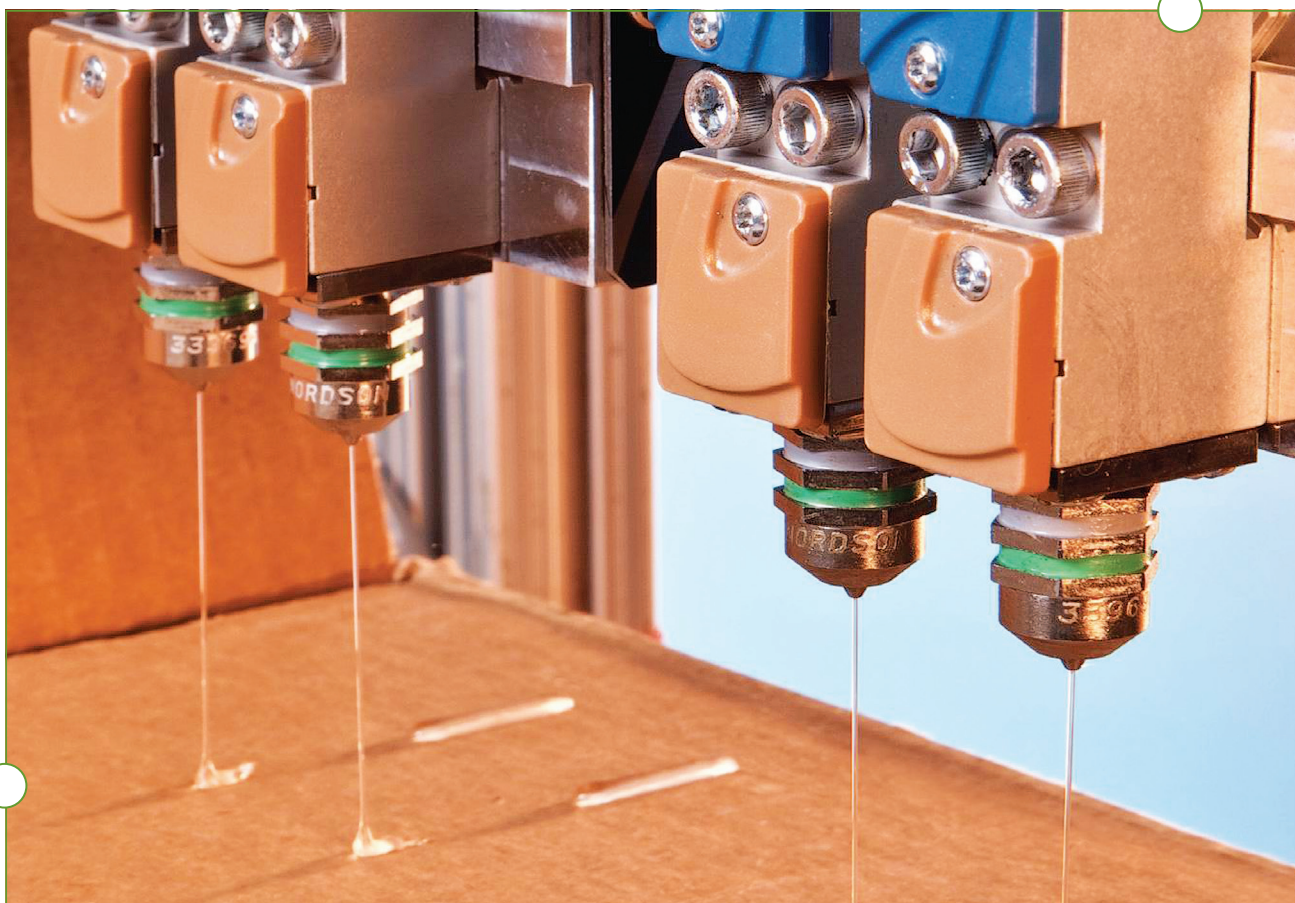

**Sustainable Manufacturing Initiative
Sector Focus Study Series**

Packaging Machinery: Sustainability and Competitiveness



This report is part of the U.S. Department of Commerce’s Sustainable Manufacturing Initiative Sector Focus Study Series. The purpose of this series of reports is to inform public and private sector stakeholders about the sustainability-related challenges, present-day best practices, and unrealized opportunities that exist in specific U.S. manufacturing sectors. By shedding light on the market drivers for a given industry’s natural resource efficiency and environmental performance, this series aims to provide clarity on the hurdles that U.S. firms face in their efforts to become more resource efficient (and thus more competitive) and to highlight the potential cost saving and value-adding opportunities associated with sustainable manufacturing practices. To learn more about the department’s Sustainable Manufacturing Initiative, *visit www.manufacturing.gov/sustainability*.

Packaging Machinery: Sustainability and Competitiveness

by Padraic J. Sweeney



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Preface

About This Series of Reports

The Department of Commerce's "Sustainable Manufacturing Initiative (SMI) Sector Focus Study Series" aims to inform public and private sector stakeholders about the specific sustainability-related challenges, present-day best practices, and unrealized opportunities that exist in specific U.S. manufacturing sectors. By shedding light on the market drivers for an industry sector's natural resource efficiency, the department aims to provide clarity on (a) the specific hurdles U.S. firms are facing in their efforts to become more resource efficient and thus more competitive, (b) what firms are doing to overcome these hurdles, (c) the potential cost-saving and value-adding opportunities associated with the sustainable production practices specific to a selected sector, (d) U.S. government programs and resources designed to help firms in a selected sector meet their sustainability-related goals, and (e) unexplored areas of public-private collaboration that could help enhance the sustainability and competitiveness of U.S. firms in a selected sector.

This paper cites several Web sites of public sector programs and resources designed to support U.S. firms in their sustainable business efforts. For comprehensive access to federal government programs and resources pertaining to sustainability-related issues highlighted in this study, we recommend that readers refer to the Department of Commerce's Sustainable Business Clearinghouse on the department's Sustainable Manufacturing Initiative home page at www.manufacturing.gov/sustainability.

The Department of Commerce also welcomes public comments and feedback on this study. Please direct any comments to Padraic Sweeney in the Office of Transportation and Machinery at padraic.sweeney@trade.gov, or by phone at (202) 482-5024.

Definitions

The terms "sustainability" and "sustainable manufacturing" are used numerous times throughout this paper. Though a variety of definitions for these terms exist today, for the purposes of this paper, both these terms will refer to manufacturing processes that minimize negative environmental impacts; conserve energy and natural resources; are safe for communities, workers, and consumers; and are economically sound.

"Competitiveness" may be defined as a company's ability to provide goods and services at least as effectively and efficiently, if not more so, than the relevant competitors. Measures of competitiveness include profitability, the extent to which a firm exports, and market share in domestic and international markets.¹

Sustainability is also referred to frequently in terms of the "triple bottom line" of economic, environmental, and social performance U.S. manufacturers, including packaging machinery OEMs, meet very high workplace safety and other social criteria when compared with many of their overseas competitors. However, this study focuses primarily on the relationship between economic and environmental sustainability.

Abbreviations

ACL	applied ceramic labeling
CE	Conformité Européene (European Conformity)
CPG	consumer packaged goods
DfE	Design for Environment
EPR	extended producer responsibility
EVA	ethylene vinyl acetate
GHG	greenhouse gases
GRI	Global Reporting Initiative
ISO	International Organization for Standards
LCA	lifecycle assessment
NAICS	North American Industry Classification System
OEE	overall equipment effectiveness
OEM	original equipment manufacturer
PMMI	Packaging Machinery Manufacturers Institute
RoHS	Restriction of Hazardous Substances (EU directive)
SMI	Sustainable Manufacturing Initiative
SPC	Sustainable Packaging Coalition
TCO	total cost of ownership
WEEE	Waste Electrical and Electronic Equipment (EU directive)

Executive Summary

U.S. manufacturers of packaging machinery can compete successfully in both domestic and international markets by pursuing business strategies based on sustainability. Many innovative U.S. original equipment manufacturers (OEMs) of packaging machinery are already doing this. The sustainability strategies identified in this report enable U.S. packaging machinery OEMs to target the largest cost per value component of the global packaging market: packaging materials, which are worth an estimated \$475 billion annually.²

The principal findings of this study include the following:

- Packaging machinery OEMs operate in a global packaging supply chain that faces increasing demands for sustainability.
- Retailers, in particular, play a key role in driving demand for more sustainable packaging throughout the supply chain, even though they generally are not end users of packaging machinery.
- Reducing customers' consumption of packaging materials and ancillary products is the common objective of packaging machinery OEMs that have incorporated sustainability into their core business strategy.
- Reducing customers' packaging-related consumption of energy and water and emissions of greenhouse gases (GHGs) are also key components of successful sustainability strategies.
- Opportunity and innovation drive a successful business strategy based on sustainability for packaging machinery OEMs.
- OEMs with sustainability strategies frequently identify and pursue opportunities for innovation as a result of their ongoing roles as technology suppliers to their customers.
- There is no appreciable demand at present for packaging machinery with sustainable characteristics, as such; end users' procurement practices for packaging machinery do not yet reflect senior management's emphasis on sustainability.
- OEMs are likely to begin encountering demand for packaging machinery with sustainable characteristics in the near future, as their customers aggressively seek to reduce energy and water use, GHG emissions, and waste throughout their manufacturing operations.
- The lack of definitions, certifications, or standards for sustainability in packaging machinery appears to contribute to the lack of demand.
- European laws, regulations, and standards concerning packaging and machinery are shaping the world market.
- Each OEM identified in this study has its own distinctive approach to sustainability, but all of them focus their efforts on technologies and services to reduce customers' consumption of the following:
 - Packaging materials
 - Ancillary products, especially inks and adhesives
 - Energy and water in selected applications

- The cost savings that a focus on materials offers manufacturers of consumer packaged goods (CPG) are what make these OEMs and their products highly competitive.
- Sustainability strategies in the packaging machinery industry typically are oriented around one or more of the following:
 - Automation and integration services and technologies, including remote monitoring
 - Reduction of energy consumption connected with ancillary products
 - Development of innovative ancillary products
 - Development of new packaging systems
- OEMs in this study use one of several recognized methodologies to measure the benefits conferred by their sustainability strategies. These include Life Cycle Assessment (LCA), Total Cost of Ownership (TCO), or Overall Equipment Effectiveness (OEE).
- OEMs in this study have frequently formed strategic relationships with converters or other suppliers of packaging materials or ancillary products.

OEMs of all sizes, involving a variety of business models, are enjoying competitive success with business strategies based on sustainability. In doing so, they are aligning themselves with many others in the packaging supply chain that have also embraced sustainability, including many of their customers. They are also preparing for the day when end users begin demanding more sustainable packaging machinery.

Introduction

*“Waste is something I purchased
but didn’t use.”*

—Attributed to Henry Ford

The U.S. Department of Commerce has undertaken this study, “Packaging Machinery: Sustainability and Competitiveness,” to determine whether U.S. packaging machinery OEMs can implement sustainable business practices and still remain or become more competitive. Although it stands to reason that sustainability contributes to competitiveness—by reducing costs associated with environmental waste—this study attempts to more thoroughly answer that question in a more rigorous manner. As the question was pursued, an important corollary emerged: In practice, what does it mean for packaging machinery OEMs to be sustainable and competitive?

Sustainability can be good for business, even in difficult economic times. A 2009 study by A.T. Kearney found that companies committed to pursuing sustainability achieved above-average financial performance during the recession. Between May and November 2008, providers of industrial goods and services listed on either the Dow Jones Sustainability Index or the Goldman Sachs SUSTAIN focus list outperformed their industry peers by 23 percent. The study linked those sustainability leaders to a variety of sound business practices, including a focus on the long-term well-being of the business, strong corporate governance, sound risk management, and a history of investment in environmental innovation.³

In fact, the report “Packaging Machinery: Sustainability and Competitiveness” found that several innovative U.S. packaging machinery OEMs are

pursuing business practices based on sustainability and that the practices appear to significantly enhance their competitiveness. This report will identify several of those companies, place them in the context of the packaging machinery industry and the larger packaging supply chain, and describe how their pursuit of sustainability has helped them be more competitive.

Considerable scope exists for making the packaging supply chain at large more sustainable. Globally, large amounts of raw materials are consumed to produce packaging, most of which becomes waste shortly after the goods are purchased. For example, an estimated 30 percent of municipal solid waste in the United States results from discarded packaging of all types.⁴ Packaging is also very conspicuous as waste, even though it generally represents only a modest fraction of the overall environmental impact of most packaged consumer products. Finally, sustainability is a relative term with respect to packaging, which involves significant environmental impacts throughout its life cycle. In practice, making packaging more sustainable means mitigating—not eliminating—those impacts.

Strong market and regulatory forces are already at work pushing the global packaging industry toward greater sustainability. Retailers and CPG manufacturers recognize that significant savings can be realized by reducing costs associated with packaging-related wastes. Consumers exert a strong—if not always consistent—influence on retailers and CPG manufacturers as well, through their increasing preference

for products that they perceive as environmentally friendly. A growing body of European law, regulation, and standards governing packaging and packaging waste is also shaping the global business environment for packaging goods and services—far beyond the member states of the European Union.

“Packaging Machinery: Sustainability and Competitiveness” was written for two audiences: U.S. packaging machinery manufacturers, their customers, and suppliers and non-packaging specialists with a serious interest in sustainable manufacturing. For U.S. packaging machinery manufacturers, in particular, this study is intended to help them be more competitive and successful in a rapidly changing industry. For those outside the packaging industry, this study is intended to provide some insight into the opportunities and challenges sustainability presents for capital equipment manufacturers in general. As a result, this study attempts to explain a rather specialized topic in language accessible to the specialist and non-specialist alike. Inevitably, some sections of the study will be of greater interest to one audience than to the other.

Because packaging machinery is such a specialized industry, “Packaging Machinery: Sustainability and Competitiveness” begins in section I, “The U.S. Packaging Machinery Industry: Scope and Market Characteristics,” with a description of what constitutes packaging machinery, as well as some basic information on packaging materials and the various functions packaging performs. Section II, “The Changing Business Environment for Packaging Machinery,” discusses the market and regulatory forces shaping global demand for more sustainable packaging. The core findings relating to packaging machinery OEMs are found in sections III (“Sustainability as Competitive Advantage”); IV (“Manufacturer Case Studies”); and V (“Challenges to Implementing Sustainability”).

Research

To produce this report, numerous participants in the packaging machinery industry and the larger packaging supply chain were consulted. Participants included representatives from several packaging machinery OEMs; packaging materials converters; and other market participants in Illinois, Indiana, Minnesota, and Wisconsin. Purdue University Calumet’s Department of Mechatronics and the Packaging Machinery Manufacturers Institute

(PMMI) organized a roundtable discussion with several packaging machinery OEMs in Hammond, Indiana. The Sustainable Packaging Coalition (SPC) 2009 spring and fall meetings, the 2009 Sustainable Packaging Forum, and PACK EXPO 2009 all provided valuable opportunities to meet with companies from throughout the packaging supply chain, including numerous CPG manufacturers. Also, an extensive review of available publications on packaging machinery, sustainable packaging, and related topics was conducted.

“Packaging Machinery: Sustainability and Competitiveness” contains several case studies of individual companies’ experiences developing and commercializing sustainable products and services. Because a principal objective of this study is to help U.S. packaging machinery OEMs to be more competitive, real-world private-sector examples are given. Accordingly, the mention of any company, product, or service should be viewed as purely illustrative—not as a recommendation or endorsement. Packaging machinery end users looking for specific packaging solutions need to conduct their own thorough due diligence to determine which vendors, products, or services best meet their needs.

Acknowledgments

A number of organizations and individuals were of great assistance in conducting this study. For introductions to packaging machinery OEMs, assistance in organizing roundtable discussions, and general guidance and insight, the author would like to thank Ben Miyares, Matthew Croson, Thomas Egan, and Jorge Izquierdo, vice presidents for industry relations, member services and communications, industry services, and market development of PMMI, respectively (Miyares is now an independent packaging market analyst); Anne Johnson, executive director of SPC; Martha Stephenson, senior project manager at GreenBlue; and Lash Mapa, professor of industrial engineering technology at Purdue University Calumet.

From the companies featured as case studies, the author would like to thank Dale Andersen, president, and Kenneth M. Sullivan, director of marketing, Delkor Systems, Inc.; Scott Smith, director, Global Market Development & Emerging Businesses, Hartness International, an ITW company; Rick Pallante, marketing development manager, Nordson Corporation’s packaging adhesives division; Jack

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Finally, the author would be remiss in not recognizing his colleague, William McElnea, international economist in the Commerce Department's Office of Trade Policy Analysis, for his many contributions—conceptual, intellectual, and editorial—to the creation of this document.

I. The U.S. Packaging Machinery Industry: Scope and Market Characteristics

Packaging machinery performs a variety of functions that include canning; container cleaning, filling, and forming; bagging, packing, unpacking, bottling, sealing, and lidding; inspection and check weighing; wrapping, shrink film, and heat sealing; case forming, labeling, and encoding; palletizing and depalletizing; and related applications. Economic data describing the packaging machinery industry is the subject of North American Industry Classification System (NAICS) category 333993, “Packaging Machinery Manufacturing.”⁵ Sections HS 842220, HS 842230, and HS 842240 of the Harmonized Tariff Schedule of the United States describe U.S. international trade data for packaging machinery.⁶ In practice, packaging machinery also includes certain types of materials handling equipment, such as conveyors and accumulators, and specialized printing and graphics machinery.

Packaging machinery manufacturers provide essential technology for a large and increasingly globalized packaging supply chain. Upstream, this supply chain includes producers of basic materials, such as paper, plastic resins, and metals, and packaging materials converters (firms that produce packaging materials from these basic products). Downstream, the supply chain includes CPG manufacturers that package their own products and contract packaging firms that package goods manufactured by other firms.

U.S. packaging machinery manufacturers follow a number of business models. Several larger companies have emerged as providers of complete, integrated turn-key packaging lines. Such companies offer value-added design, engineering, and integration services, along with machinery and traditional

after-sales service and support. Others dominate specialized technologies, such as equipment for dispensing adhesives or coding packages. A number of converters also manufacture equipment to process the materials that are their principal business. Many other companies offer specific equipment types, components, and technology services.

The Market for Packaging Machinery

The total U.S. market for packaging machinery in 2008 was worth \$6.3 billion, with domestic manufacturers reporting \$4.8 billion in sales.⁷ The U.S. Census Bureau reports that 551 companies manufactured packaging machinery in the United States in 2007. Most packaging machinery producers are quite small, with nearly 64 percent having fewer than 20 employees.⁸

Manufacturers of processed food and beverages represent approximately 55 percent of the packaging machinery market. Pharmaceutical manufacturers purchase another 10 percent. Other significant packaging machinery end-user segments account for another 20 percent and include household, agricultural, and industrial chemicals; personal care products; hardware; and paper products.⁹ Although retailers are not usually end users of packaging machinery, they exert powerful influence over the packaging industry through their purchasing power and increasing focus on more sustainable packaging.

Manufacturers of packaging machinery face a rapidly changing and highly competitive environment. The large CPG manufacturers that purchase most packaging machinery have global supply chains not only for their production inputs, but also for the machinery and materials they use to package

their finished goods. Machinery manufacturers face a growing tension between their customers' demand for more flexible, productive equipment and their own need to maintain their profit margins, standards, and reputation for quality.

The leading competitors for U.S. packaging machinery OEMs are, for the most part, European. U.S. industry participants identify European companies' ability to provide turn-key service—design, engineering, and installation of complete processing and packaging lines, rather than simply providing individual machines—as their most important competitive advantage. Leading competitors are from Germany, Italy, and several smaller northern European countries. Japanese manufacturers are also major, well-established competitors. Imports from China have grown strongly in recent years.

The U.S. packaging machinery industry includes many successful exporters that do business with customers around the world. Nevertheless, the industry has lost ground in recent years to foreign competitors. Exports worth \$787.4 million represented 14 percent of total shipments in 2007, a slight decrease from 15.1 percent in 2002. Imports worth \$2.2 billion accounted for 39 percent of the domestic market the same year, which was up from 26.2 percent in 2002.¹⁰

Not surprisingly, the recession has affected both U.S. exports and imports of packaging machinery. Exports and imports of packaging machinery both peaked in 2008, at \$863.2 million and \$2.3 billion, respectively. In 2009, exports fell 16.4 percent to \$721.8 million, and imports fell 28.8 percent to \$1.6 billion.¹¹

Packaging Types and Materials

Packaging can be separated into four basic categories. Packaging machinery is sometimes described according to these categories, as well. Primary packaging directly wraps or contains the product, for example a bottle. Secondary packaging wraps or contains the primary packaging, for example, a plastic wrap containing a small number of bottles. Distribution packaging wraps or contains a product during distribution and provides for efficient handling, for example, a case containing a larger number of bottles. Unit load or transport packaging assembles multiple containers into a single combined bundle suitable for materials handling equipment. For transport, such packaging is frequently stabilized through the use of pallets,

strapping, shrink-wrapping, or similar means to form a single unit.¹²

Packaging performs a variety of functions. Packaging protects products during transportation and storage from physical impact, crushing, abrasion, heat, cold, moisture, and other threats that could render the goods unfit for sale. Packaging also protects products from contaminants during transportation and storage, keeping them sanitary and sterile until they are consumed. Packaging contains products so that they can be transported and stored. Packaging provides security from theft and tampering and communicates essential information about products. For CPG manufacturers, packaging also plays a vital role in marketing and establishing brand awareness in an intensely competitive marketplace.¹³

A wide range of materials are used as packaging and processed by packaging machinery. Commonly used materials include paper and paperboard, plastics (rigid, flexible, and films), metals (steel, aluminum, and tin), glass, wood, and textiles. In recent years, paper and paperboard have represented approximately 45 percent of total packaging materials sales, plastics 22 percent, metals nearly 17 percent, and glass and wood slightly more than 4 percent each. Consumer products account for 80 percent of all packaging, including food, beverages, household chemicals, personal care products, and consumer durables such as household appliances, furniture, and computers. Industrial products, such as electrical machinery, medical devices, and other goods account for the balance.¹⁴

Packaging is a major consumer of materials. For example, approximately 72 percent of converted paperboard, 20 percent of glass, and 18 percent of aluminum are used for packaging. Packaging is a major end use for many ancillary products, including adhesives (44 percent) and ink (32 percent). Packaging is the third-largest market for steel after transportation and construction.

Packaging comes in many forms. Rigid packaging includes containers such as boxes, bottles, drums, cartons, crates, tubs, and pails. Flexible bags, pouches, tubes, wraps, and laminates made of paper, plastic films, and aluminum foil—often in combination (for example, a potato chip bag) are widely used packaging forms. Packaging also includes numerous components and ancillary products, such as closures, tamper-evident materials, cordage, twine, strapping, pallets, skids, and more.¹⁵

II. The Changing Business Environment for Packaging Machinery

Packaging machinery manufacturers do business in an environment where reducing the overall volume of packaging materials consumed is both a major market demand and, especially in the EU, a legal and regulatory requirement. OEMs must adapt to the fact that sustainability has become a powerful design criteria for new materials and packaging systems that will be run on their machines. Manufacturers must also ensure that their machinery can run more conventional materials whose characteristics are changing because of higher recycled material content.

Three forces are driving the packaging supply chain toward greater sustainability: cost reduction, consumer attitudes, and regulation. Major retailers that purchase most packaged consumer goods increasingly demand that their suppliers reduce the costs associated with packaging and packaging waste—principally by redesigning their packaging to reduce its weight and volume. Eliminating waste at the source rather than after it has been created is commonly referred to as source reduction. The preferences of consumers, a growing share of whom want products they perceive as environmentally friendly, also influence retailer behavior. Many countries, especially in Europe, regulate packaging and packaging waste. It is likely that there will be greater regulation of packaging waste in the United States in the future, as well, especially at the state level.

These forces represent not only necessity, but opportunity, for any company in the packaging supply chain that can capture value by reducing the costs and wastes associated with packaging.

Cost Reduction

CPG manufacturers consume a wide range of packaging materials and generate significant volumes and varieties of waste. Extracting raw materials, converting them into packaging materials, packaging consumer and other products, and transporting both the materials and the packaged goods entail significant costs. Materials wasted during packaging operations, when packages fail before being opened or at other points in a package's life cycle, also represent significant costs. In addition to packaging materials themselves, packaging-related inputs include: hazardous materials, especially petroleum-based resins used in many adhesives and heavy metals contained in many inks; energy, consumed during materials extraction, manufacturing, and conversion, and during packaging and transport operations; and water, as a process input and as a lubricant for bottle, jar, and canning lines. Packaging wastes include discarded packaging materials, greenhouse gases, hazardous wastes, and wastewater.¹⁶

Packaging inputs that do not result in a saleable product, or are discarded once the good is sold, are waste. Eliminating packaging wastes before they are created—source reduction—can lower manufacturing costs for companies throughout the packaging supply chain. When processed efficiently, recovered packaging waste can also return significant economic value. Indeed, the more energy intensive the material is, the more lucrative its recovery and reuse can be (for example, aluminum).¹⁷

Manufacturing operations can be deliberately designed to maximize waste and cost savings. The proper configuration of packaging lines, especially

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