



HIGH-PERFORMANCE BARRIER FILMS:

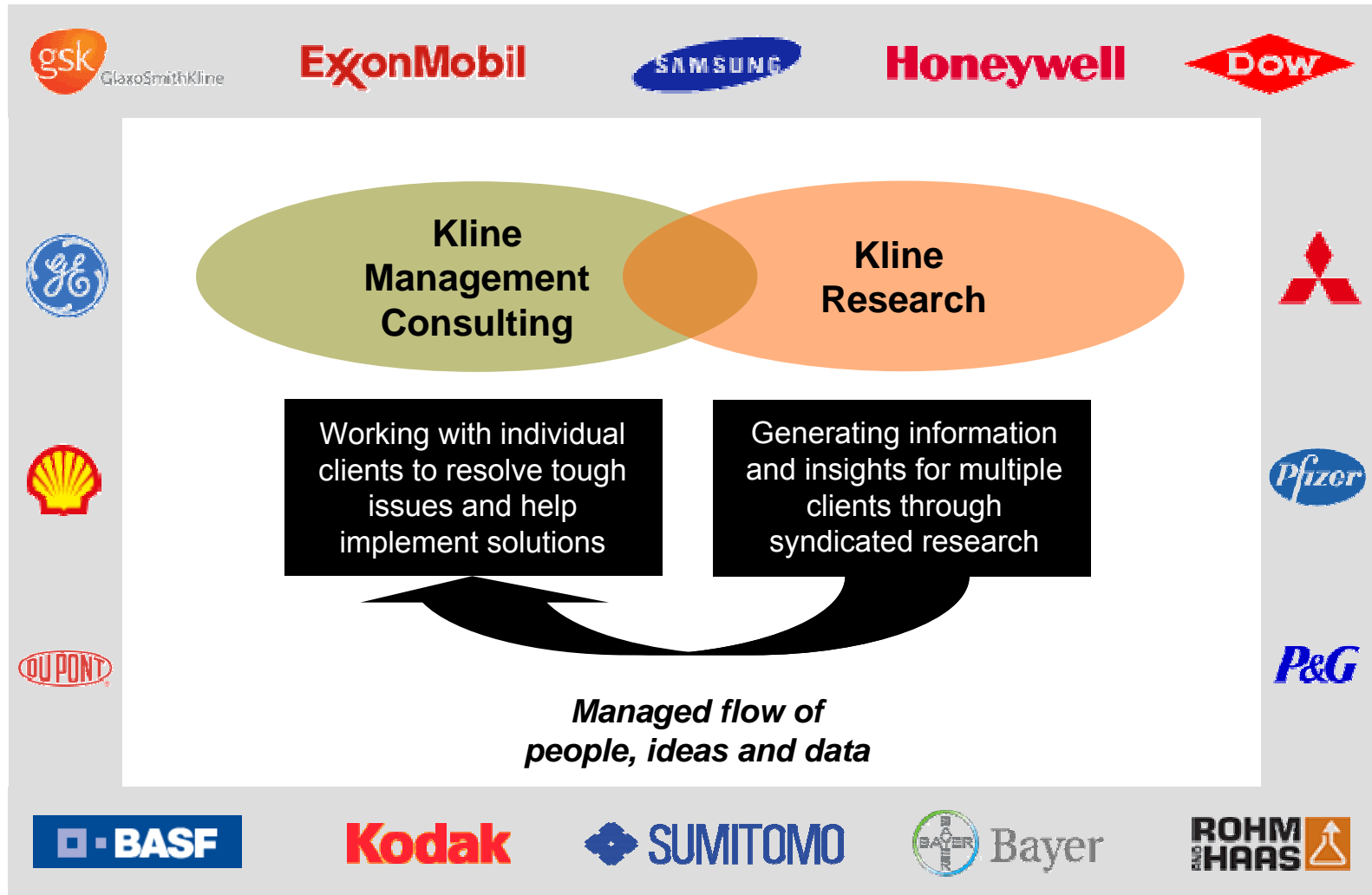
Examining Global Trends from a US Perspective

**A Presentation for
The Barrier Film Symposium**

February 13, 2007

Ver. 2

Kline and Company is a leading management consulting and market research firm.



AGENDA

Definitions

Opportunities in the U.S. Market for High-
Performance Barrier Packaging Films

Global Trends

Question and Answer Session

Information is on a 2005/06 estimated basis unless otherwise noted



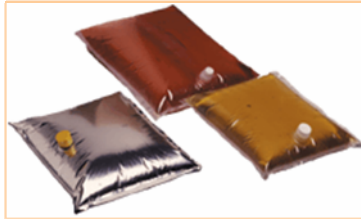
Background & Definitions

Opportunities in the U.S. Market for High-Performance Barrier Packaging Films

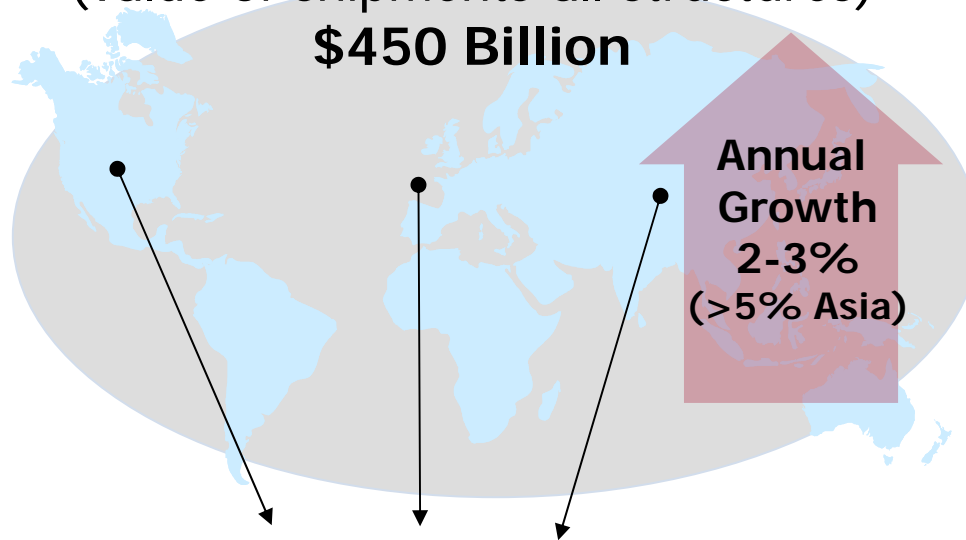
Global Trends

Question and Answer Session

The global packaging market is huge; offering many opportunities in barrier packaging, led by flexibles.



Global Packaging Market
(value of shipments-all structures)
\$450 Billion



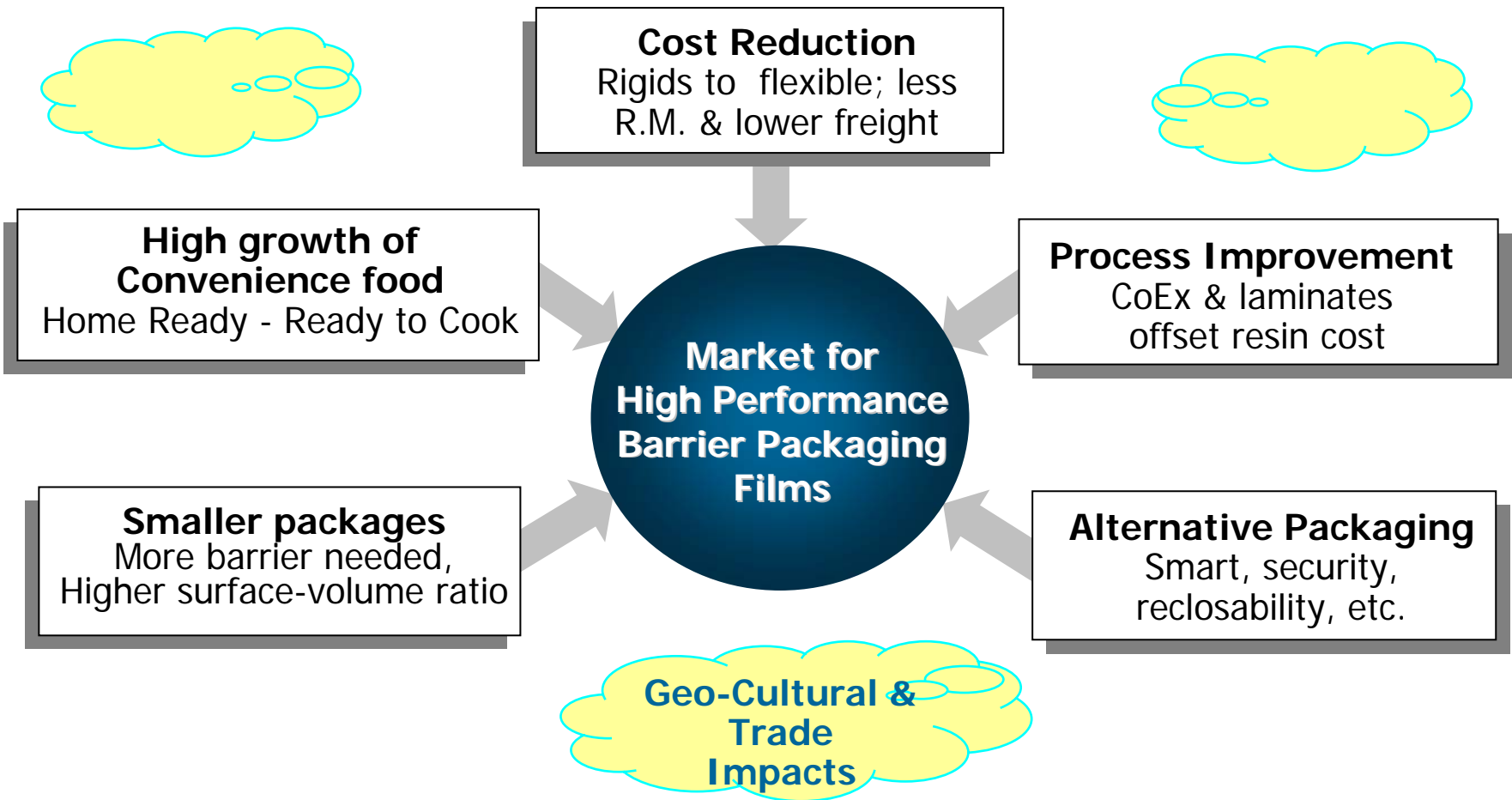
N. America and Europe account for roughly 55% of global packaging value, but growing at slower rates than rapidly developing regions such as Asia

Kline's definition for high-performance barrier packaging films is specific, as follows.

- Film structures providing high barrier levels to oxygen, water vapor, aromas/flavors, and/or UV light
 - A barrier film is usually a coextruded, coated, or metallized substrate
 - Barrier components include PVdC resin/coating, EVOH, nylon, MET films, or Al_2O_3 or SiO_x
 - But excludes all structures that use Al foil as the barrier, paper as a structural member, or MET films used only for graphic enhancement
- Film structures <10 mil (e.g. multilayers of printed layer, barrier & sealant)
- Includes film structure laminations (with a barrier film), or a coextrusion containing a layer of barrier resin, or a substrate coated with a barrier material that might also function as a sealant

A mono-structure of only barrier film is very rare; real value is created when the barrier film is a 'component' that enables the final package

The market for H.P. barrier packaging films is positively influenced by many factors.



Our focus is on food packaging, with some comments on medical devices



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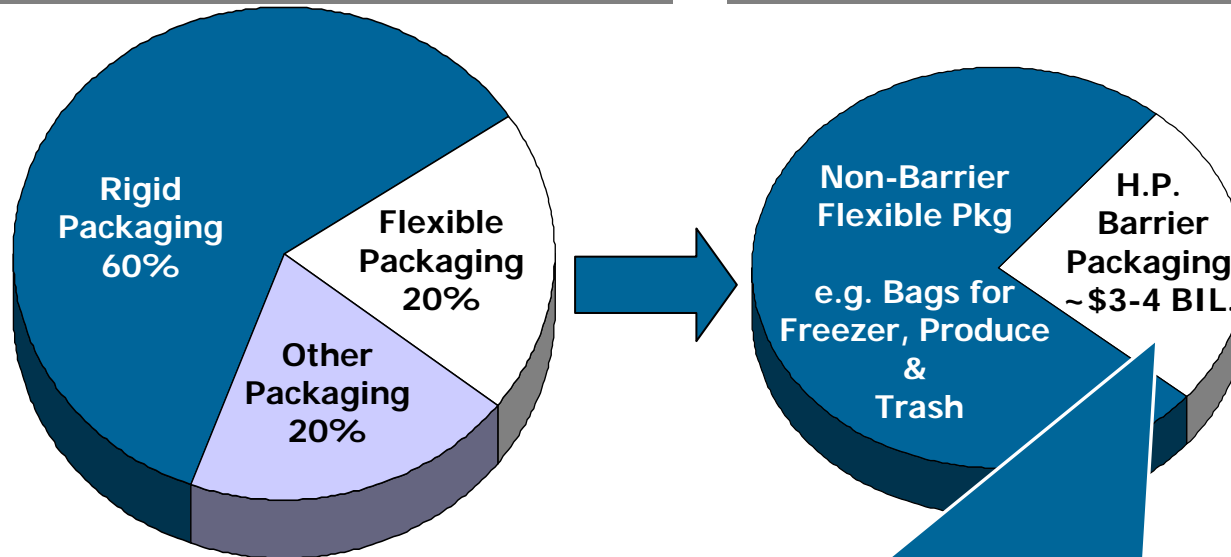
Question and Answer Session

The value of H.P. barrier film in flexible packaging is relatively small compared to overall packaging.

**Total US Packaging Demand, 2005 est.
US\$125 BIL. (value of shipments)**

**US Flexible Packaging
\$25 BIL. estimate**

**Value Added From
Barrier Resins**



Package Structure 790 MIL Ib (360 KMT) \$3,200 MIL
↑ Film 415 MIL Ib (190 KMT) \$1,250 MIL ↑
↑ Resins 150 MIL Ib (68 KMT) \$250 MIL ↑

Converted H.P. barrier package structures are about 20 % of all flexible packaging (\$3-4 BIL). Added value is significant, with contained value of H.P. barrier film about \$1.2 BIL

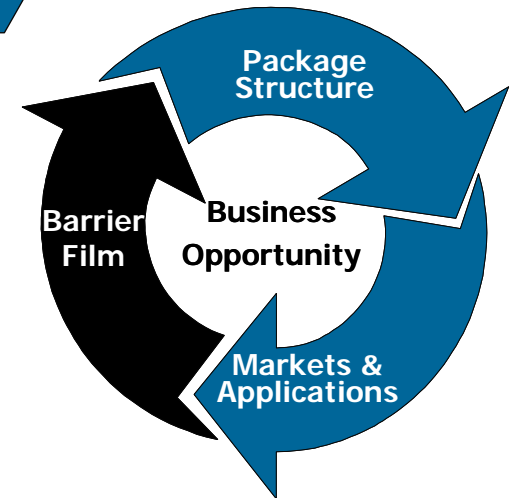
Business opportunity emanates from the value chain continuum of application, film and structure.



- Perishable Food
 - Fresh meat
 - Prepared food
 - Processed meat & cheese
- Dry Food
 - Confections & snack bars
 - Pet food
 - Snacks & baked snacks
- Medical & others

- PVdC
- EVOH
- Nylon
- Metallized
- Specialty oxides
- CoEx. & laminates

- Bags
- Lid stock
- Stand-up pouches
- Forming web
- Wraps

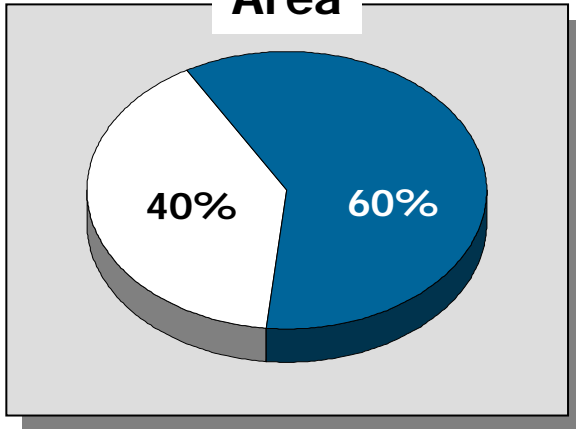


US H.P. Barrier Film
\$1.2 BIL

We use sophisticated applications model to combine film & package conversion costs, area and package structure to determine various market size relationships

Of the \$1.2 BIL barrier packaging film market, perishable food is the largest US category.

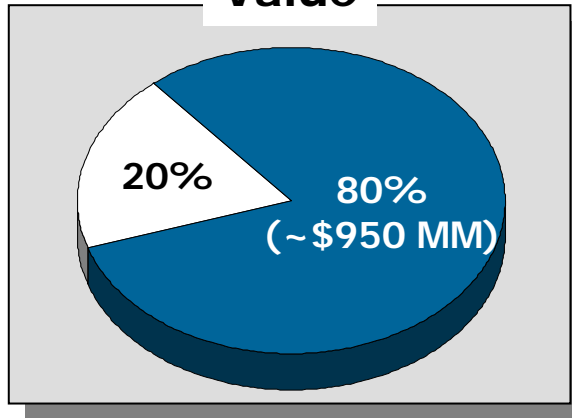
Area



8.5 trillion sq. in

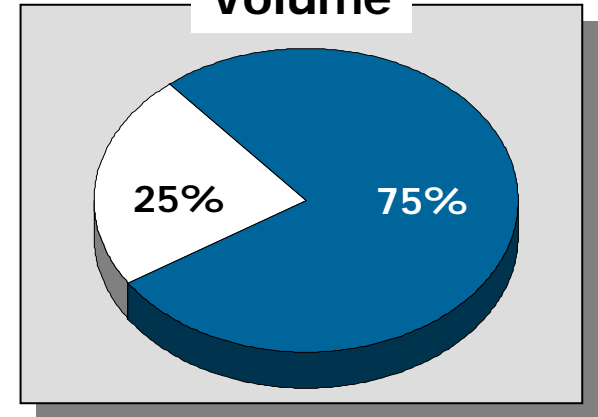
Perishable food represents 80% of the value of barrier films in food applications

Value



\$1.2 billion

Volume

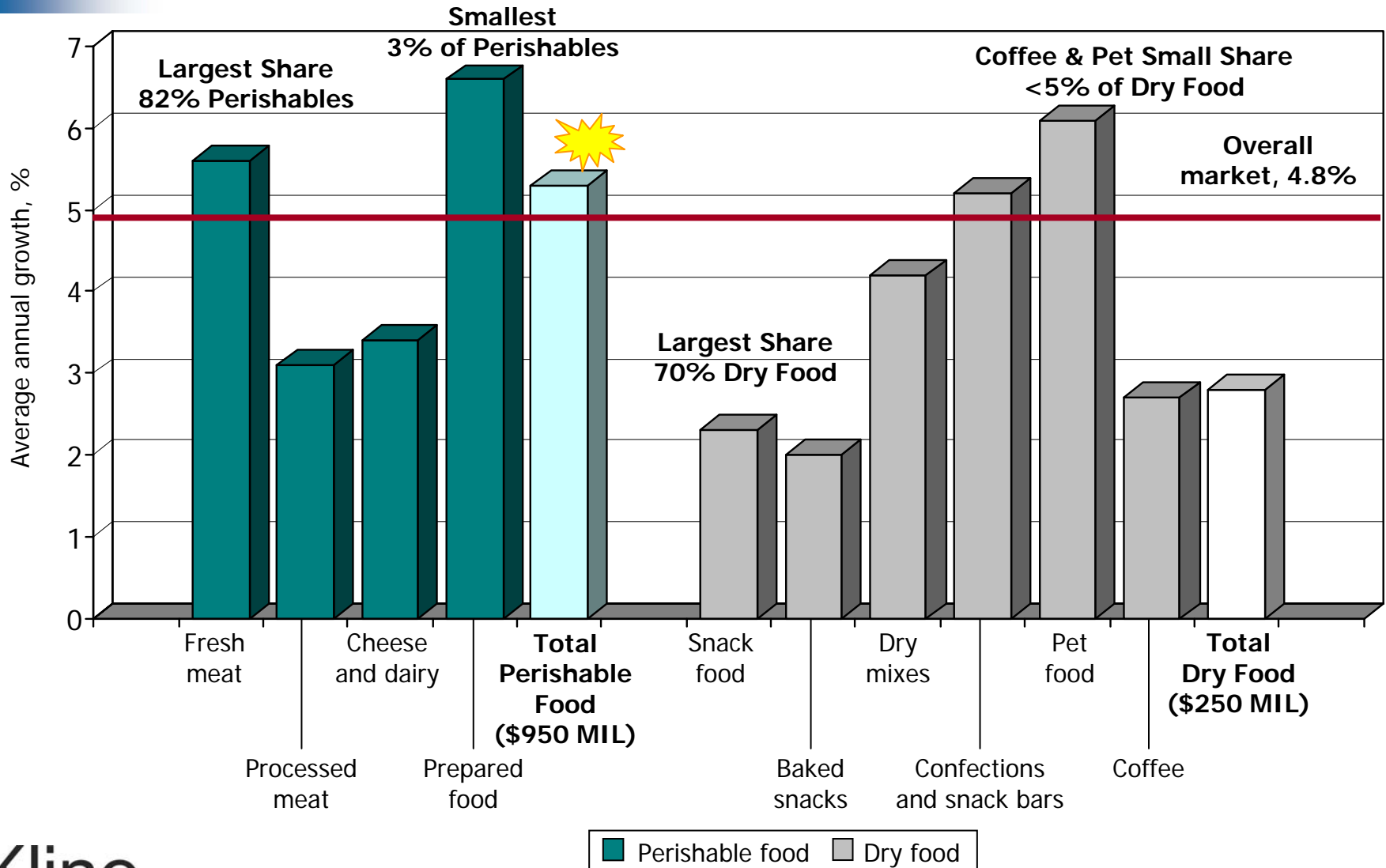


415 million lb

■ Perishable food
□ Dry food

Perishables usually need more barrier protection than dry foods

The overall barrier film market is forecast to grow at a good AAGR of 4.8% over the next five years.



In perishable food, consumption of barrier films for fresh-meat applications is to grow AAGR of 5.6%.

Key Stats:

Fresh Red Meat:

- \$720-740 MIL Film
- 5.6% Growth/yr
- 82% of Perishables
- 67% of Barrier Pkg

Examples:

- Case-ready red meat focus
- Pork & poultry already case-ready & maturing

- Penetration of case-ready meat to drive growth of barrier films
- Trend toward the production of more case-ready red-meat products
- Increase in the use of shrink bags for case-ready and value-added products
- Refrigerated space allocated for fresh meat expected to decline, as consumers demand convenience products; i.e. need increased O2 barrier & shelf life

The prepared food segment will exhibit strongest growth, forecasting AAGR of 6.6%.

Key Stats:

Prepared Food:

- \$20-30 MIL Film
- 6.6% Growth/yr (high)
- 3% of Perishables
- 2% of Barrier Pkg

Examples:

- Home meals – veggies, pasta, meats, diet food too
- Sauces & gravies

- Rising transportation costs will drive the trend toward replacement of rigid metal packaging, especially in foodservice applications, by bags & pouches
- Clear barrier films have all but replaced MET films for bag-in-box wine and will continue to replace MET films in foodservice applications
- The trend in HMR (Home Meal Replacement) is toward the replacement of messy domed trays with barrier lidding films
- Demand for convenience has created a rapidly emerging market for pre-cooked meats – retailed entrees & larger food-service portions

Processed meat, cheese and dairy segments will exhibit more steady growth, at about 3-3.5%.

Key Stats: Proc. meats, cheese, dairy:

- \$100-110 MIL Film
- 3-3.5% Growth/yr
- 14% of Perishables
- 11% of Barrier Pkg

Examples:

- Deli meat & cheese slices
- Natural chunk cheese
- Milk, pudding, yogurt

- The image of processed meats (deli) as unhealthy is changing, with some products now viewed by consumers as convenient sources of protein
- The use of barrier films to package cheese will continue to increase as consumers' preference for natural cheese continues to grow at the expense of processed cheese that requires less barrier packaging
- Consumer demand for smaller, more convenient packages will contribute to the increase in barrier film consumption
- Cost reduction will continue to drive the trend toward replacement of laminations with coextrusion technology

In dry-foods, consumption of H.P. barrier films for dry-mixes is forecast strong AAGR of 4.2%.

Key Stats:

Dry mixes:

- \$25-30 MIL Film
- 4.2% Growth/yr
- 12% of Dry Foods
- 2% of Barrier Pkg

Examples:

- Cake mixes
- Pudding powder
- Powder flavoring

- The dry food category is much smaller than perishables at about \$250 MIL, or 20% of barrier film share
- Dry mixes is a relatively small part of the dry food category, driven by consumer preference for standup pouches and away from rigid packaging
- To reduce investment risk, many companies are increasing the use of contract packagers as a means of converting to standup pouches
- Trend toward clear packaging to view contents favors clear barrier film solutions

Similarly, AAGR for confections and snack bars segment is forecast to at a robust 5.2%.

Key Stats:

Confections & snack bars:

- \$15-20 MIL Film
- 5.2% Growth/yr
- 6% of Dry Foods
- 1% of Barrier Pkg

Examples:

- Chocolates
- Candy & gum
- Energy bars, nut bars

- MET PP structures are expected to grow 4% to 6% annually (graphic appeal)
- The adult-oriented functional bar sector is growing at >20%
- The growing Hispanic & other ethnic population and associated taste preferences is becoming a significant driver in the confections industry (flavor & aroma barrier important)

Pet foods consumption of H.P. barrier films is forecast as the strongest AAGR, exceeding 6%.

Key Stats:

Pet Foods:

- \$2-5 MIL Film
- >6% Growth/yr
- 1% of Dry Foods
- <1% of Barrier Pkg

Examples:

- Dog food
- Cat food
- Bird seed, etc.

- Growth is from a small base (high growth rate) – people increasingly like to feed their pets like themselves, e.g. chicken/veggies & rice!
- Shift from wet to dry pet food, with dry dog food accounting for nearly 80% of all dog food sales
- Standup pouches for semi-moist pet snacks are attributed to spurring the 10% growth rate in the treats sector

Snack-foods & baked-snacks to have respective modest growth, at AAGR of 2.3% & 2% each.

Key Stats:

Snack food/baked-snacks:

- \$160-170 MIL Film
- 2-2.5% Growth/yr
- 79% of Dry Foods
- 16% of Barrier Pkg

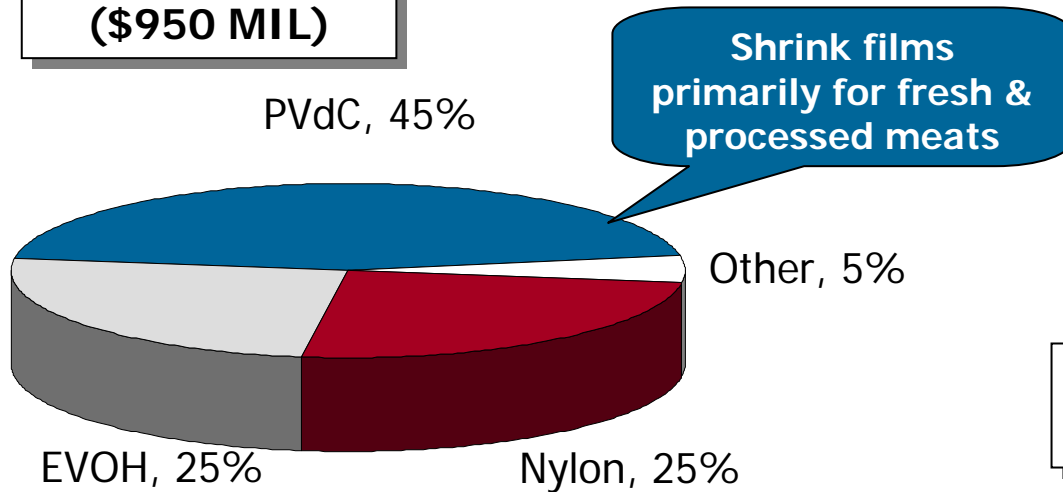
Examples:

- Chips, nuts, cookies, dried fruits, raisins, etc
- Baked (healthy snacks) – no preservatives

- One of the biggest trends in snack foods is the move toward products packaged in single servings that are easily portable and consumed on-the-go; we work 24/7, have a family and need convenience
- The snack food category will continue to move away from rigid containers in favor of flexible packaging (SUP), with new introductions by major suppliers of snack nuts, cookies, and most recently, crackers
- The use of barrier films in the baked-snack segment is expected to increase overall, driven by consumer desire for healthier products that require more protection from moisture and oxygen to retain freshness

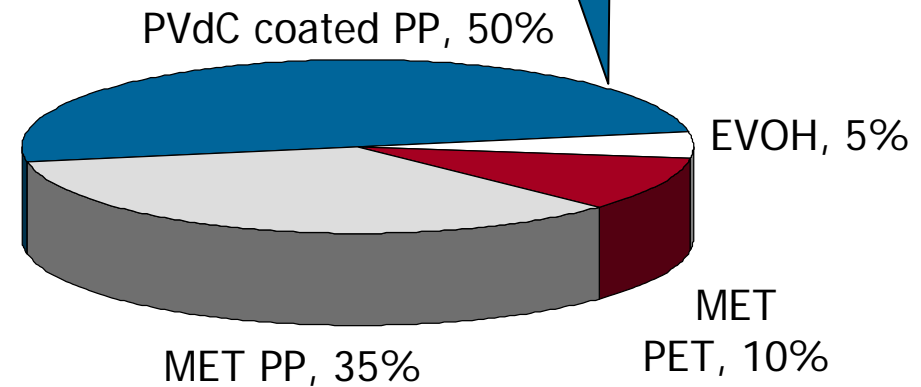
PVdC is the leading barrier film used for perishable food. In dry-food, PVdC-coated PP leads.

**Perishable food
(\$950 MIL)**



Snacks, clear-packs & pillow-packs

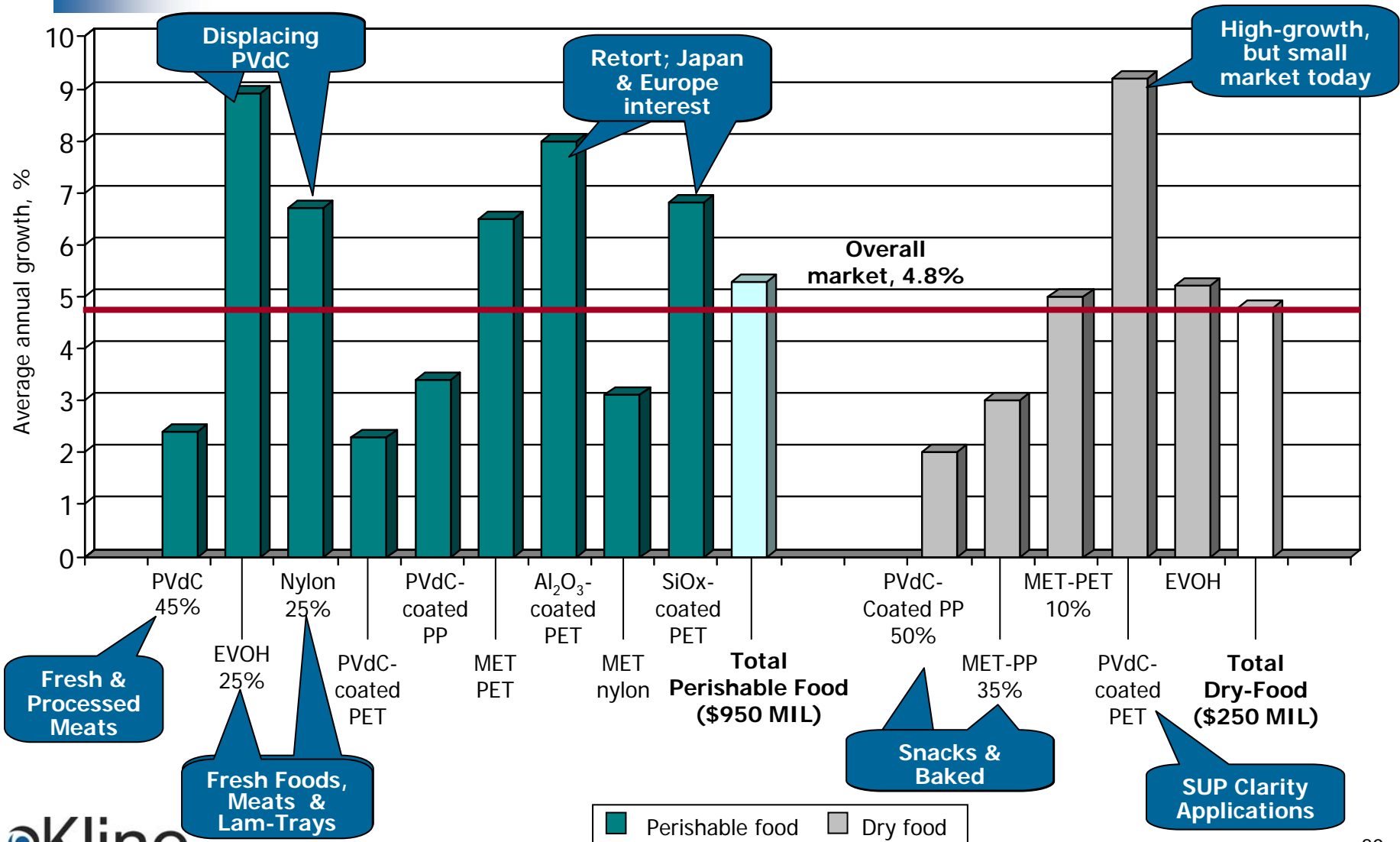
**Dry food
(\$250 MIL)**



Modified Atmospheric Packaging (MAP)

Films vs. coated films; e.g. PVdC does both

High-growth expected in perishable foods for EVOH & Al₂O₃-PET films (8%+); in dry-foods PVdC-PET (9.2%).



Primary converters of shrink bags for fresh & processed meat entrenched in PVdC CoEx-tech.

- Although PVdC is inherently difficult to process, primary converters of shrink bags for packaging fresh and processed meat (Cryovac, Curwood, and Alcan) are entrenched in PVdC coextrusion technology for narrow web
- Dow has introduced patented encapsulation technology to blow multilayer film and for producing wider width substrate. Licensing of this technology is likely to spur growth of PVdC resin for blown multilayer film
- New growth markets for PVdC include lid stock and retort applications for prepared foods, which require moisture stability
- Despite environmental issues, PVdC is still widely used for shrink bags in Europe, and its use in the U.S. does not appear to be a threatened

Growth in case-ready MAP for fresh meat will translate into growth for multilayer EVOH film.

- EVOH coextrusions in packaging processed meats and cheese will continue to displace more expensive PVdC-coated films
- Trend toward clear EVOH/nylon structures as replacements for MET PET in prepared foods and bag-in-box wines
- EVOH to continue growing in laminated food trays

Growth in case-ready fresh meat will continue to drive growth in nylon film.

- Multilayer nylon film structures displacing PVdC in case-ready meats; e.g. nylon film liners for cases holding multiple packs of non-barrier trays under MAP
- Nylon's strength, toughness and added barrier properties to aromas & flavors continues to drive its extensive use in forming webs for processed meats/foods
- Clear EVOH/nylon films replacing MET PET in foodservice bags & wine bag-in-box; although more expensive, provides lower total package cost & puncture resistance
- Growth of 20% to 30% in retort pouches will drive growth of nylon films incorporated into both foil and clear pouches (multiple package structures)
- The use of nylon film in chubs (clear plastic tubes) will continue to decline as more ground beef is packaged in MAP case ready trays for retail sale

PVdC-coated PET, used as lid-stock & inner ply of clear standup pouches for is growing.

- Increase in the use of PVdC-coated PET lid stock for packaging prepared foods – MAP, hot-fill and retort
- The use of PVdC-coated PET in packaging processed meats will decline
- Lamination and coating processes are being displaced by coextrusions
- However, PVdC-coated PET, commonly used as the inner ply of standup pouches for snack foods, dry mixes, and pet food, is expect to grow for applications requiring clarity

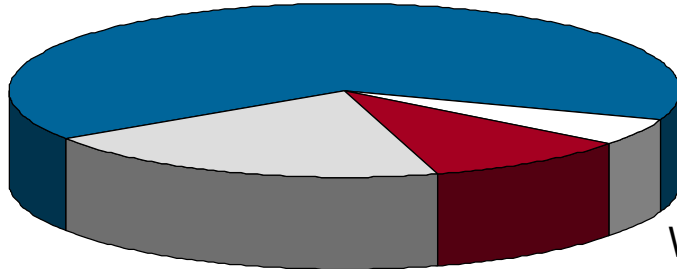
MET PP has all but replaced higher-priced MET PET in the snack foods category.

- MET PP is the film of choice in packaging candy and snack bars (graphics appeal)
- Use of MET PET as the inner ply of standup pouches for snack foods, dry mixes, and pet food will continue due to good dimensional stability and heat resistance are critical
- The use of MET PET bags in foodservice applications, will continue to grow with the trend toward clear barrier films, replacing metal cans

Bags are the leading packaging structure utilizing barrier packaging films.

**Perishable food
(480 MIL lb. or 218 KMT)**

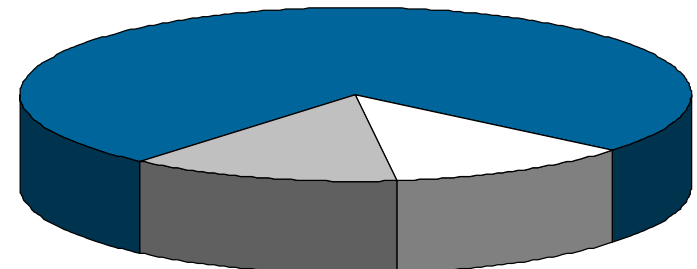
Bags, 65%



In Europe, standup pouches more popular for perishables, but in US more popular for dry foods

**Dry food
(310 MIL lb. or 141 KMT)**

Bags, 75%



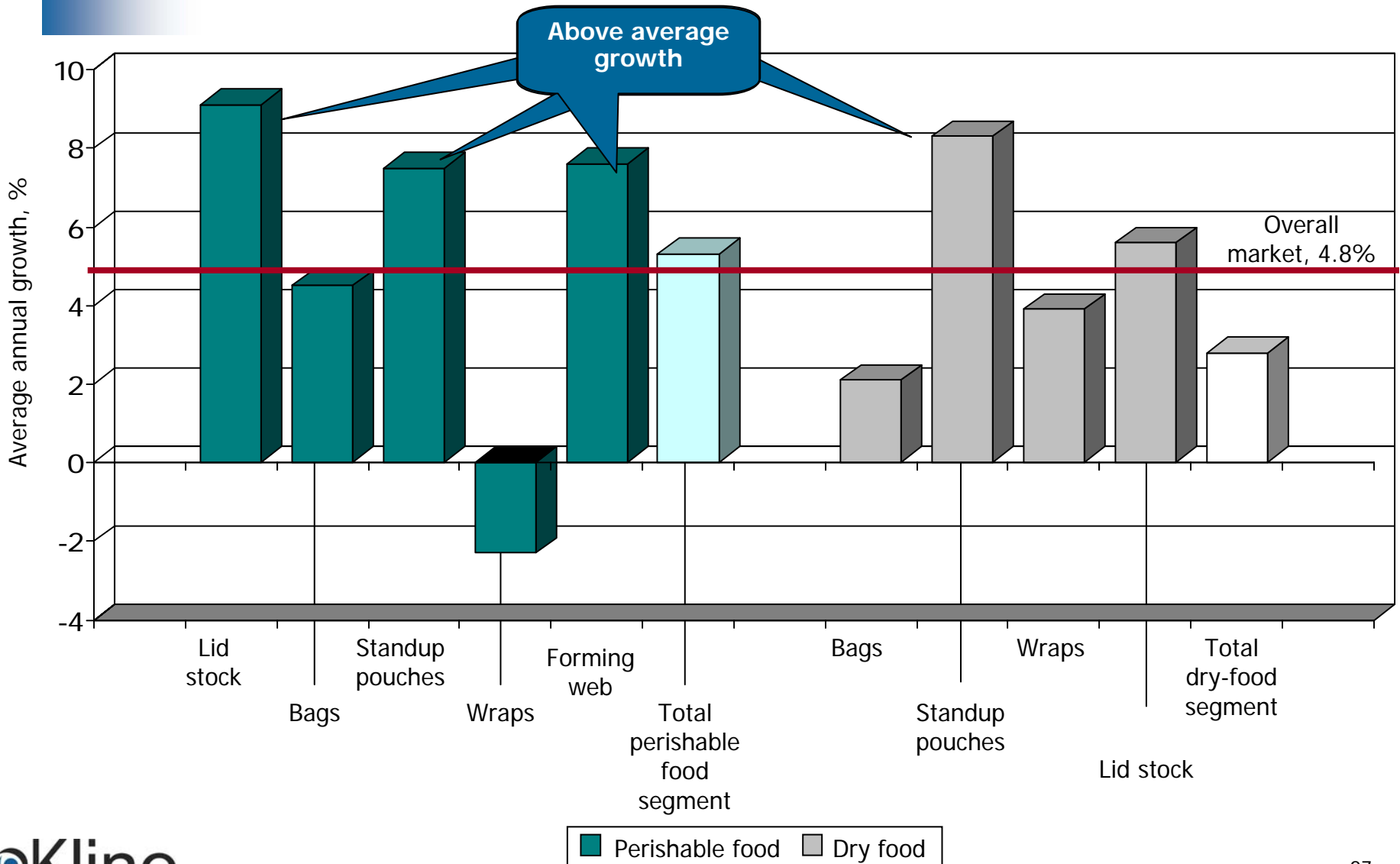
Standup pouches, 12%

Wraps, 13%

Meat & cheese, also laminated trays – takes the shape of wrapped item, creating bottom, top & sides

Bundle wraps for cookies, crackers, candy bars, includes tray packaging too

Barrier packaging films for lid stock & standup pouches in the food sectors forecast to grow at above rates.



Bags continue to be the major flexible barrier packaging structure, growing at average rates.

- Bags are extensively used in packaging dry foods — most are pillow packs & bag-in-box type, supplied as rollstock to end users to run on form/fill/seal lines
- Square-bottom bags, used to package coffee, becoming popular for other dry food with improved graphics, reclosability & overall cost reduction vs. bag-in-box
- Increases in oil prices will continue to fuel growth in 1 gal foodservice bags as replacements for #10 metal cans
- The use of barrier shrink bags for packaging case-ready & processed meats growing at about 3-4%, led by convenience products - fresh meat & cooked

Standup pouches are being introduced into every category of dry-foods to differentiate products.

- Standup pouches with zippers offer reclosability, improved barrier & material savings in a one-component flexible package vs. multi-component rigid containers they are replacing for packaging dry food
- Rising fuel prices drive the trend toward metal can replacement with standup pouches; one truckload of flat bags/pouches equals 25 truckloads of cans
- Sales of shelf-stable foods in retort pouches grown 20-30% in recent years, reaching \$100 MIL in pouches. Many are foil laminates with clear barrier films
- Standup pouches are also gaining popularity for packaging processed meats like bacon bits and pre-cooked bacon.

In addition to Standup pouches, other growth structures include forming web and lid-stock.

- Forming Webs: largest use is packaging processed meat and cheese, which continues to grow exceeding 3%/year
 - Case-ready products will drive double-digit growth in forming webs laminated to trays for low-oxygen MAP packaging of fresh meat
 - Thermo-formed film as an alternative to pouches and trays for retort
- Lid-stock: the trend toward case-ready fresh meat packaged in trays under low-oxygen MAP to drive growth in barrier film lid stock
 - Barrier film forming webs & lid stock combinations grow for perishables
 - Lid stock providing tamper evidence to replace domes for home meals
 - Clear barrier film lid stock withstanding pressure & temperature of retort, provides microwaveability; recently commercial, but double-digit growth

US medical device H.P. flexible barrier packaging is valued at about \$10 MIL; film at about \$1-2 MIL.

- Flexible packaging market for medical and pharmaceuticals estimated at \$1.5 BIL
- Sterile medical device packaging represents 33%, (\$500 MIL) in the US; worldwide market is roughly \$1 BIL; medical device packaging growth 5% AAGR, with flexible growth faster at 8%
- The majority of the market is made up of coated papers and TYVEK for devices that require only a sterile barrier, without moisture protection or need for clarity
- Only about 20% of the market requires a barrier to moisture, oxygen, UV light, or odor, and foil laminations of paper or film have historically been the materials of choice
- Medical devices requiring higher barrier film structures is small, about \$10 MIL, AAGR 15%
 - Growing use of drug-coated and impregnated devices, alternative drug delivery devices, diagnostic kits and individually packaged reagent strips
 - Primary barrier include metallized films for drug-impregnated dressings for wound care and Al₂O₃-coated films as foil replacements for implants
 - Clear-barrier Al₂O₃-coated films and PCTFE will gain share replacing foil laminates in packaging body-absorbable sutures, drug-eluting stents & components of diagnostic kits
- Flexibles growth trends:
 - Industry increasingly favor flexibles over rigid packaging with clear high-barrier materials.
 - Rapidly developing more sophisticated drug/device combinations that require H.P. barrier
 - Looking to eliminate foil so labeling can be read through packaging, to quickly identify contents without opening, contaminating an expensive product, reducing surgical errors
 - Trend away from EtO gas sterilization, in favor of continuous radiation sterilization with more efficient bacteria kill & where porous packaging (e.g., TYVEK) not required

In pharmaceuticals, flexible H.P. barrier packaging is insignificant; growth of unit-dose blister packs

- The pharmaceutical segment is comprised of prescription drugs, medications, and dietary supplements sold over-the-counter (OTC)
- World demand for pharma packaging to reach \$24 BIL in 2009, increasing 4-5% annually.
- 80% of demand from the US, Japan, China, Germany, France, UK, Italy, & Switzerland. The US will remain the largest consumer driven by aging baby boomers
- Blister packaging is the fastest-growing segment of the pharma market. Worldwide demand expected to grow 7% AAGR, reaching \$5.6 BIL by 2009, driven by unit dose & sterile applications
- It is estimated that less than 1% of all pharmaceuticals are packaged in barrier films, as defined by our definition and therefore not a significant consuming segment of barrier films
- However, future barrier may be needed to maintain drug potency or inhibit degradation. A moisture barrier is critical for gels or liquids, sensitive to moisture loss. Foil used for UV barrier
- In addition to unit-dose blister packs, companies are converting to flexible pouches
- Unit doses maintain the 'five rights' of medicine monitoring: Right patient, right drug, right dose, right time, and right route of administration. Thus safer & tamper resistant
- New delivery systems, nasal, transdermal and parenterals in home-care and self-care applications also growing - not having to visit a doctor's office cuts costs and saves time
- Key trend is aging population - 75% of pharma consumers are senior citizens
 - Healthy lifestyle & fitness craze has fuel popularity of vitamins and dietary supplements
 - The market for cosmeceuticals also experiencing rapid growth - aged refuse to look old
 - Opportunities exist for the growth of barrier films in alternative pharma delivery. The use of Al₂O₃- and SiO_x-coated films are expected to grow in niche applications



Going forward, the outlook for high performance barrier packaging films is very positive.

- Large and non-cyclical market
- Sustainable growth drivers
 - Cost reduction
 - Convenience-oriented food
 - Smaller packages
 - Demand for alternate packaging formats



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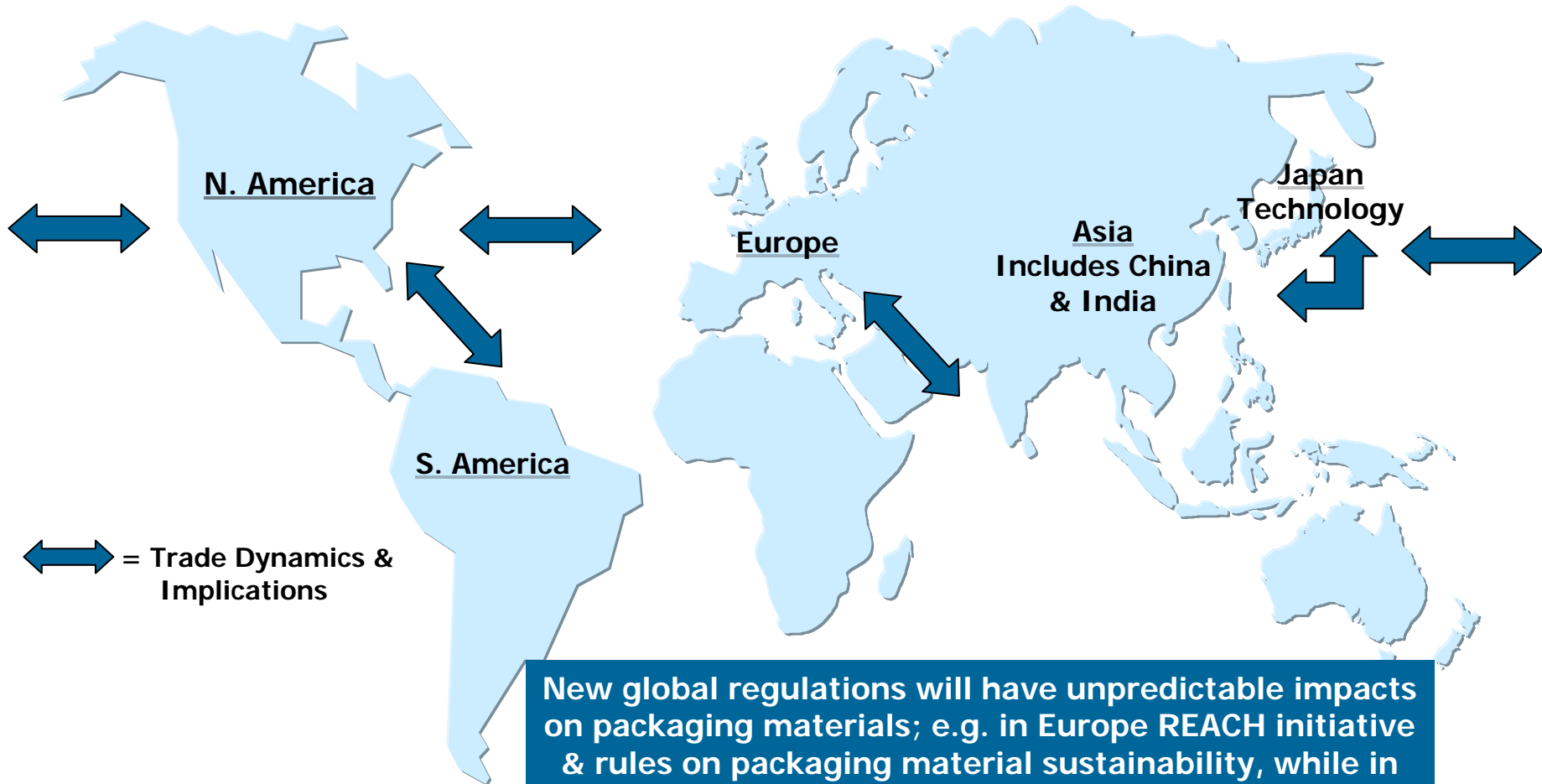
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But the US perspective is only one side of a growing global opportunity for barrier packaging.

Both market and technology induced opportunities link major global regions



New global regulations will have unpredictable impacts on packaging materials; e.g. in Europe REACH initiative & rules on packaging material sustainability, while in China new 11th 5-year plan environmental initiative

Packaging opportunities gleaned from other regions.

Drivers	Western Europe	China & Japan
Consumer Preference	<ul style="list-style-type: none"> ▪ Traditional frequent trips to market ▪ Few long lunches at home; grab-n-go ▪ Higher income – spend more at stores 	<ul style="list-style-type: none"> ▪ Rapid lunches-aesthetics outweigh costs ▪ Local shops provide flexible single serve ▪ Refrigerator limitations (small or none)
Demographics	<ul style="list-style-type: none"> ▪ Smaller families – singles, working women ▪ Growth in aged and non-married women ▪ Small apartments, urban pop. density ▪ Smaller package – growth of single-serve 	<ul style="list-style-type: none"> ▪ Low birth-rate ▪ More singles & elderly ▪ Displaced families - move to coastal cities
Environment	<ul style="list-style-type: none"> ▪ European Union packaging directive ▪ Space and waste reduction, recycling 	<ul style="list-style-type: none"> ▪ Environmental directives affect plastics use ▪ Space and waste reduction, recycling ▪ Energy from incineration
Promotion Marketing	<ul style="list-style-type: none"> ▪ Package catches the consumer's eye ▪ Brand owner marketing influence ▪ Brand owner environmental awareness ▪ Perception that less is more; buy efficient products, e.g. dry detergent; smaller size 	<ul style="list-style-type: none"> ▪ Eye-catching aesthetics important ▪ Environmental awareness ▪ Want more efficient products, i.e. reduce package size - easy to store/use
Innovation Technology	<ul style="list-style-type: none"> ▪ New solutions – quick digital printing, e.g. <ul style="list-style-type: none"> – team logo on package, quick to shelf ▪ Use of alternative substrates, e.g. barrier ▪ New resin technology drives innovation <ul style="list-style-type: none"> – e.g. Topas COC, new metallocenes 	<ul style="list-style-type: none"> ▪ Packagers switch to new materials ▪ Less concern on amortizing investments ▪ Using new barrier films for perishable food ▪ Japanese resin innovation, e.g. Mitsui

Europe & Asia markets have similarities and yet differences vs. the US; but, flexibles are favored.

■ Europe

- Improved package shelf-life; high-quality techno-product needs; new advances in flexible aseptic dairy packaging - flexibles environment & disposal convenience
- Bundle brand recognition and functionality with new flexible designs
- Coffee in single portion flexibles to increase convenience; coffee in regular size flex packs increase product quality, brand differentiation
- Growth in frozen food flexible packaging market due to stronger brand development and increased popularity of prepared foods

■ Asia

- Improved aesthetics via flexible constructions; improve recloseability and dispensing systems, less freight for flexibles (China is key)
- Japan leads in different MAP balances for different products; create new aseptic flexible packaging designs; unique combination of materials for new function
- Flexible structures to withstand pasteurization at 116 degrees C - crucial in the sterilization of low-acid foods like milk, meat and vegetables.
- Need shelf-life with no significant difference in taste, compared to glass
- Compared to Japan, the rest of Asia is less advanced in packaging. Many rely on innovations from Japan and West; advances from S. Korea, Singapore & Taiwan
- Packaging materials in Japan, Singapore, Korea are influenced by disposability recycling laws; incineration laws ban PVC; China's new 5-year plan pro-environment



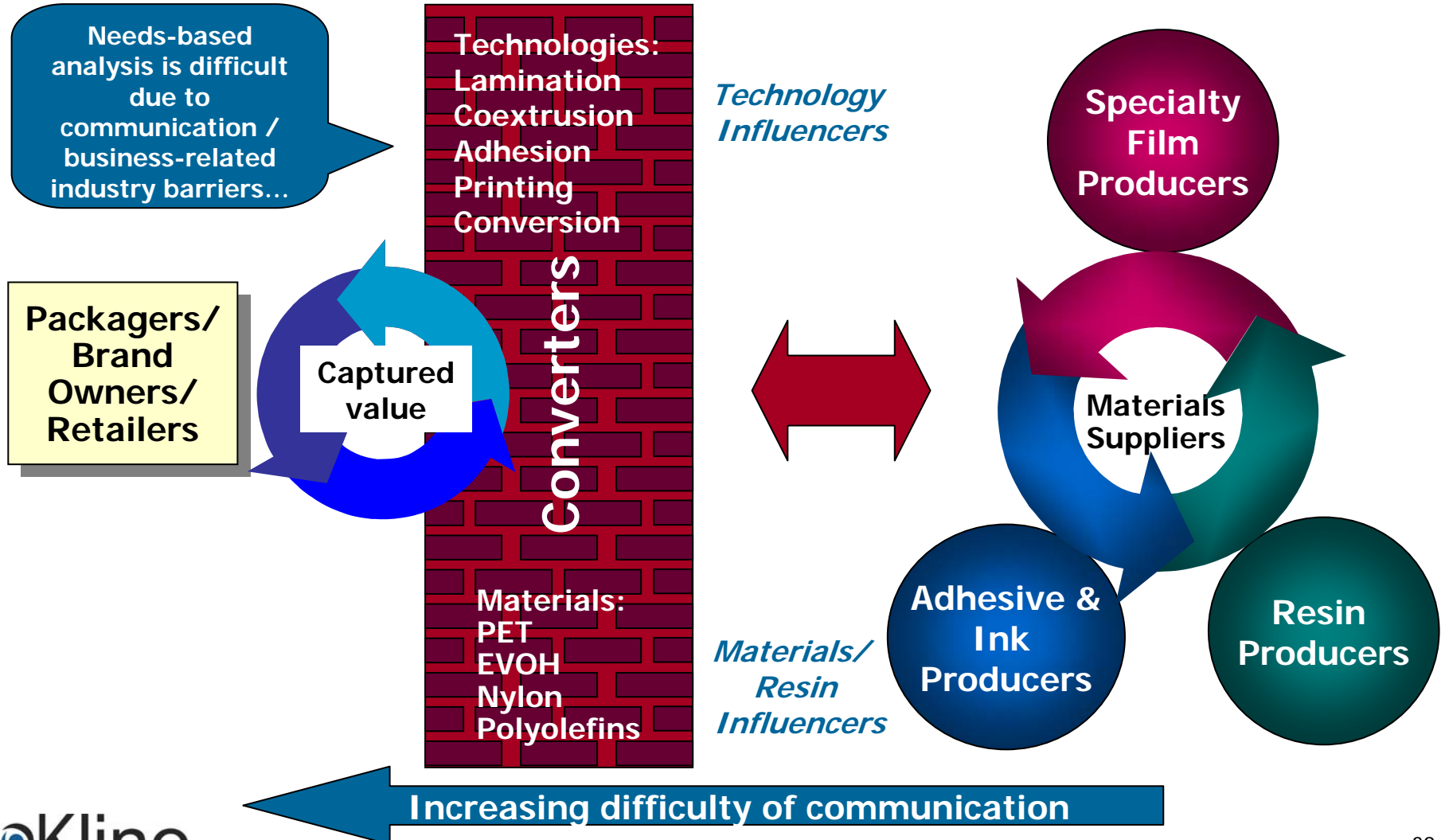
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To summarize, opportunities are created when your solution meets the unmet needs of end users.



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