

2023 MASTIO PE FILM MARKET STUDY

CHAPTER 3

MEAT AND POULTRY

INTRODUCTION

Fresh and frozen meat and poultry packaging in North America is required to comply with **Food and Drug Administration (FDA)** regulations. The meat industry is the largest sector of agriculture and agriculture is the largest sector of the United States (U.S.) economy. A wide variety of films and film constructions have been developed to meet the requirements of industry regulations due to concerns for bacteria-free products. The specific film structures are dependent on the type of meat or poultry to be packaged, the distribution process, the end use (restaurant, institutional, or consumer), and time of storage before final sale and consumption.

The term "meat" refers to the skeletal muscle from the carcasses of animals such as beef and veal (cattle), lamb and mutton (sheep), and pork (hogs).

Meat is packaged in either primal or sub-primal cuts. The primal cuts are typically contained in primal cut shrouds, and sub-primal cuts are shipped in multi-layer coextruded barrier bags. Retail food stores repackage the meat before selling it to the consumer. Consumer-ready meat cuts, such as pre-cut steaks and roasts, are prepared in vacuum sealed packages to be placed directly in refrigerated supermarket meat cases.

Most beef has been sold as "boxed beef", which is prepared at a packing plant by removing more of the bone and fat from the carcass as it is cut into smaller portions, vacuum-packed to reduce spoilage and shrinkage, and then placed into boxes that are easier to ship and handle. The U.S. is the world's largest producer of beef.

Other than the skeletal portion of the livestock, up to 15.0% of the value of the live animal may be consumed in the form of by-products such as hides, inedible and edible tallow, meat and bone meal, brains, kidneys, sweetbreads (calf thymus glands), livers, ears, hearts, tail, and the tongue. By-products, also known as edible offal's, are an essential sector of the meat packing business.

Fresh and frozen poultry covers an assortment of domesticated birds, which are raised to provide food. Included among the list of poultry items are chicken, turkey, duck, goose, and other game birds such as guinea fowl, pigeon, quail, and pheasant. Chicken is by far the largest and most important due to consumption of both meat and eggs. Just over half of all chicken is packaged in parts, with a portion of the larger parts being further processed into boneless products. Poultry is extremely susceptible to microbiological deterioration by salmonella microorganisms; therefore, oxygen transfer and reducing water vapor loss is extremely important in poultry packaging. Guinea fowl, pigeons, pheasants, and other game birds are produced in smaller numbers for specialty markets.

Turkey is shipped to packing plants where the slaughtering, scalding, and picking processes take place. Turkey meat is typically packaged whole and sold either fresh or frozen in vacuum shrink bags.

Like chickens, ducks are bred for their meat and eggs. Ducks are typically slaughtered, bled, scalded, and rough-picked in one machine operation and are packaged whole and frozen.

Polyethylene (PE) film currently dominates the meat and poultry packaging market. Polyvinylidene chloride (PVDC) films, laminations, and coextrusions are also used in both the institutional and retail prepackaged meat and poultry market.

This chapter will focus on PE meat and poultry film. A market analysis, including discussions of market size, product specifications, factors affecting the market, materials competition, and participants will be provided. This chapter will also discuss PE film extrusion and resin technology, provide a value-in-use analysis, and a forecast of resin use and consumption for 2022 and 2025.

MARKET ANALYSIS

Market Size

Total PE resin consumption in 2022 for meat and poultry packaging reached approximately [REDACTED] MM lbs., and the market is expected to increase at an average annual growth rate (AAGR) of 2.9% through the year 2025, reaching a PE resin consumption level of [REDACTED] MM lbs.

The meat and poultry industry feeds over 334.0 million Americans and is the largest segment of U.S. agriculture. According to the **United States Department of Agriculture (USDA)** and the **National Agriculture Statistics Service (NASS)**, total federally inspected meat and poultry production in 2022 was approximately 107.0 billion lbs. According to the **USDA** and **National Chicken Council**, meat and poultry consumption is measured on a retail weight basis while turkey and “other poultry” is measured on a carcass-weight basis. Retail weight basis refers to the weight of the meat purchased at retail stores.

Meat:

According to the **USDA** and **NASS** in 2022, the U.S. produced approximately 54.9 billion lbs. of federally inspected red meat. Red meat includes beef, veal, lamb, mutton, and pork. Approximately 26.9 billion lbs. of federally inspected pork and 116.4 million lbs. of federally inspected lamb and mutton were produced in 2022.

According to the **USDA**, U.S. per capita consumption for total red meat (retail weight) was approximately 111.6 lbs. in 2022. This is further broken down by beef, veal, lamb and mutton per capita consumption representing 59.1 lbs., and pork per capita consumption representing 51.1 lbs. In 2023, U.S. per capita consumption for total red meat (retail weight) is expected to drop to 109.2 lbs. with beef, veal, lamb and mutton per capita consumption decreasing to 56.7 lbs. Pork per capita consumption will represent 51.0 lbs. in 2023.

In 2023, according to the **USDA** and the **NASS**, beef cattle (at 28.9 million head) were down 4.0% from 2022. Texas accounted for roughly 15.0% of the beef cattle in the U.S., and seven states had more than 1.0 million beef cattle in 2023. Rankings of states with the most beef cattle were Texas, Oklahoma, Missouri, Nebraska, South Dakota, Kansas, and Montana. In 2022, the top hog producing states were Iowa, Minnesota, North Carolina, Illinois, Indiana, Nebraska, Missouri, Ohio, Oklahoma, and South Dakota. Nearly one-third of the nation's hogs are raised in Iowa.

Poultry:

According to the **USDA** and **NASS** in 2022, the total federally inspected poultry market encompassed, raised, and processed an estimated 52.1 billion lbs. of meat. The **USDA** and **National Chicken Council** reported in 2022 that total poultry per capita consumption (retail weight) reached 115.2 lbs. Preliminary figures show this is expected to increase to 117.8 lbs. in 2023.

The largest sources of poultry production are commercial broiler farms. Broilers are seven- to eight-week-old chickens marketed at about 2.0 to 5.0 lbs. (1.0 to 2.5 kg) live-weight. In the U.S., Iowa, Ohio, Indiana, Texas, Pennsylvania, Georgia, Arkansas, North Carolina, Michigan, and California were the top chicken producing states in 2022. Furthermore, Georgia, Arkansas, Alabama, North Carolina and Mississippi were the top *broiler-producing* states. Ontario is the largest poultry producing province within Canada. The **USDA** and **NASS** reported that the total federally inspected broiler market encompassed an estimated 46.2 billion lbs. in 2022. According to the **USDA** and **National Chicken Council** in 2022, per capita broiler consumption (by retail weight) reached 98.9 lbs. This is expected to increase to 100.2 lbs. in 2023 (preliminary figures).

Turkey is consumed mainly in the U.S., Canada, and the United Kingdom. The U.S. raised and processed an estimated 5.2 billion lbs. in 2022. Top turkey producing states are primarily North Carolina, Minnesota, Indiana, Missouri, Arkansas, Iowa, and Virginia. According to the **USDA** and **National Chicken Council**, per capita consumption (by carcass weight basis) of turkey in 2022 was 14.6 lbs. and is expected to increase to 15.9 lbs. in 2023 (preliminary figures).

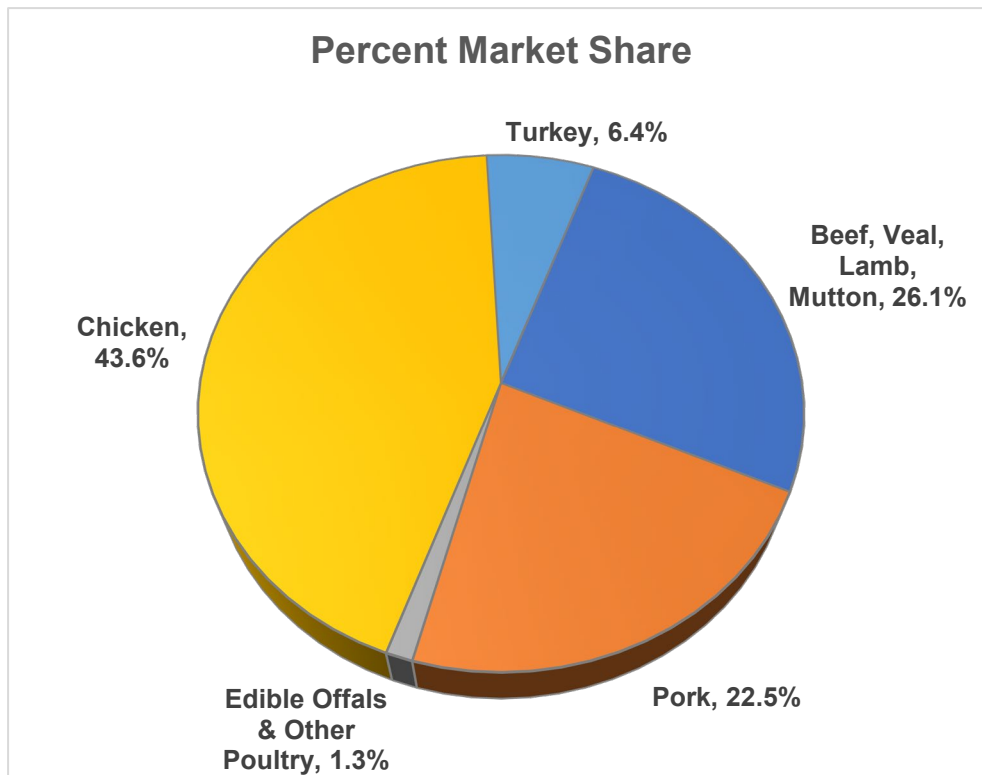
In the U.S., the “other poultry” (game birds) federally inspected category represented an estimated 569.3 million lbs. in 2022. According to the **USDA** and **National Chicken Council**, per capita consumption (carcass weight basis) in 2022 for “other poultry” was approximately 1.7 lbs. and is expected to remain the same through 2023.

In conclusion, in 2022, per capita consumption of red meat and poultry was 226.8 lbs. This is further broken down as follows: beef, veal, lamb and mutton at 59.1 lbs., pork at 51.1 lbs., chicken at 98.9 lbs., turkey at 14.6 lbs., other poultry at 1.7 lbs., and edible offal's at 1.4 lbs.

Please see Exhibit 3-1 for a graphic display of meat and poultry per capita consumption in the U.S. for 2022 by market share.

Exhibit 3-1

MEAT AND POULTRY PER CAPITA CONSUMPTION IN THE U.S. (2022)



Source: Mastio & Company Polyethylene Film Market Study, the USDA and National Chicken Council

Please see Exhibit 3-2 listing the top 25 meat and poultry companies along with their U.S. headquarters location and net sales (millions) for 2022.

Exhibit 3-2

TOP 25 MEAT AND POULTRY COMPANIES ALONG WITH THEIR U.S. HEADQUARTERS LOCATION AND NET SALES (MILLIONS) FOR 2022

Company Name and HQ Location	Net Sales (Millions)
Tyson Foods, Inc. (Springdale, Arkansas)	\$43,185
JBS USA (Greeley, Colorado)	\$39,300
Cargill Meat Solutions Corp. (Wichita, Kansas)	\$20,000
SYSCO Corp. (est. sales of custom meat operations) (Houston, Texas)	\$17,900 ¹
Smithfield Foods, Inc. (Smithfield, Virginia)	\$16,000 ¹
National Beef Packing Co., L.L.C. (Kansas City, Missouri)	\$11,600 ¹
Hormel Foods, Inc. (Austin, Minnesota)	\$11,386
Perdue Farms, Inc. (Salisbury, Maryland)	\$7,100 ²
OSI Group, L.L.C. (Aurora, Illinois)	\$6,100
ConAgra Brands, L.L.C. (Omaha, Nebraska)	\$6,000 ³
Sanderson Farms, Inc. (Laurel, Mississippi)	\$4,799
Koch Foods, L.L.C. (Pack Ridge, Illinois)	\$3,600 ²
American Foods Group, L.L.C. (Green Bay, Wisconsin)	\$3,100 ²
Oscar Mayer/Part of Kraft Heinz Co. (Chicago, Illinois)	\$2,650 ³
Foster Farms (Livingston, California)	\$2,500 ²
Mountaire Farms, Inc. (Millsboro, Delaware)	\$2,353 ¹
Wayne Farms, L.L.C. (Oakwood, Georgia)	\$2,200 ²
Greater Omaha Packing Co. (Omaha, Nebraska)	\$1,900 ²
Georgia's, Inc. (Springdale, Arkansas)	\$1,700
Seaboard Foods, L.L.C. (Shawnee Mission, Kansas)	\$1,609 ³
Butterball, L.L.C. (Garner, North Carolina)	\$1,500 ³
Boar's Head Provisions Co., Inc. (Sarasota, Florida)	\$1,300 ³
Wolverine Packing Co. (Detroit, Michigan)	\$1,300 ³
House of Raeford Farms, Inc. (Rose Hill, North Carolina)	\$1,300
Fresh Mark, Inc. (Massillon, Ohio)	\$1,210

¹ Company did not respond to the 2022 survey but provided information within two years prior.

² Estimated from other company reports or other published data.

³ Sales data estimated using most recent available information.

Source: Mastio & Company Polyethylene Film Market Study and The National Provisioner

Market and Product Specifications

At the slaughterhouse, primal cuts are packaged in large carcass covers or shrouds to help protect the meat from dust and debris while they are shipped in refrigerated rail cars or trucks. This PE film is typically constructed with a low density PE (LDPE) and linear low density PE (LLDPE) resin blend.

Sub-primal cuts of meat are packaged in barrier bags which are typically three-layer coextruded structures. LDPE-ethylene vinyl acetate (LDPE-EVA) copolymer and PVDC resins make up the layers typically in a LDPE-EVA copolymer/PVDC/LDPE-EVA copolymer structure. The PVDC resin provides the required oxygen barrier properties. The packaged meat is then placed under a vacuum and sealed until the film is shrunk around the meat. Other more sophisticated coextruded film structures can have as many as six or seven layers, which may consist of PE/tie-layer/nylon/ethylene vinyl alcohol (EVOH) copolymer/nylon/tie-layer/PE resins.

Sub-primal cuts of meat are transported from the slaughterhouse to retailers in barrier bags. It is very important to control the temperature and air exposure to prevent spoiling. After large meat cuts reach the retail level, it is cut into smaller pieces and packaged in tray overwrap. Small bags typically contain turkey, hams, steaks, and deli meats. The small bags would be covered in *Chapter 7 – Deli Bags and Wrap*.

At the food service level, film for large bags or pouches are commonly manufactured with LDPE-EVA copolymer (2.0% to 4.0% EVA content) for 10.0 and 25.0 lb. meat shipments. Meat patties for institutional use are also packaged in LDPE-EVA copolymer (2.0% to 4.0% EVA content) bags.

Preserving the freshness of red meat to delay spoilage is the purpose of oxygen barrier meat packaging. The color of red meat is an interpretation of freshness and depends on the presence of oxygen. At the consumer level, consumers do not like the looks of gray or blue beef on grocers' shelves. The red color is associated with the freshness of the meat, even though other technologies are being developed to maintain freshness without the red color.

Modified atmosphere packaging (MAP) is a technology that has been developed to ensure that packaged food products stay fresh and attractive for as long as possible. Some technologies, such as a peel-away oxygen barrier film, are utilized by grocery store personnel by peeling off the top oxygen barrier, causing the beef to change color within minutes from brown to red. This makes the meat more appealing to consumers. A benefit of case-ready and MAP packaging is to promote a longer shelf-life. MAP wrapped ground beef can last up to 14 days after the sell-by date versus three to four days for traditionally wrapped beef. This transfers into less food waste. Grocers can cut in-store labor and stock MAP meat for round-the-clock sales and three-day weekends. Gas flushed MAP allows grocers to sell uncooked fresh meat, marinated varieties, and ready-made meals for quick preparation at home. Furthermore, a central meatpacker using MAP may cut steps in the distribution chain. The process prevents localized surface contamination such as salmonella or E. coli bacteria, which minimizes a grocer's food-safety liability.

Offal products, such as feet, ears, hide, brains, kidneys, livers, tongues, sweetbreads, and intestines are packaged in non-shrink, non-barrier PE bags.

Chicken is typically packaged in parts, and large pieces continue to be processed further into boneless products. Poultry products, such as whole birds, are individually packaged in well fitted vacuum-shrink bags. The bags can be square bottom or round bottom bags which help prevent the bag from splitting and chicken juices from leaking. They can also be side-seal or end-seal bags. Poultry bags vary in size depending on what type of bird is placed in the package and the size of the bird.

Participants

Mastio & Company profiled 28 producers of PE film for the meat and poultry market. [REDACTED]

[REDACTED] of PE resin consumption for this market during 2022.

There have been some major changes with a few large PE film packaging giants. On May 2, 2023, **Sealed Air Corp.** officially changed their corporate brand to **SEE**. The goal is that **SEE** will continue to bring automation, digital and sustainability solutions together. They will have a new corporate brand and logo. There are plans in place to more than double their automation portfolio by 2027. They will add digital printing and online services to authorize brand owners to improve business performance. They expect over 80.0% of their sales to be transacted digitally by 2027. **SEE** will continue to bring customers sustainable materials and applications that reduce waste, extend shelf-life and reduce their carbon footprint.

Also, in May 2023, **Berry Global Group, Inc.** announced plans to close 15 sites across the globe as part of a cost cutting plan to improve efficiency. Demand for **Berry** products was modestly below expectations for the first half of the company's 2023 fiscal year, and this decision is to help offset the demand decrease. They will focus on internal growth versus acquisitions, internal cost-reduction efforts and inflation recovery. According to **Berry**, there is potential to increase production in eastern Europe to supply western Europe, India to supply elsewhere in Asia, and Mexico to produce products for North America.

Please see Exhibit 3-3 displaying names and locations of major PE meat and poultry film manufacturers. The parent company names are listed first, with the division names (where applicable) listed in parentheses. The number of locations was provided by the respondent and may or may not represent their total facilities.

Exhibit 3-3

NAMES AND LOCATIONS OF MAJOR NORTH AMERICAN
PE MEAT AND POULTRY FILM PRODUCERS

Company	Location	# of Plants
	Charlotte, North Carolina	3
	Toronto, Ontario, Canada	1
	Deerfield, Illinois	26
	Van Buren, Arkansas	1
	Evansville, Indiana	44
	Troy, Michigan	1
	Chicago, Illinois	14
	Carol Stream, Illinois	4
	Mount Pearl, Newfoundland, Canada	1
	Montreal, Quebec, Canada	3
	Hillside, New Jersey	1
	Tomball, Texas	1
	Monroe, Louisiana	1
	Bolton, Mississippi	1
	Johnstown, Colorado	1
	Hawthorn, New Jersey	1
	Hartsville, South Carolina	19
	Carol Stream, Illinois	2
	Brampton, Ontario, Canada	1
	North York, Ontario, Canada	1
Printpack, Inc.	Atlanta, Georgia	4
Sealed Air Corp. (SEE) (Cryovac Div.)	Charlotte, North Carolina	6
Sigma Plastics Group ¹	Pompano Beach, Florida	34
Sigma Plastics Group (Coastal Films of Florida Div.)	Jacksonville, Florida	1
	Summit, Mississippi	1
	Montreal, Quebec, Canada	7
	Richmond, Virginia	2
	Winnipeg, Manitoba, Canada	3

¹ Sigma Plastics Group includes all divisions of Sigma Plastics Group except Coastal Films of Florida Div.; Mercury Plastics of Canada, Inc. Div.; Republic Bag, Inc. Div.; and Sigma Stretch Corp. Div., which are each listed separately.

Source: Mastio & Company Polyethylene Film Market Study

Please see Exhibit 3-4 listing names and locations of other known North American PE meat and poultry film manufacturers.

Exhibit 3-4

NAMES AND LOCATIONS OF OTHER KNOWN NORTH AMERICAN PE MEAT AND POULTRY FILM MANUFACTURERS

Company	Location
API Industries, Inc. (Aluf Plastics, Inc. Div.)	Orangeburg, New York
Balcan Plastics Ltd.	Saint-Leonard, Quebec, Canada
Decker Plastics Corp.	Council Bluffs, Iowa
General Films, Inc.	Covington, Ohio
Hamilton Plastics, Inc.	Chattanooga, Tennessee
Manchester Packaging Co.	Saint James, Missouri
NorPlex, Inc.	Auburn, Washington
Poly Films, Inc.	Oklahoma City, Oklahoma
PPC Flexible Packaging, L.L.C.	Buffalo Grove, Illinois
Spectrum Plastics Group (PPC Industries, Inc. Div.)	Pleasant Prairie, Wisconsin
Valgroup	Findlay, Ohio

Source: Mastio & Company Polyethylene Film Market Study

Please see Exhibit 3-5 listing the producers of PE meat and poultry film with their market shares, volumes for 2022 and 2025, and the AAGR for each company.

Exhibit 3-5

ESTIMATED RESIN CONSUMPTION, MARKET SHARE, AND AAGR FOR PE MEAT AND POULTRY FILM BY NORTH AMERICAN PRODUCER 2022 AND 2025

	2022		2025		2022-2025 AAGR (%)
	Consumption (MM lbs.)	Market Share (%)	Consumption (MM lbs.)	Market Share (%)	
	191.9	25.8	206.7	25.5	2.5
	148.9	20.0	158.0	19.5	2.0
	111.1	14.9	119.6	14.7	2.5
	75.0	10.1	86.8	10.7	5.0
	42.8	5.8	46.1	5.7	2.5

		2022		2025		
		Consumption (MM lbs.)	Market Share (%)	Consumption (MM lbs.)	Market Share (%)	2022-2025 AAGR (%)
		18.8	2.5	20.5	2.5	3.0
		12.7	1.7	12.7	1.6	0.0
		9.6	1.3	12.8	1.6	10.0
		9.4	1.3	12.5	1.5	10.0
		8.8	1.2	9.7	1.2	3.2
		8.4	1.1	9.7	1.2	5.0
		7.4	1.0	8.0	1.0	2.5
		6.5	0.9	6.5	0.8	0.0
		5.8	0.8	5.8	0.7	0.0
		5.5	0.7	5.5	0.7	0.0
		5.5	0.7	5.9	0.7	2.5
		5.2	0.7	5.8	0.7	3.8
		3.7	0.5	4.0	0.5	3.0
		2.5	0.3	2.5	0.3	0.0
		2.5	0.3	3.1	0.4	7.5
		2.5	0.3	2.9	0.4	5.0
		2.2	0.3	2.2	0.3	0.0
		2.1	0.3	4.1	0.5	25.0
		1.7	0.2	1.8	0.2	2.3
		1.5	0.2	2.6	0.3	20.0
		0.5	0.1	0.5	0.1	0.0
		0.5	0.1	0.6	0.1	5.0
		0.4	0.1	0.5	0.1	10.0
		50.0	6.7	53.8	6.6	2.5
GRAND TOTAL						

Source: Mastio & Company Polyethylene Film Market Study

Growth Projection By Processor

The exhibit compares the processor’s company growth estimate with their overall market growth estimate. This table and the explanation for differences can be found in the electronic edition (file name: Growth Comparisons).

2022		2025		Explanation -Company & Market Growth/Decline
Consumption (MM lbs.)	Market Share %	Consumption (MM lbs.)	Market Share %	

Capacity Utilization By Processor

Please see the electronic edition (file name: Process Type, New Equipment and Capacity Utilization). An example of the table included in the electronic edition is provided below.

Processor Name/HQ Location	Operating Capacity 2022	Projected Operating Capacity 2023	Reason(s) for the Capacity Difference
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FACTORS AFFECTING THE MARKET

Please see the electronic edition (file name: Factors Affecting the Market), for all *Factors Affecting the Meat and Poultry Film Market by processor name and HQ location*. Topics discussed in the electronic edition include: film imports and exports for the market; key factors affecting growth or decline for the market and their company; challenges or threats the market faces (economy, imports, mergers and acquisitions, etc.); growth opportunities; environmental issues (recycling, biodegradable polymers, government/customer shareholder pressures, and design for recycle (D4R)); changes over the last two years (big historical events or market trends); solutions and goals for sustainability; number of resin formulations for an end-use market in order to have flexibility; new resin formulations or duplicating the existing resin formulation when purchasing a new film extrusion line; sources of market intelligence used to help grow business; and perfluoroalkyl and polyfluoroalkyl substances (PFAS) discussions. An example of some of the table headings included in the electronic edition is provided below.

Processor Name/HQ Location	Key Factors Affecting Market & Company Growth/Decline	Challenges & Growth Opportunities Faced in Markets Served	Changes Over the Last 2 yrs.	Environmental Issues & Sustainability Solutions	Resin Formulations for a Market or Duplicating for a New Line	Sources of Market Intelligence	PFAS Discussions
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In the U.S. meat and meat-packing industry, livestock marketing and prices are affected by weather patterns, livestock feed prices, federal import and export policies, the economy, population growth, and consumer demand. Since the mid-1970's, total U.S. per capita beef consumption has declined a little over 60.0%. Per capita consumption of beef reached an all-time high of 94.3 lbs. in 1976 when beef supplies were at record levels, due to the liquidation of the nation's beef herd. As mentioned earlier, per capita consumption of beef, veal, lamb and mutton in 2022 was 59.1 lbs. The decline is largely due to the relatively higher prices for beef versus other meats and the concerns about the health effects of diets heavy in fat-rich red meats. Saturated animal fats are suspected in the etiology of heart disease and certain types of cancer.

There are a few film companies expanding their salesforce, gaining better market visibility, and expecting or experiencing high rates of growth. However, many film extrusion companies today are less focused on expecting growth; instead, they are trying to remain profitable and not lose any production. A few companies stated they will remain stable or flat due to the introduction of tighter industry standards. Legislation is hindering their business because manufacturers must spend more money on certifications, which is not cost effective due to low production. However, processors have a long-term commitment to food safety and quality management systems.

Participants stated the unemployment rate, shortage of quality laborers, rising energy prices, and power outages have negatively affected the meat and poultry film market. According to the **Congressional Budget Office (CBO)**, the unemployment rate is projected to increase from 3.6% at the end of 2022 to 5.1% at the end of 2023 before gradually declining to 4.5% by the end of 2027.

Capital expenditures, expansions, and acquisitions will allow more growth for some companies. However, a few film processors claim that real estate has been extremely expensive and long lead times for purchasing equipment have been major factors that will not allow for growth. Another processor claims that growth is hindered because they cannot export products due to the high cost of freight. Higher freight costs and fuel surcharges have prohibited expansion and worsened with the onset of COVID-19. Today, COVID-19 has run its course and processors are finding ways of going back to normal.

Some participants feel that most syndicated market research for the food industry has growth rates that are too high. Growth rates can be dependent on their placement within a store. For example, in the perimeter of the grocery store some industry sources see the food and packaging markets growing at a 2.0% to 3.0% compounded annual growth rate. However, consumer packaged goods in the center of the store are growing less. One processor states that meat and poultry continues to be all the rage and remain a strong center-of-plate choice. Most of the meat and poultry film extrusion companies believe they will grow at a rate between 2.0% and 5.0% over the next three years. The challenge for many participants is the lack of resources to expand and produce innovative packaging that will keep customers coming back to them.

The few companies experiencing a double-digit AAGR are increasing capacity, gaining better market visibility, upgrading, and installing new extrusion equipment, focusing on the coextrusion film process, building goodwill within the industry, having valued supply chain partners that are committed to helping with growth, and producing more sophisticated food packaging.

The Economy

Industry economists claim that plastics do well when the economy does well, and plastics don't do well when the economy doesn't do well. Furthermore, the current and sluggish state of the North American economy, along with inflation, have a direct effect on consumer consumption of meat, fish, and poultry and therefore its packaging. The meat and poultry industry feeds our economy. Store promotions, restaurant promotions, and consumer interest in upscaled meat purchases also affect the meat and poultry market.

According to the **USDA**, in July 2021, U.S. President Biden signed an executive order to help promote competition in the economy. Industry analysts claimed to see too many industries become dominated by a handful of large companies that control most of the business and most of the opportunities, thus raising prices and decreasing options for American families and entrepreneurs.

According to the opinions of the **Biden-Harris administration** and **USDA**, the meat and poultry processing business is an example of a lack of competition hurting consumers, producers, and the economy. Four large meat-packing companies control 85.0% of the beef market. In poultry, the top four processors control 54.0% of the market. And in pork, the top four processors control about 70.0% of the market. The meatpackers and processors buy from farmers and sell to retailers like grocery stores, making them a key bottleneck in the food supply chain. When dominant middlemen control so much of the supply chain, they can increase their own profits at the expense of both farmers (who make less) and consumers (who pay more). Economists claim that when too few companies control such a large portion of the market, the U.S. food supply chains are susceptible to shocks. When COVID-19 or other disasters such as fires or cyberattacks close a plant, many ranchers and farmers have no other place to take their animals. The excessive reliance on just a handful of large processors leaves everyone vulnerable, with disruptions rippling throughout the food chain.

For many meat and poultry film processors, growth continues to remain in line with real gross domestic product (GDP) (real-GDP is adjusted to remove the effects of inflation) at around 3.0%. According to the **CBO**, inflation was higher in 2021 and 2022 than in any other years of the previous four decades at 5.7% and 5.5% respectively, as measured by the price index for personal consumption expenditures. The annual growth of that price index is projected to remain above the **Federal Reserve's** long-term goal of 2.0% through 2024 and then fall near to that goal by 2026.

At the height of COVID-19, resin prices were volatile. Resin prices reached an all-time high many have not experienced in 25 years. Recently, resin prices have started a downward trend, closing in on pre-COVID-19 pricing.

Government Regulations

Meat and poultry film producers must follow guidelines set by several organizations including the **Occupational Safety & Health Administration (OSHA)**, the **FDA**, the **Canadian Food Inspection Agency (CFIA)** and the **International Standards Organization (ISO 9000)**.

It is essential for food packaging manufacturers to demonstrate to the **FDA** that all materials encountering food are safe before being authorized for use. If a substance is added to a food for a specific purpose, it is referred to as a direct additive. Indirect food additives are those that become a part of the food in trace amounts due to its packaging, storage, or other handling requirements. Any substance implemented in the production, processing, treatment, packaging, transportation, or storage of food, which affects the characteristics of any food, must be pre-approved by the **FDA**.

Environmental Issues

Many film processors, including meat and poultry participants, continue to lean towards recycling and sustainability, trying to make the environment a better place while meeting consumer demands for sustainability. Film processors even anticipate government initiatives and consumer demand to drive the requirement for sustainable options. In the past, the **FDA** has prohibited the use of post-consumer resin (PCR) in all food packaging markets; therefore, most meat and poultry film manufacturers are recyclers of internal PE film scrap to be utilized in nonfood markets such as mattress covers, sand and salt bags, and garbage bags. Additionally, it has also been a tremendous challenge to find and purchase PCR materials for meat and poultry film processors who also produce nonfood film products. Many participants stated that the price of PCR resin doubled in the past few years. This could be caused partly by some film manufacturers sending their scrap to be recycled and returned to themselves for nonfood use instead of selling their scrap to be recycled and sold in the marketplace.

During 2023, **Chevron Phillips Chemical (CPChem)** introduced a new material called Marlex[®] Anew[™] Circular PE, which is made using an advanced recycling technology and is certified through the *International Sustainability and Carbon Certification PLUS (ISCC PLUS)* process. **CPChem** claims that this process uses pyrolysis oil, made from difficult-to-recycle waste plastics, as a feedstock to produce a circular PE with characteristics identical to **CPChem's** original Marlex[®] PE.

Circular PE is expected to reach the U.S. market very soon with **Charter Next Generation, Inc.** utilizing this material in some of their major film product markets. This new material is designed primarily for food and consumer packaging films. Its characteristics help preserve food, keep medical instruments secure and sterile, and supply lightweight and durable packaging properties. For a little more than a decade, **Charter Next Generation, Inc.** has used recycled content as a part of several food and consumer packaging films. In 2023, **Charter** announced *ISCC PLUS* certification at their Lexington, Ohio plant, which serves key markets such as paper and personal care overwrap for towel and tissue, fresh produce, frozen foods, meat and poultry, e-commerce, and more.

Although there is much talk around sustainability and less use of plastic products in the market, optimists conveyed that COVID-19 showed, from a traditional standpoint, that plastics have a place. Temporarily, COVID-19 helped reduce some of the attacks on food packaging.

Air and water quality concerns have led to the establishment of emission regulations for the printing of plastic film. The regulations require companies to capture or eliminate airborne solvents while using solvent-based inks in their printing processes. Greater use of water-based inks provides a more feasible solution to this issue.

Sustainability Issues

Sustainability is a term that many companies are using more frequently. Some extrusion companies have already been implementing sustainable practices, such as recycling, for decades. They have done this by reducing the amount of material used in production, re-using most of their internally generated waste, producing film from food-grade post-consumer resins, and reclaiming material through collection programs for post-consumer and post-industrial recycling. Sustainability has been such a big focus that nearly all film processors are trying to figure out how to present what they do in a sustainable light.

Sustainability has resulted in discussions around biodegradable materials (bioresins). The term “biodegradable” refers to the degradation process of plastic waste. Consumers like the idea of biodegradable products until learning about the higher price of the material used to produce biodegradable film. Many companies that produce meat and poultry film may also produce other PE films that utilize biodegradable materials.

In a report published in March 2023, the White House **Office of Science and Technology Policy (OSTP)** outlined bold goals for helping the U.S. become a leader in bioeconomy technology. President Joe Biden’s administration is setting goals of replacing 90.0% of fossil-fuel based plastics with biobased alternatives over the next 20 years.

Please see Exhibit 3-6 listing North American meat and poultry PE film producers along with their sustainability solutions.

Exhibit 3-6

NORTH AMERICAN MEAT AND POULTRY PE FILM PRODUCERS AND THEIR SUSTAINABILITY SOLUTIONS

Company	Sustainability Solution
[REDACTED]	Minimizes the environmental impact of their operations. Whenever possible, they utilize PCR resin, PIR resin, or sustainably sourced plant-based feedstocks for extruding film. With their multi-layer extrusion capabilities, they continue to make strides to reduce the amount of plastic used in their products.
[REDACTED]	Utilizes plant-based resins and exploring that market.
[REDACTED]	Has pledged by 2025 to have everything recyclable or recycle-ready. Introduced EcoGuard™ technologies and products, which include diverse packaging solutions that deliver sustainability benefits such as: recycle-ready packaging, lower carbon footprint, containing recycled content, and using biomaterials or other similar materials.

Company	Sustainability Solution
[REDACTED]	<p>Researching samples and trials for both plant-based and compostable resins. Testing PCR resin. Recycles 100.0% of scrap film, repurposes all printed film scrap, and recycles all corrugated and plastic waste materials. Accurately reduces and measures the ink in their printing equipment to decrease chemical consumption. Reclaims 100.0% of residual ink during production.</p>
[REDACTED]	<p>Continuously involved with sustainable projects and has a three-year plan to reach sustainability goals. Minimizing and downgauging is important corporate-wide. Supplies “green films” and purchases “green” PE from Braskem. Spends millions of dollars in the sustainability movement and part of the Alliance to End Plastic Waste. Constantly researches and develops new structures to reduce their carbon footprint.</p>
[REDACTED]	<p>Has environmentally friendly manufacturing practices and access to the latest in sustainable material technology. Focuses on innovative and meaningful solutions that are safer for the environment. Uses only water-based or solventless printing and lamination systems. Developed a wide range of sustainable products and tested them in a variety of different packaging applications. A part of a USDA Bio-Based Program.</p>
[REDACTED]	<p>Offers the GreenArrow™ platform of sustainable films designed to power a new generation of sustainable, flexible packaging without the trade-off in performance. Reduced carbon footprint and greenhouse gas (GHG) emissions. Use of PCR resins and a new material by CPChem called Marlex® Anew™ Circular PE, which is made using an advanced recycling technology. Announced ISCC PLUS certification at their Lexington, Ohio plant, which serves many markets. Converts multi-material, unrecyclable packaging into recyclable store-drop off approved formats. Helps brand owners reach their long-term sustainability goals. Makes high density PE (HDPE), low density PE (LDPE), and linear low density (LLDPE) films with high content of food-grade PCR.</p>
[REDACTED]	<p>They have a closed-loop system, and all scrap resin is recycled, cardboard is recycled, water is recycled, and skids are taken away.</p>

Company	Sustainability Solution
[REDACTED]	<p>Operates in compliance with all relevant federal, provincial/state, and municipal environmental regulations. At each stage of their operations, strives to reduce all waste and pollutants at the source; thereby reducing environmental impacts. Encourages employees, through training and educating, the importance of minimizing the negative impacts on the environment. Avoids unnecessary use of hazardous materials and products, seeks substitutes whenever possible, and takes all reasonable steps to protect human health and the environment when hazardous materials must be used, stored, and recycled. Strives to continually improve environmental performance by a periodic evaluation and compares these with their objectives. Educates suppliers and sub-contractors about their environmental awareness.</p>
[REDACTED]	<p>Takes the same approach to sustainable options and biopolymers that they do with more traditional products. Uses less material and has a lower carbon footprint from sourcing, fabrication, and transportation. Reuses scrap in nonfood film markets, minimizing waste. Has recycling stations in their plant and office to recycle as many cans, bottles, and paper as possible. Installing a recycling line at their plant. Testing compostable materials on cast film lines.</p>
[REDACTED]	<p>Uses PIR and PCR materials.</p>
[REDACTED]	<p>Primary outlook is to recycle at all times and has been since the 1960's before it was a hot topic. Looking at new recycling equipment and has a new warehouse for this equipment.</p>
[REDACTED]	<p>Involved in How2Recycle, How2Compost, Forest Stewardship Council, Sustainable Forestry Initiative, Biodegradable Product Institute, Compost Manufacturing Alliance, and American Society for Testing Materials (ASTM). Has a 100,000 sq. ft state-of-art recycling facility in Shawano, Wisconsin to sort, shred, wash and pelletize post-consumer film scrap, which redirects over 13.0 MM lbs. of post-consumer film scrap from the landfills back into reusable industrial packaging. Participates in the Leadership in Energy and Environmental Design (LEED) program and meets the Environmental Protection Agency (EPA) Comprehensive Procurement Guidelines. Compliant with California state requirements put forth by CalRecycle for regulation of plastic trash bags. Meets Washington state PCR inclusion requirements for 2023. ASTM D6400 and Biodegradable Plastics Institute certified for compostability. Uses bioplastic materials. Vision rests on three pillars that support efforts to achieve ambitious environmental, social, and governance goals. Established a 30.0% reduction target for 2030 against the 2019 baseline as part of a Sustainability-Linked Financing Framework.</p>

Company	Sustainability Solution
[REDACTED]	Qualified for PCR usage, thus lowering consumption of fossil fuel sources of energy by using solar arrays. Formulating materials allow for reduction in material consumption. Recycles and creates recyclable products.
[REDACTED]	Tries to keep their carbon footprint down by using the right recyclers. Uses PCR and additives/compatibilizers for lightweighting and downgauging.
[REDACTED]	Recycles all scrap back into their products. Has the following goals to aid in having a small carbon footprint: a 20.0% real reduction in the amount of waste to landfills, increase recycling in all plants from 80.0% to 85.0%, reduce intensity factor for energy 1 per ton production by 10.0%, reduce GHG emissions by 10.0%, reduce intensity factor for hazards waste generated in production by 10.0%, and reduce intensity factor for water usage by 15.0%.
[REDACTED]	A solutions company with plans to continue to bring automation, digital and sustainability solutions together. Machinery technology continues to evolve with new, state-of-the-art components and engineering designed to reduce energy consumption and improve customer productivity and efficiency. Reduces the amount of leftover scrap that commonly results from creating pre-formed flexible packaging. Scrap that does remain is re-used for internal recycled film. Offers their customers a cost-effective and environmentally responsible alternative to virgin films. All facilities worldwide adhere to their local and regional environmental laws and standards. Lean manufacturing processes and quality management systems minimize waste and resource consumption in production. Dry mixed recycling efforts have resulted in more than a 50.0% reduction of everyday waste. Has recycling bins throughout their facilities for used products to be sent directly to recycling facilities instead of going to landfills. Leading the packaging industry in creating a more environmentally, socially, and economically sustainable future. Pledged to design or advance 100.0% of their packaging materials recyclable or reusable by 2025, with a bolder goal to reach net-zero carbon emissions in their global operations by 2040.
[REDACTED]	“Green for 3 Sustainability” (Reuse, Reduce, Recycle) Program for flexible packaging manufacturing at their facilities, reducing waste and choosing renewable resources. Reusing materials, including PIR and PCR co-ex and secondary packaging fit. Reducing waste by innovative technology improvements that make thinner films with equal functionality and reducing size and gauge through a “right sizing” program. Recycling wherever and whenever possible.
[REDACTED]	Recycles 100.0% of their industrial scrap. Sampling several types of PCR from several different suppliers.

Company	Sustainability Solution
[REDACTED]	Utilizes closed-loop reprocessed resins. Personnel are exposed to sustainability best practices and understanding of how to apply sustainability to the business to limit risk, open new opportunities, and drive innovation. In June of 2022, personnel went through sustainability training over the course of five months. The committee meets periodically to update progress and seek out new actions to add value to the business. Sustainability is an agenda item at every board-level meeting to chart progress, minimize risk and seek out new opportunities.
[REDACTED]	Integritite™ PCR collation bundling films are made to have a lower environmental impact while providing excellent machinability. By incorporating PCR waste into their films, they have created a sustainable solution that delivers strength, protection, and shelf appeal without sacrificing quality. Through investment, technology, research & development, supply chain partnerships, and innovation, their teams are working with great intensity to solve the challenge of plastic waste. Working to ensure that they meet their 2025 goals whereby all their products are sustainable. Growing in PCR and making their own recycled resins in Montreal, Quebec.
[REDACTED]	Has goals to develop landfill-free initiatives, manage waste streams and ensure all air and water emissions meet regulatory requirements. Uses all PIR scrap internally.
[REDACTED]	Meeting the needs of customers asking for sustainable solutions. Has a Corporate Sustainability Director assigned to each site whose role is to steward their products and environmental impact and messaging. 40.0% of converter films sold are recycle-ready. Eliminates waste in their products and processes.

Source: Mastio & Company Polyethylene Film Market Study and Individual Participants' Websites

Imports and Production Shifts from U.S. and Canada

In 2003, China banned U.S. beef imports following concerns about bovine spongiform encephalopathy. The shipment was brought in by **Cofco Meat Holdings Ltd.** from **Tyson Foods, Inc.** It was not until May of 2017 that the Chinese government agreed to resume accepting U.S. beef imports. China processed the first shipment of beef from the U.S in July of 2017.

According to the **USDA**, red meat and poultry products from slaughter also contribute to the positive trade balance in agriculture. However, shipping challenges and a sluggish global economy (especially in the wake of the COVID-19 pandemic) limited greater export and import volumes. In 2022, the U.S. exported \$11.7 billion in beef. South Korea was the top destination at \$2.7 billion, Japan followed with \$2.3 billion, and China with \$2.2 billion.

According to the **USDA Foreign Agricultural Service**, in 2022, the U.S. produced 11.0% of the world's pork. U.S. pork exports surpassed \$7.7 billion in value. In total, more than 2.5 million metric tons of pork was exported to other markets.

According to the **National Chicken Council**, a little over 7.3 billion lbs. of broilers were exported in 2022. The **USDA** claims that China continues to demonstrate its importance to boosting U.S. poultry and poultry product exports. Most shipments are chicken paws, a product for which there is virtually no other major market. U.S. exports of chicken paws to China accounted for 13.0% of total U.S. poultry and product exports in 2021. For the poultry sector, during the past few years, the U.S. continued to face market access issues in South Korea, South Africa, and Saudi Arabia due to non-tariff barriers and purported sanitary issues. Additionally, competition from Brazil (the leading world exporter) continues to be strong in many markets.

In terms of packaging, it is difficult for U.S. plants to compete with the cheap labor and land costs that Asian countries have to offer. However, some film markets are said to continue to grow and remain "China-proof" if they can shorten lead times and make high-end quality products. As film complexity increases, it can result in fewer competitors and higher profit margins.

Mergers and Acquisitions

A few acquisitions have occurred in the meat and poultry film market over the past few years. **Charter NEX Films, Inc.** merged with **Next Generation Films, Inc.** and no longer operates as separate entities. Today, they are referred to as **Charter Next Generation, Inc.** In August 2022, **Charter Next Generation, Inc.** also announced the acquisition of **Polymer Film & Bag, Inc.** of Massillon, Ohio, which serves the food service and industrial coextrusion film markets.

In February 2023, **Sealed Air Corp. (SEE) (Cryovac Div.)** completed the acquisition of **Liqui-Box Corp.**, a leader, innovator and manufacturer of bag-in-box liquids packaging and dispensers for fresh food, beverage, consumer goods and industrial end-markets. The acquisition accelerates **SEE's** fastest growing market segment, which is their **Cryovac®** brand fluids and liquids business.

Although **Spectrum Plastics Group** is represented in the *Others Exhibit 3-4*, they have expanded their blown film capacity. They added new capabilities with the acquisition of **KCS Plastics** in 2021, which is based in Langley, British Columbia, Canada. Prior to that, **Spectrum Plastics Group** closed on the acquisition of **PeelMaster Medical Packaging Corp.** in December 2020, which is based in Niles, Illinois. **PeelMaster** is a converter, and they produce pouches, header bags and die cut lids for medical applications. Since the acquisition of **PeelMaster**, **Spectrum Plastics Group** was granted "Authorized Converter" status from **DuPont Co.** In May 2023, **DuPont Co.** was working on an agreement to acquire **Spectrum Plastics Group**. The transaction is expected to close by the end of the third quarter of 2023, subject to regulatory approvals and other customary closing conditions.

In December 2020, **PPC Flexible Packaging, L.L.C.** of Alliance, Ohio, acquired **Custom Poly Bag, Inc.** **Custom Poly Bag, Inc.** is the sixth acquisition of specialty and differentiated flexible packaging firms by **PPC** in the past three years. All businesses have been successfully integrated into the **PPC Flexible Packaging, L.L.C.** enterprise.

New Designs and Technological Trends

Most of the meat and poultry film extrusion companies are continuing to promote growth through improved technology, high quality materials, good customer service, and attaining the image of being sustainable. Innovation with stronger materials and lighter gauges are still as important today as they were years ago.

Meat and poultry film still incorporate the following market drivers: promoting product freshness, increasing shelf-life extension, preventing food spoilage, and optimizing packaging (both gauge and performance). Currently, there are some active packaging opportunities that a few companies are looking into, such as increasing the recyclability of meat, poultry, and cheese packaging or incorporating more PE layers into the packaging. One participant states they are trying to put together a package in many food markets where PE resin makes up the outside and inside layers of the film structure. If this happens, PE resin may grow another 1.0 billion lbs.

FILM EXTRUSION TECHNOLOGY

During 2022, PE film for meat and poultry packaging was produced by the blown film and cast film extrusion processes and consisted of monolayer and multi-layered coextruded structures.

Coextruded film remains the dominant structure used to manufacture meat and poultry film. Most companies typically coextrude three or five layers; however, some companies have the capabilities to coextrude two to thirteen layered film structures. Coextruded film structures offer additional barrier properties that monolayer films cannot provide. Highly layered films are tailored to create specific levels of barrier properties for meat and poultry packaging. This helps keep oxygen or ultraviolet (UV) light out and flavors intact. A common seven-layer coextruded film structure produced for meat and poultry consists of outer PE layers followed by tie-layers, adhering the nylon layers and incorporating a middle layer of EVOH copolymer resin. The following tables show a three-layer and a seven-layer meat and poultry film structure:

Three-Layer Structure
PE Blend
PVDC or PVC
PE Blend

Seven-Layer Structure
PE
Tie-layer
Nylon
EVOH Copolymer
Nylon
Tie-layer
PE

Sealed Air Corp. (SEE) (Cryovac Div.), Charter Next Generation, Inc., and ABX Innovative Packaging Solutions, L.L.C. have gone beyond nine layers by creating an eleven-to-thirteen-layer structure, but only by self-laminating or “collapsed surface welding” a tube of six or seven layers into a single flat web.

Please see Exhibit 3-7 displaying estimated resin consumption and market share for the types of film extrusion processes and constructions utilized in the meat and poultry film market for 2022 and comparison film extrusion process market shares from 2019.

Exhibit 3-7

BREAKDOWN OF RESIN CONSUMPTION FOR PE MEAT AND POULTRY FILM BY PROCESS TYPE AND FILM CONSTRUCTIONS

	2022		2019
	Consumption (MM lbs.)	Market Share (%)	Market Share (%)
Film Extrusion Process			
Blown Film Extrusion		89.6	86.4
Cast Film Extrusion		10.4	13.6
Totals		100.0	100.0
Coextruded Film Constructions		89.9	90.7
Monolayer Film Constructions		10.1	9.3
Totals		100.0	100.0

Source: Mastio & Company Polyethylene Film Market Study

Equipment Utilization and New Equipment Purchases

Please see the electronic edition (file name: Process Type, New Equipment and Capacity Utilization). An example of the table included in the electronic edition is provided below.

Processor Name/HQ Location	Description of Process Type	Plans to Purchase New Film Extrusion Equipment	Brand and Equipment Type of Planned Purchases

RESIN TECHNOLOGY

LLDPE resin continues to be the most prevalent in this market because it offers better downgauging capabilities than LDPE resin. Film producers in the meat and poultry film market utilized all grades of LLDPE resins including LLDPE-butene, LLDPE-hexene, LLDPE-super hexene, LLDPE-octene, and mLLDPE. mLLDPE resin is more tear resistant, has good puncture resistance, good impact properties, and sealability. mLLDPE resin is the highest grade of LLDPE resin, due to its superior strength allowing further film downgauging, thus reducing costs and source reduction to landfills.

Specific types of PE resins and film configurations are used in meat and poultry film for specific packaging requirements. Meat barrier bags for beef are typically comprised of a three-layer coextruded structure of LDPE-EVA copolymer/PVDC/LDPE-EVA copolymer resins.

Offal products, such as liver or sweetbreads, are typically packaged in a LDPE non-shrink PE bag. The primary purpose of the bag is to protect the organs from freezer burn. Most pork is packaged in PE non-barrier bags made of LDPE and LLDPE film. Processed pork is often packaged in barrier bags with a high LDPE-EVA copolymer resin content.

Poultry bags for turkey are typically constructed with a three-layer coextruded structure of LDPE-EVA copolymer/LLDPE/LDPE-EVA copolymer resins. The LDPE-EVA copolymer layers give the bag clarity, sparkle, an improved printing surface, and the inner layer of LLDPE provides additional strength.

In the past, a few processors utilized LDPE-ethylene acrylic acid copolymer (LDPE-EAA copolymer) resin, also referred to as ionomer resin (Surlyn™ supplied by **DuPont**). However, LDPE-EAA copolymer resin was not reported by meat and poultry film processors since some companies have replaced LDPE-EAA copolymer resin with mLLDPE resin. mLLDPE is less expensive and offers clarity, downgauging, seal strength and toughness while maintaining nearly the same processability of LDPE, and the grease resistance equivalent to ultra low density PE (ULDPE). LDPE-EAA copolymer resin is still a choice of material used, and it has high seal strength, low temperature heat seals, transparency, high shrink force at low temperatures, reduced leakage rate, and outstanding puncture, abrasion, and tear resistance. LDPE-EAA copolymer resin is typically coextruded with LDPE-EVA copolymer, LLDPE, nylon, and PVDC resins.

High molecular weight-HDPE (HMW-HDPE) and medium molecular weight-HDPE (MMW-HDPE) resins are occasionally utilized for meat and poultry applications due to their strength and excellent barrier properties.

Nylon and EVOH copolymer resins are used along with PE resin for meat and poultry packaging. Nylon resin is used as a barrier resin for hermetic seal (no leaks), temperature resistance, and oxygen migration. EVOH copolymer resin is used as the inner layer of coextruded meat and poultry bags, providing superior oxygen and gas barrier properties while keeping out odors.

Other resins reported included PE-based adhesive resin (tie-resin), PVDC resin, medium density PE (MDPE), ULDPE, and very LDPE (VLDPE) resin. PVDC film properties include ease of use, clarity, and low cost. Although not evident in 2022, a few participants sometimes utilize **ExxonMobil's** Vistamaxx™ propylene-based elastomer instead of ULDPE resin. Vistamaxx™ performance polymers are semi-crystalline copolymers with adjustable amorphous content that is compatible with other polyolefins. This versatility allows companies to tailor end-product attributes, such as: toughness, cling, sealability, softness, clarity, dispersion, adhesion, elasticity, and flexibility.

VALUE-IN-USE

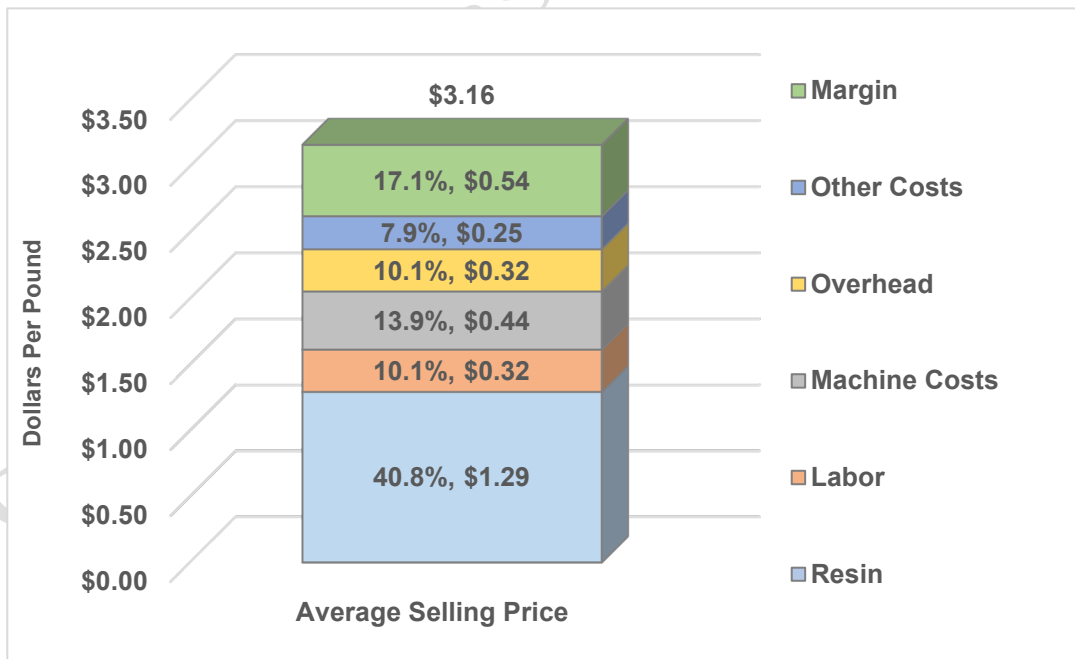
Meat and poultry packaging is a specialty application and requires lengthy approval times for product development. The average selling price of meat and poultry packaging will increase as other resins and layers, such as LDPE-EVA copolymers, EVOH copolymers, and nylon resins are incorporated into the films.

For the first value-in-use analysis, **Mastio & Company** will present a cast coextruded (seven, nine or eleven layers) [REDACTED] utilizing a combination of LLDPE-octene and mLLDPE (50.0%), LDPE-homopolymer (20.0%), nylon and EVOH copolymer materials used for core and barrier properties (20.0%), and PE-Adhesive as tie layers (10.0%). T [REDACTED]

Please see Exhibit 3-8 illustrating the value-in-use analysis for a [REDACTED]

Exhibit 3-8

VALUE-IN-USE ANALYSIS FOR A COEXTRUDED [REDACTED]



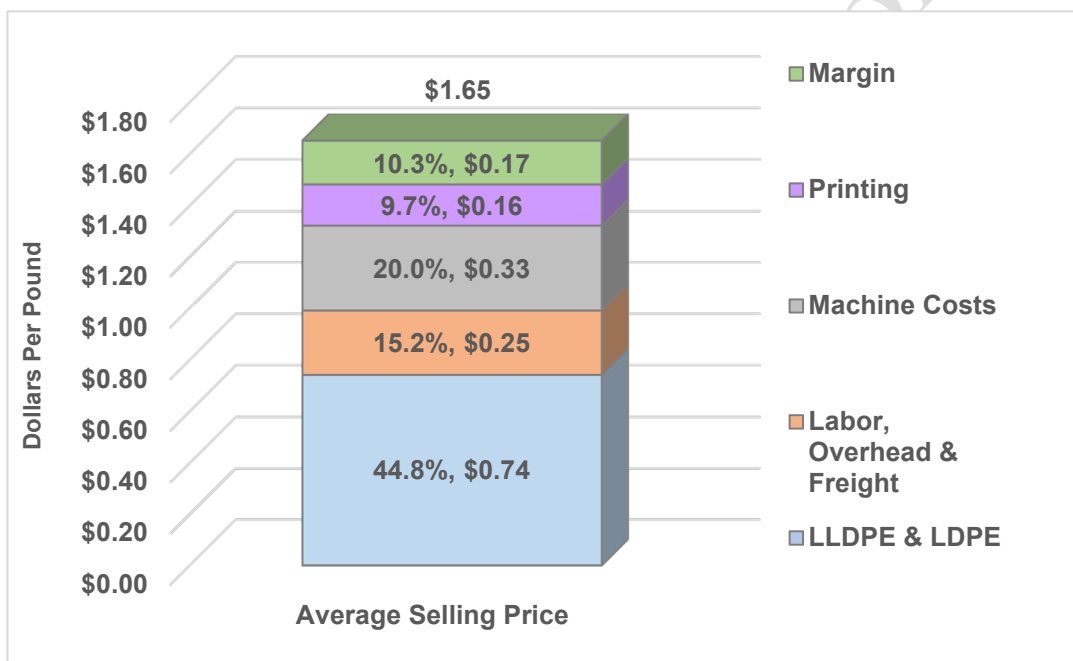
Source: Mastio & Company Polyethylene Film Market Study

For the second value-in-use analysis, **Mastio & Company** will present a blown monolayer roll of [REDACTED] utilizing a LLDPE-octene (70.0%) and LDPE-homopolymer (30.0%) resin blend. The average selling price is approximately \$1.65/lb. The weighted industry average cost of LLDPE-octene resin was \$0.74/lb., and LDPE-homopolymer resin was \$0.73/lb. resulting in the total average resin cost to be \$0.74/lb.

Please see Exhibit 3-9 illustrating the value-in-use analysis for a [REDACTED]

Exhibit 3-9

VALUE-IN-USE ANALYSIS FOR A MONOLAYER ROLL OF [REDACTED]



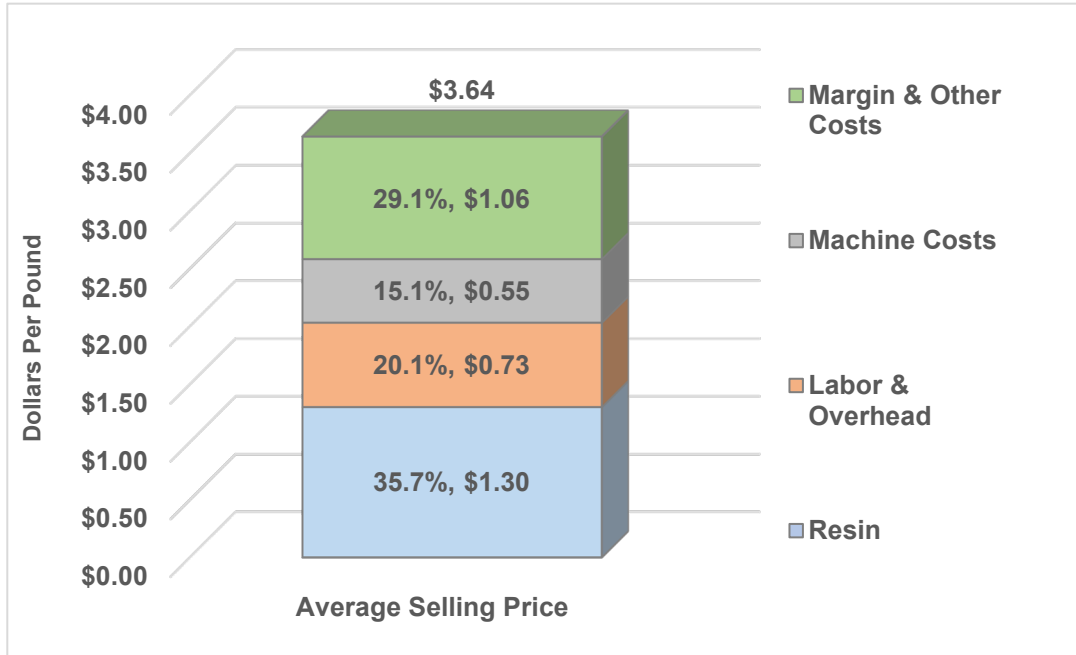
Source: Mastio & Company Polyethylene Film Market Study

For the third value-in-use analysis, **Mastio & Company** will present a blown coextruded (three to nine layers), [REDACTED] utilizing a combination of LLDPE-octene (20.0%), mLLDPE (10.0%), LDPE-homopolymer (40.0%), LDPE-EVA copolymer (10.0%), and nylon and EVOH materials used for barrier properties (10.0% each). This product sells for an average price of approximately \$3.64/lb. The weighted industry average cost of LLDPE-octene resin was \$0.91/lb., mLLDPE resin was \$0.74/lb., LDPE-homopolymer resin was \$0.74/lb., LDPE-EVA copolymer resin was \$1.10/lb., EVOH copolymer resin was \$3.92/lb., and nylon was \$2.52/lb. resulting in the total average material cost to be approximately \$1.30/lb.

Please see Exhibit 3-10 illustrating the value-in-use analysis for a [REDACTED]

Exhibit 3-10

VALUE-IN-USE ANALYSIS FOR A COEXTRUDED



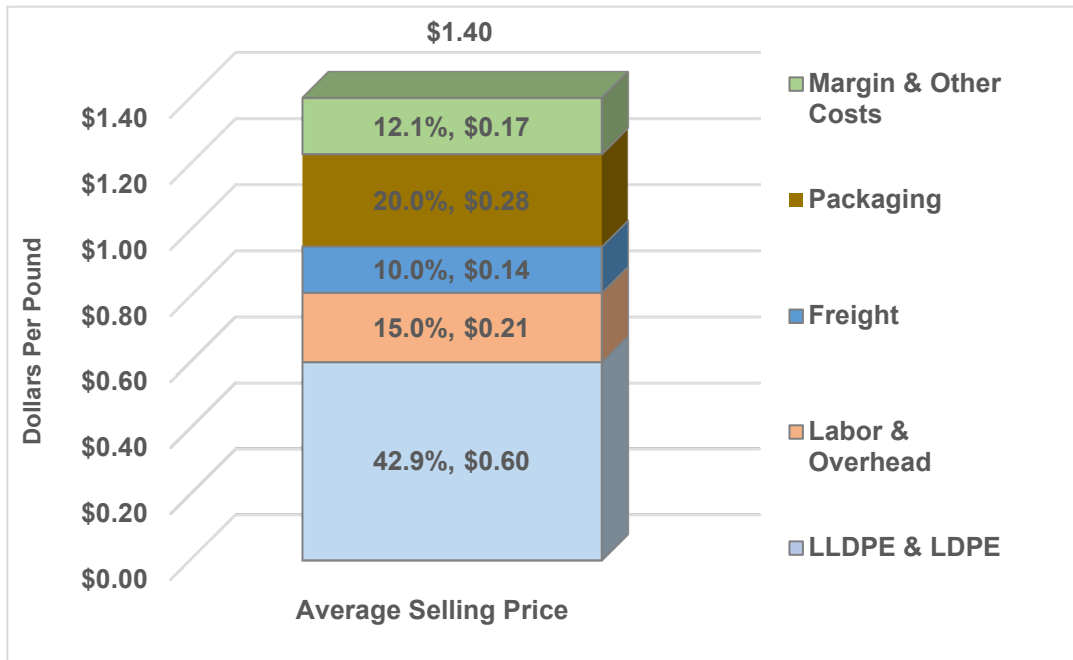
Source: Mastio & Company Polyethylene Film Market Study

For the last value-in-use analysis, Mastio & Company will present a [REDACTED] utilizing a LLDPE-hexene (60.0%) and LDPE-homopolymer (40.0%) resin blend. This product sells for an average price of approximately \$1.40/lb. The weighted industry average cost of LLDPE-hexene resin was \$0.58/lb., and LDPE-homopolymer resin was \$0.62/lb. resulting in the total average resin cost to be \$0.60/lb.

Please see Exhibit 3-11 illustrating the value-in-use analysis for a [REDACTED]

Exhibit 3-11

VALUE-IN-USE ANALYSIS FOR A [REDACTED]



Source: Mastio & Company Polyethylene Film Market Study

FORECAST OF RESIN USE AND CONSUMPTION

Total PE resin consumption in 2022 for meat and poultry film was [REDACTED] MM lbs. and is projected to increase to [REDACTED] MM lbs. by the year 2025, with an AAGR of 2.9%.

Please see Exhibit 3-12 displaying the forecast of resin use and consumption for meat and poultry film, by resin type, for 2022 and 2025.

Exhibit 3-12

FORECAST OF RESIN USE AND CONSUMPTION, MARKET SHARE, AND AAGR
FOR MEAT AND POULTRY FILM BY RESIN TYPE
2022 AND 2025

Resin	2022		2025		2022-2025 AAGR (%)
	Consumption (MM lbs.)	Market Share (%)	Consumption (MM lbs.)	Market Share (%)	
mLLDPE					
LLDPE-octene					
LLDPE-butene					
LLDPE-hexene					
LLDPE-super hexene					
Total LLDPE					
LDPE-homopolymer					
LDPE-EVA copolymer					
Total LDPE					
MMW-HDPE					
HMW-HDPE					
Total HDPE					
EVOH copolymer					
Nylon					
VLDPE					
PVDC					
PE-Adhesive					
MDPE					
ULDPE					
GRAND TOTAL					

* Market share not shown due to rounding.

Source: Mastio & Company Polyethylene Film Market Study