assumed prices

Opportunities.....

Continued improvement in pouch filling speeds will make retort pouches a more attractive alternative for new packaging room equipment. "No.10 can-sized" pouches provide waste disposal, product identi-

[19] http://www.flex-news-food.com/console/PageViewer.aspx?page=12653&str=Fruit%20Georgia
[20] *Recent developments in the tuna industry;* FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS/Rome, 2010, 151pp
[21] Retorted plastic trays, cups, and bowls use flexible barrier lidding, constructed of materials very similar to retort pouch laminations. (Allied Development Corp., Burnsville, MN (2011); *Retort Pouches*, *Global Markets, Economic, Environmental Impact and Technology- 2011-2015; 446 pp.*)

fication, and weight advantages for hotel, restaurant and other institutions, but currently cost more than tin-plate steel cans.

The advent of high barrier transparent films, usually OPET, allowed replacement of foil in retort laminations. Although the shelf life of foods packaged in the transparent materials may be less than comparable foil laminations provide, the all-plastic alternative gives consumers the option to prepared table-ready food directly from a microwave. Easy-open features (e.g. linear –tear laminations) enhance convenience.

As with the standup pouch generally, various consumer goods companies elsewhere round the world have already developed many retort pouch applications yet to be adopted in the US market. The market drivers of convenience and portability have made retort pouches successful in some niche markets (e.g. wet pet food and table-ready microwaveable foods), but the format has yet to find wide spread acceptance comparable to the ubiquitous steel can. Unit material costs and packaging line efficiencies for retort pouch technology have improved over the past three decades, but not enough to put the pouch in the mainstream of consumer products. Much greater progress for these two issues must occur before the promise of the pouch is realized.

8. Lidding

Scope.....

This segment includes a specific component of various rigid containers (cups, trays, bottles and jars) sold business to business.

These are products with a polymeric layer capable of sealing to a plastic, metal or glass container. Induction coils and heated platens are used to make those seals and the overall composition of the lidding must conform to the requirements of the method used. The "Methodology" section below provides detail on packaging formats used to estimate this segment's size

Summary.....

Table 9: Volume, Revenue and Substrates - Lidding

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Yogurt lidding	8	25	12.1%	3.6	7.7	7.9%
Frozen tray lidding	3	5	5.6%	2.4	3.3	3.2%
Lidding	11	30	10.5%	6.	11	6.2%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Yogurt lidding	Al(43), Paper(43),OPP(14)	Print/(Laminate)-(Liquid coat)
Frozen tray lidding	OPET (100)	Cast Film
Lidding	OPET (40), Al(30), Paper(20), OPP(10)	

Background .....

The lidding segment is relatively small (<1% of the FPA membership sales in 2011), but it has many categories:

- Monolayer sealable OPET film is typically used for frozen dinners, packaged in compartmented CPET trays, and heat-and-serve prepared meals prepared in central commissaries for same-day distribution to individual institutional or retail outlets (e.g. school lunches, deli meals, etc).
- Foil lidding with heat seal coatings and/ or laminated plastic layers for refrigerated or shelf stable foods (e.g. dairy products, apple sauce, foods and meals in plastic cups/trays, etc.)
- Induction-sealed coated and laminated foil on bottles and jars (e.g. pharmaceuticals, spices, hygroscopic mixes, etc.). In this format, the lidding protects food quality and serves to indicate package tempering.
- Various heat-seal coated materials to seal thermoformed sterile medical device trays (e.g. Tyvec, porous to gaseous ETO for in package sterilization etc.)

The converted, multilayer lidding dollar value estimated here equals the amount indicted by FPA statistics. The plain OPET lidding may not be included in those numbers.

The lidding may be applied from stacks of die-cut shapes matching the flanged perimeter of the container to be sealed, or directly from roll stock and cut to length (and width) during the sealing process. In the latter case, essentially all of the film may be utilized as lidding or alternatively, significant amounts

may remain as a lattice of excess material with voids reflecting the cut-out shape of the containers' openings.

Methodology.....

Primary Source:	
Yogurt lidding	Allied Development: Flexible Lidstock Packaging-2008
Frozen tray lidding	Freedonia Group: Frozen Food Packaging to 2013
Critical Assumptions:	
Yogurt lidding	Estimated area extended with assumptions for segment structures; nominal yields, and assumed prices
Frozen tray lidding	Volume extended with segment-standard structures; nominal yields, and assumed prices

Note: Other categories for this segment were not estimated.

Opportunities.....

Tray formats for retail and institutional foods (meals and meal components) match consumer preferences for convenience and portability. CPET trays for refrigerated and frozen items can be directly reheated in microwave ovens, and then consumed, avoiding any need for either cooking or eating utensils. Barrier coextruded polypropylene trays provide all plastic retortable containers. Lidding materials for such applications essentially duplicate the laminations used to make retort pouches.

Induction-sealed lids on bottles and jars have become industry standard for dry and many liquid products. The format offers barrier, virtually pilfer-proof closures and easy-opening for its many uses.

9. Sleeve Labels

Scope.....

This segment includes a specific component of various cups, trays, bottles and jars sold business to business.

Such labels require a compressive force to affix them to their containers. The force is accomplished in one approach by *stretching* the circumference of the sleeve as it is placed over a container. (With the force removed, the sleeve snaps back to hold snugly around the container.) Alternately, heat is used to relieve residual stresses heat-set in the film after the sleeve is placed over the container. This relaxation *shrinks* the sleeve to a tight fit around the container. The "Methodology" section below provides detail on packaging formats used to estimate this segment's size.

Summary .....

Table 10: Volume, Revenue and Substrates - Sleeve labels

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Sleeve labels	$1,408	$2,070	3.9%	670	817	2.0%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Sleeve labels	PVC(54); PETG(21); OPP(5); OPS(9); ldpe(11)	Print/(Sleeve making)

Background .....

Processes and materials using sleeves of plastic to label containers, whether by stretching over/snapping back or sliding on and shrinking around were developed in the mid 1970's. Shrink label technology began as protection for caps on battles and jars. With the 1982 Tylenol-tampering scare the use of such tamper evident cap seals and their applicators increased. Printing the material and using it as a full wrap around label system was a natural extension of that concept.

Films for shrink labels are stretched and annealed in that condition to maintain the intrinsic stresses at ambient temperatures. This film is printed and a solvent used to seal one side of the web to the other. This tube-shaped material is cut into container-height sleeves or rolled on spools for delivery to a label applicator, often integrated into a filling line. After a label is placed over a container, both travel through a heat tunnel where steam or hot air shrinks the label sleeve tightly around the container. A newer category of shrink label involves material that can be applied much as wrap around labels (Cut/wrap segment). When affixed to the container, they are shrunk tightly around the container.

Stretch sleeves are seamed using polyethylene heat sealing methods and rewound for automatic application to containers. The applicator expands the sleeve so that it will fit over the container and then snap back snugly around the container.

Methodology.....

Primary Source:	
	Llewellyn "*Sleeve Label Industry Overview-2012*"; Alexander Watson Associates.[xiv]
Critical Assumptions:	
	Llewellyn volumes and percentages for US extended with segment-standard structures; nominal yields, and assumed prices

Opportunities.....

The graphic impact of sleeve labels has the ability to give otherwise plain rigid containers the kind of visual impact routinely provided by printed flexible packages. This 360 degree “billboard” effect has given sleeve labels the market boost enjoyed over the study period.

Developments in this segment have successfully addressed challenges posed to it since 2002. The temperature instability of OPS opened the door for substitution by PETG shrink labels. Certainly as PET container recycling efforts expand beyond traditional carbonated beverage and water bottle sources, PET containers now wrapped in sleeve labels will encounter initiatives to find label materials more compatible with existing systems (See cut/wrap label discussion). In such circumstances, LDPE stretch and OPP roll on shrink on sleeve labels have significant advantages.

10. Shrink Bundling

Scope.....

This segment comprises various films used to collate rigid containers and sold business to business.

Polyethylene film "heat set" to preserve residual stress is unwound and in a sequence similar to flow wrapping is formed into a tube around multiple articles (e.g. beverage bottles). This loosely wrapped bundle then passes a heat source that relieves the residual stress, shrinking the film around the articles, securely holding them together. The method can be used to bundle dozens of articles at a time, or simply to protect a single product and/or package from dirt, scuffing, and other abuse during distribution and merchandising. At some point depending on the number and size of articles, a corrugated tray may be used to stabilize the bundle for stacking and transport.

Summary .....

Table 11: Volume, Revenue and Substrates - Shrink Bundling

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Shrink bundling	$775	$993	2.5%	745	866	1.5%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Shrink bundling	ldpe(100%)	Blown Film

Background .....

This segment is limited to the roll stock bundling items by wrapping it around the items, sealing it in one or more directions and then using heat to shrink the roll stock around the items. The sleeve label segment includes those "bundling" applications for which pre-formed sleeves combine several containers into a single retail purchase unit.

Various means for causing LDPE-based film to shrink when heated above certain temperature had been developed in the 1940s and 1950s. A 1965 patent applied the use of such films to bundling bottles standing in a tray-like container[22]. The resulting package, after shrinking the film around the bottles and trays had essentially the same stability and stack-ability as 6 panel paperboard or corrugated cases holding the bottles. With less paper/paperboard, the package was lighter and left less packaging waste after delivering the bottles. Graphic developments allowed the shrink film multipacks to communicate just as effectively as the rigid alternatives. With growing market priority for sustainable packaging formats, shrink bundled packages, with or without the rigid tray, have become an increasingly favored mean of merchandising products in multi-packs.

Methodology

Primary Source:	
	Freedonia "Plastic Film to 2012"[xv]
Critical Assumptions:	
	volumes extended with segment-standard gauges; nominal yields, and advertised prices

[22] *Method of Making a Carrying Case for Bottles of the Like;* US Patent 3,353,326; William C. Becker; assigned to Reynolds metals Company, Richmond, VA. (Filed February 1, 1965; Granted November 21, 1967)

Opportunities.....

Shrink bundling has proven to be a cost effective, more sustainable packaging alternative than multi-packs using paperboard or corrugated boxes. The format still lacks the consumer convenience features offered by these older formats. The traditional paper formats have incorporated easy-open features and die-cut holes for ease of carrying. The paperboard Fridge Pack transformed a multipack carrier into a convenient consumer dispensing system for beverages aluminum cans.

Shrink bundling would do well to look beyond its advantages in distribution and merchandising to its use by consumers after purchase. Simply imitating the best consumer features of paper boxes-- easy open features and the ability to stabilize remaining articles after removing the initial ones—will help to grow this segment.

11. Stretch Film

Scope

This segment is limited to various films used as pallet-load unitizers sold business to business. Stretch film used as for smaller packages is included in Cut/wrap and Shrink bundling segments.

Stretch films have sufficient elasticity to stretch when pulled along the sides of rigid articles stacked on a pallet. Then, as the extensive force is removed, they contract somewhat. When repeatedly wrapped around and up and down a load on a pallet, the residual compressive forces in the film restrain the loaded components and serve to dampen oscillations from vibration (e.g. while in transit). The elasticity results from a combination of film gauge, resin tensile properties, and plasticizing additives.

Summary .....

Table 12: Volume, Revenue and Substrates - Stretch Film

Volumes	Million US$*		2002-2012	Million pounds		2002-2012
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Stretch film	$1,047	$1,219	1.5%	910	938	0.3%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	Substrates*	Manufacturing process
Stretch film	ldpe(100%)	Cast Film, Blown Film

Background .....

Following the US energy crisis of the mid 1970s, stretch films emerged as an energy efficient alternative for unitizing pallet loads compared to the process by which shrink shrouds loosely covered pallets as the whole assembly went through a heated shrink tunnel. Parallel advances in linear LDPE resins and blends of older polymers have allowed steady down-gauging of the films without loss of functionality or efficiency.

Methodology.....

Primary Source:	
	Freedonia "Plastic Film to 2012"[xii]
Critical Assumptions:	
	volumes extended with segment-standard gauges; nominal yields, and advertised prices

Opportunities.....

Unitizing pallets with stretch film offers little opportunity for expansion in its already saturated market.

With little room for product differentiation in the segment, increasing production efficiencies and using best in class resin technology. Success for players in this segment requires attention to technological development for resin grades that would allow down-gauging and perhaps greater efficiency in pallet wrapping for customers.

12. Retail Carry Bags

Scope

This segment includes a range of item containers sold business to business and given—or sold—to retail customers for transporting goods at the time of sale. Both paper and plastic materials are included.

The bags help retail consumers collect purchased items together and, and carry them from the retail outlet.

Summary .....

Table 13: Volume, Revenue and Substrates - Retail carry bag

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Retail carry bags-plastic	$962	$1,962	7.4%	943	1263	3.1%
Retail carry bags-paper	$607	$788	2.6%	639	949	1.9%
Retail carry bags	$1,569	$2,750	5.7%	1,582	2,212	3.4%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Retail carry bags-plastic	ldpe (33%); hdpe (67 %)	Blown Film-Cast Film Blown Film
Retail carry bags-paper	Paper (100%)	Cut-fold-glue
Overall Retail carry bags	Ldpe(19); hdpe(38),paper(43)	

Background .....

Plastic carry bags represent a logical evolution of the paper carry bag. In his book on incremental design improvements[23], Prof. Henry PetroskI (Duke University Civil Engineering and History) describes the many patents and improvements for paper bag design and fabrication in American during the second half of the nineteenth century. These relied on prior envelop design technology and used glue to fasten together the folded bottoms of the paper bags. Equipment for sealing thermoplastic films was adapted to producing plastic retail bags a century later.

Economic incentives to replace paper grocery bags with plastic ones were lacking until ultra-high molecular weight high density polyethylene. “T-shirt” bags were introduced in the 1970’s. The toughness of the film made with these polymers allowed thin (well under 0.001 inch) bags capable of carrying heavy loads with convenient handles. Use of “plastic” instead of paper grew from 5% to over 60% during the decade of the 1980s.

The T-shirt bag has become so ubiquitous and lightweight that its very success has made it a target for extinction. Efforts around the world have motivated various localities to ban the product, or tax its use at retail. Recycling….

Methodology.....

Primary Source:	
	Freedonia “Plastic Film to 2012”[xii] US Census of manufacturing; 2007 Economic Census and 2011Annual Survey of Manufacturing NAICS category 322224 and subcategories
Critical Assumptions:	
	Freedonia value for retail carry bags extended with segment-specific film and dimensions; nominal yields, and assumed prices

[23] *Small things Considered*; Henry Petroski, 2003, Random House, 288 p

Opportunities.....

A victim of its own success, retail carry bags face an uncertain future. The visible litter issue prompts private groups to demand that local governments make the product go away by banning it or taxing it. Consumer behavioral changes have already decreased demand for the bags by substituting reusable merchandise bags.

The industry faces the technical challenges of making the bags go away on their own (e.g. degrade if littered) while maintaining the strength and economies of the current product. Some of the technology pursued for plastic trash bags, including biopolymers, offer promise for this segment.

13. Storage Bags

Scope

This segment includes a range of item containers sold business to consumer for improvised storage of household goods.

These bags are used to contain and protect various items in a household. They protect from dirt and excessive moisture changes and may also serve to help transport items being carried away from the house hold.

Summary .....

Table 14: Volume, Revenue and Substrates - Storage bags

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Storage bags	$673	$950	3.6%	660	612	-0.8%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Storage bags	ldpe (100%)	Blown Film. Cast Film

Background .....

Harry F. Waters is given credit in the November, 1945 Issue of Popular Science (pg, 119) with the idea of storing foods in plastic bags instead of glass jars. Waters was very active in plastic film technology from the 1930s to the 1950s, but his insight about the potential for plastic bags for home use stimulated one the industry's bigger segments. Consumer sandwich bags were introduced about 1957.

Methodology.....

Primary Source:	
	Polyethylene household food storage bags and pouches (2007 US Dept Commerce Economic Census; NAICS Code 32611114)[xvi]; 2012 Standard Report on Plastics Bag & Pouch Manufacturing; Anything Research
Critical Assumptions:	
	2007 US Census percentage of house food storage bags (4.7%) applied to annual totals for plastic bag manufacturing (NAICS 326111). This value for storage bags extended with segment-specific film and dimensions; nominal yields, and assumed prices

Opportunities.....

Technology offers some opportunities for competitive advantages among products: down gauging using metallocene-catalyzed LDPE; Increased margins with consumer enhancements (closures/color/identifiers); and deflecting solid waste disposal objections by using biodegradable resins

14. Trash Bags

Scope

This segment includes a range of item containers sold business to consumer as well as business to business for collection and disposal of discarded goods.

Unlike storage bags, trash bags by definition serve to contain various wastes and discards destined for disposal. Some are designed to mask or absorb odors from the wastes to some degree. Bag colors and printed messages may serve to identify wastes for with special disposal handling is required (e.g. medical wastes). Both Institutional and household products are included in the category.

Summary .....

Table 15: Volume, Revenue and Substrates - Trash bags

Volumes	**Million US$***		**2002-2012**	**Million pounds**		**2002-2012**
SEGMENT	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR ($)	Est. Annual Volume – 2002	Est. Annual Volume – 2012	CAGR (lb)
Trash bags	$1,601	$2,258	3.5%	801	1,129	3.5%

[#] ***Converter Sales value***: B to B transactions

Composition (% by wgt):		
SEGMENT	**Substrates***	**Manufacturing process**
Trash bags	ldpe (100%)	Blown Film; Cast Film

Background .....

Canadians Harry Wasylyk, Larry Hansen and Frank Plomp are credited with inventing the disposable polyethylene garbage bag about 1950. The bags were first sold to line garbage cans in the Winnipeg General Hospital rather than for home use[24]. Shortly after, Union Carbide commercialized consumer plastic trash bags with its *Glad* product line.

In 1969, the New York City Sanitation Department's "New York City Experiment" concluded that *plastic refuse bag* curbside pickup is cleaner, safer and quieter than metal trash can pick-up. The evaluation began a shift to plastic trash bags among consumers.[25]

Bags are sold in many sizes, usually designated by an effective volume, with a specific lay flat length, width and gauge. While no official industry standards exist for converting length, width and bag gusseting pattern to effective volume, consumer products tend to common sizes. Commercial and industrial products are more varied in sizes and thicknesses and are often referred to as “can liners”

Methodology.....

Primary Source:	
	Polyethylene refuse bags (2007 US Dept Commerce Economic Census; NAICS Code 32611112)[xvii]; 2012 Standard Report on Plastics Bag & Pouch Manufacturing; Anything Research
Critical Assumptions:	
	2007 US Census percentage of polyethylene refuse bags (21.5%) applied to annual totals for plastic bag manufacturing (NAICS 326111). This value for refuse bags extended with segment-specific film and dimensions; nominal yields, and assumed prices

[24] (http://www.collectionscanada.gc.ca/cool/002027-2005-e.html; retrieved 9/25/2012
[25] http://www.plasticsindustry.org/IndustryGroups/content.cfm?ItemNumber=521; retrieved 9/25/12

Opportunities.....

Similar to the storage bag segment, three technology areas (down gauging; consumer enhancements and degradable material) offer competitive advantage opportunities.

ANNEX I: Raw material abbreviations*.....

Al	Aluminum foil
evoh	Ethylene vinyl alcohol
hdpe	High density polyethylene
ldpe	Low density polyethylene
OPET	Oriented polyester film
OPP	Oriented polypropylene film
OPS	Oriented polystyrene shrink film
Paper	Paper
pe	Polyethylene (including copolymers and various densities)
PETG	Glycol-modified polyester shrink film
pp	Polypropylene
PVC	Polyvinyl chloride shrink film
WOPP	White oriented polypropylene film

“Caps” only abbreviations: films

“Lower case” only abbreviations: resins

“Caps & Lower case” mixed abbreviations: foil and paper

ANNEX II: Sources .....

[i] *State of the U.S. Flexible Packaging Industry Report (2012); Flexible* Packaging Association (2012); 126 pp.

[ii] *2012 Standard Report on Plastics Bag & Pouch Manufacturing*; Anything Research, Nov. 2012; 8 pp.

[iii] *2012 Standard Report on Uncoated Paper & Multiwall Bag Manufacturing*; Anything Research, Nov. 2012; 8 pp.

[iv] *US Department of Commerce; 2007 Economic census NAICS 32611116;* http://www.census.gov/econ/industry/products/p326111.htm *; retrieved 8 Nov., 2012*

[v] *Labels to 2015;* Freedonia Group; August, 2011; 349pp.

[vi] Shrinking Uncoated Freesheet Demand Continues To Pose a Key Challenge; Harold M. Cody, Paper Age Magazine, Mar-Apr 2012 e; pp .16-17.

[vii] *Made in North America – Tissue*; Sanna Kallioranta and Soile Kilpi, Paper Age Magazine, Nov-Dec, 2010, pp. 18-21.

[viii] *US Confectionery Sales; Manufacturing Confectioner Magazine*; October, 2012, pp. 14-20.

[ix] *U.S. Cookie and Snack Sales; Manufacturing Confectioner Magazine*; February, 2012, pp. 17-20.

[x] *ANNUAL REPORT (For the fiscal year ended December 31, 2011); REYNOLDS GROUP HOLDINGS LIMITED, New Zealand; Mar.2012; 334 pp*

[xi] *PRODUCT & MARKET OVERVIEW - POUCHES TO 2016;* Freedonia Group; July, 2012; 331pp.

[xii] *PRODUCT & MARKET OVERVIEW - POUCHES TO 2016; Freedonia Group; July, 2012 331pp.*

[xiii] *Retort Pouches;* Allied Development Corp, 2011, Burnsville, MN, 446 pp.

[xiv] *Sleeve Label Industry Overview*; William Llewellyn; International Sleeve Label Conference; Cincinnati,;April 2012; 21 p

[xv] *Plastic Film*; Freedonia Group July, 2008 373 pp

[xvi] *US Department of Commerce; 2007 Economic census NAICS 326111; http://www.census.gov/econ/industry/products/p326111.htm ; retrieved 8 Nov., 2012*

[xvii] US Department of Commerce; 2007 Economic census NAICS 326111; http://www.census.gov/econ/industry/products/p326111.htm ; retrieved 8 Nov., 2012