IMPACTS OF SUSTAINABILITY & EPR ON PACKAGING

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GLOBAL: SUSTAINABILITY IMPACTS PACKAGING



Packaging - Sustainability Goals

- Starting in 2018-2020
- Over 1,200 organizations including the top 25 Consumer Packaged Goods (CPG)
- Pledged to:
  - ➢ Reduce virgin plastic
  - ➢ Increase recycled content
  - ➢ Recyclable, Reusable
  - ➢ Compostable, Biodegradable

Nestle, 2025
- Reduce use of virgin plastics by 33%
- 100% recyclable or reusable packaging

Procter & Gamble, 2030
- Reduce virgin plastic in packaging by 50%
- 100% recyclable or reusable packaging

PepsiCo, 2025
- Reduce virgin plastic in beverages by 35%
- 100% recyclable, compostable, biodegradable

Unilever, 2025
- Increase recycled content in plastic to 25%
- 100% plastic recyclable, reusable, compostable

Anheuser-Busch, InBev, 2025
- All products with recycled content
- All products in returnable packaging

Source: Ellen MacArthur Foundation, The Global Commitment 2020 Progress Report

Prioritize Sustainability, Change Happens (2018-2024)

- Signatories represent 20% of global plastic packaging
- Signatories are doing much better than the global average
- Source Reduction: Eliminated over 14 million tonnes of unnecessary packaging
- Designed for Recyclability: 72%
- Post-Consumer Recycled Content (PCR): Tripled use

	2024	
Target areas (brands and retailers)	**Global Market**[1]	**Global Commitment signatories**[2]
Virgin plastic use (% change by weight vs 2018)	↑ +13%	↓ -6%
Items commonly identified as problematic or unnecessary - EPS/XPS, PS, PVC[3] (% change by weight vs 2020)	↑ +9%	↓ -6%
Reuse (change vs 2018)	Roughly flat	Roughly flat
Reusable, Recyclable, or Compostable[4] (percentage point change vs 2018)	n/a[5]	↑ +10pp
Post-consumer recycled content (percentage point change vs 2018)	↑ +1pp	↑ +11pp
Production of recycled plastics (in % increase vs 2018)	↑ +28%	↑ +61%

1 Source: Wood Mackenzie plastic packaging market data

2 Based on the weighted average of Global Commitment Brand and Retail signatories reporting all years of analysis

3 These are items and materials that a significant number of Global Commitment signatories have identified as problematic or unnecessary. This analysis includes EPS and XPS such as for takeaway and retail food packaging as well as packaging peanuts. EPS for transport packaging has been excluded from this analysis.

4 Metric is significantly influenced by portfolio composition and sector

5 The Global Commitment developed its own definition of 'recyclability', requiring 'recyclability in practice and at scale'. Therefore no comparable market data is available. While there are indications the signatory group might be outperforming the market (e.g. signatories' substantial investments in technical recyclability and outperformance on the elimination of non-recyclable items such as PVC), there is no robust data available to validate this.

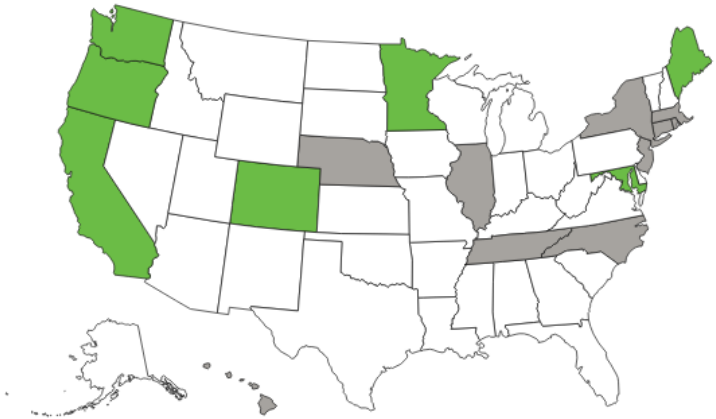
Source: Ellen MacArthur Foundation, The Global Commitment 2025 Progress Report

US: EPR IMPACTS PACKAGING



Where is US Packaging EPR?

- As of late 2026, seven states have passed EPR for packaging legislation: Maine, Oregon, Colorado, California, Minnesota, Maryland, and Washington.
- NJ and NY have introduced EPR bills multiple times since 2020; none have passed.
- RI and IL have active Needs Assessments in process, laying the groundwork for 2027 or 2028.
- Other states that have been active are HI, MA, VT, and CT. Even TN, GA, NE, and OK have had some activity.



Seven EPR states account for almost 20% of US population. If driven to make packaging changes, brands will do so on a national basis which will impact recycling on a national basis

Source: https://epr.sustainablepackaging.org/

Structure of US EPR



Producers:
- Covered materials
- Pay fees

Producer Responsibility Organization (PRO) is Circular Action Alliance (CAA):
- Structures programs and timelines
- Harmonizes data requirements
- Calculates fees
- Collects and distribute fees

Goals:
- Design for recyclability; increase recycling rates
- Recycled content
- Reuse
- Source Reduction:
  - Reduction in the total volume of packaging placed on the market relative to a baseline year.
- Compostability
- Responsible End Markets (REM):
  - Compliance with EPR state laws and regulations
  - Chain of custody verification
  - Recycling yield performance
  - 'Environmentally sound' processes

Policy Levers:
- Fees
- Eco-modulation
- Fee changes over time

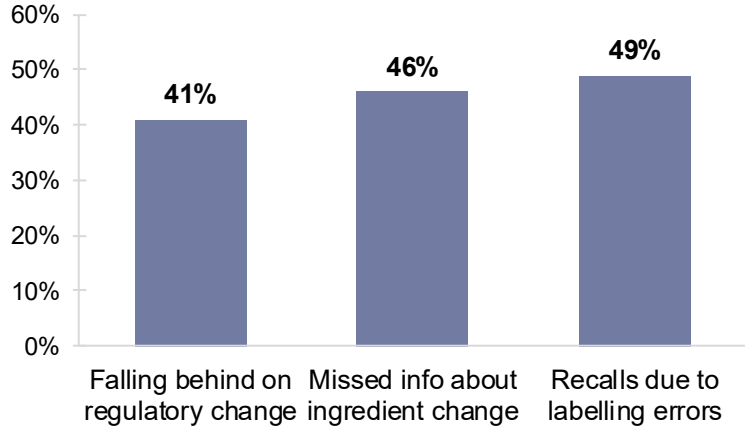
Beneficiaries:
- Fund outreach and education for consumers
- Improve infrastructure for the collection, sortation, and processing of materials
- Support expansion of REM

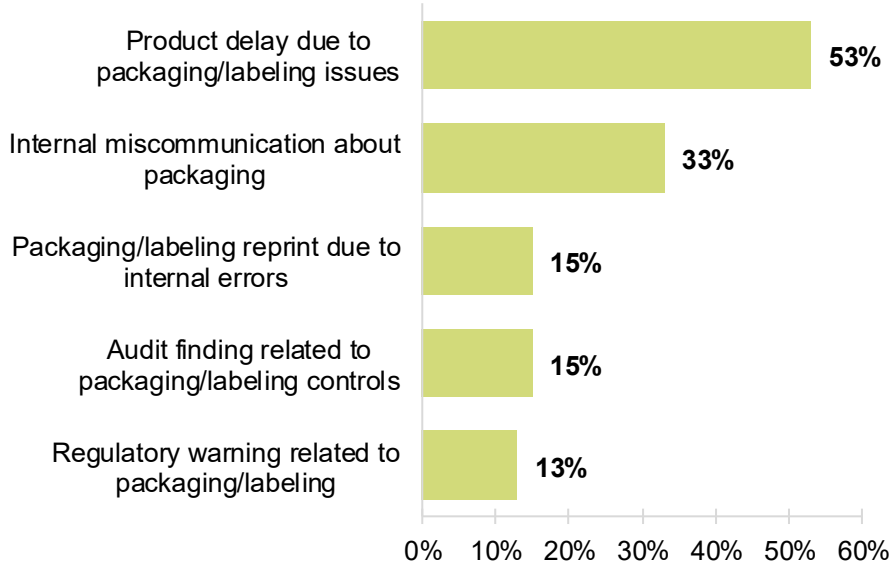
PACKAGING CHALLENGES



Packaging is Slowing Down Product Launches

- 20,000 new items hit US grocery shelves annually; 75% don't make it past one year
- Packaging 'workflows' are not keeping up with the pace of change: regulatory, ingredients, labeling
- Mistakes leads to delays, recalls, higher costs.





Source: TraceGains, Esko, Informa "What Today's Packaging Workflows Miss…" Spring 2026 survey of 150 packaging leaders

Updating Systems for the Future

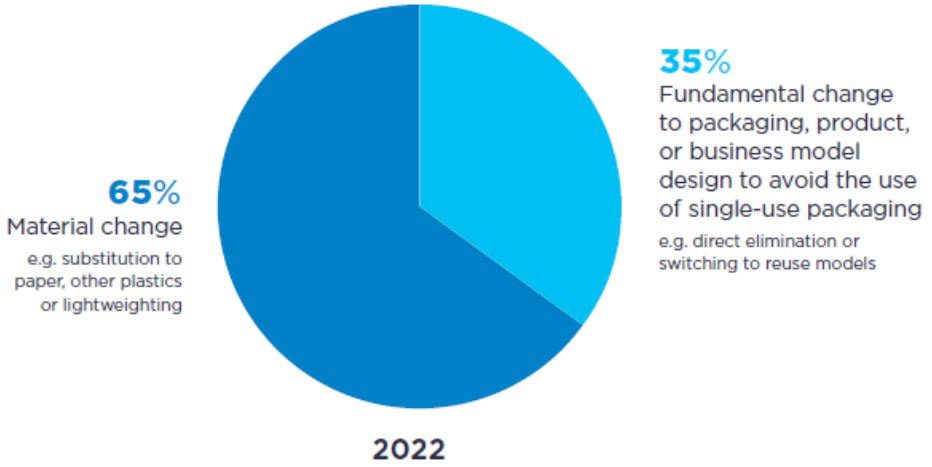


- Most companies have a blend of digital and manual processes: only 5% have fully digital and automated processes
- Just 18% say they have the tools they need to do their jobs effectively while 82% are juggling 3 and 7 software systems for packaging development.
- 79% of leaders plan to invest in new technology in the next one to two years.
- What they want new investments to deliver:
  - *Real-time ingredient and formulation change alerts* to surface supplier and formulation changes as they happen (49%)
  - *AI-assisted compliance checking* to automate routine checks for faster approval (47%)
  - *Integration between specification and artwork management* to align artwork with the latest approved specs, reducing errors (41%)

Source: TraceGains, Esko, Informa "What Today's Packaging Workflows Miss…" Spring 2026 survey

What Companies are Doing

- 300+ packaging changes eliminated 148,000 tonnes of plastic
- 2/3 replaced plastic with paper, or lightweighted plastic



Bain, 2023: “Expect rigid paper to see the largest growth among substrates, potentially exceeding plastic growth rates by 2026.”

Packaging CEO, 2023: “25% of the growth in the business is replacing plastic with paper. Five years ago it was all about plastic.”

Source: Ellen MacArthur Foundation, The Global Commitment 2023 Progress Report

Issues in Changing Substrates



- Cost
- How to transition entire product lines if you can't change all your equipment overnight
- Time to market for new material choices when meeting customers planning windows
- Customer is in existing packaging style, but, for new material choice, more warehouse space is required and more training for employees has to be built
- Confidence in your decision meeting your requirements
- Open communication between departments
- Performance needs: barrier properties, puncture and tear resistance, etc. > Lack of understanding from end users as to best courses to achieve sustainability causes them to change direction
- Performance / total cost impact; testing and qualification of materials; qualification of "sustainability"
- Changing customers, perception of change
- Stability tests of products have to be performed with new materials
- Quality
- Alignment between machine manufacturers and package material suppliers
- Environmental concerns with material transport and long term stability
- Compatibility and conformance with brand identity
- Tooling, yield, setup, and training
- Sustainable products are typically innovative solutions and cause scale up and storage differences
- Lead time
- Being sure of your decision because change can be long and costly
- Impacts speed, waste, performance
- Runnability
- Timing, scalability and performance – the balance
- Private and national legislation
- Material certification, for example BPI certification process
- Dimensional suitability for multiple products; retooling; procurement

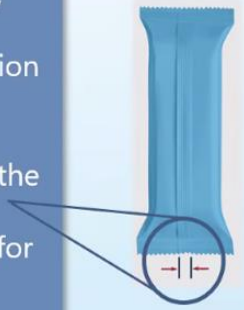
Source: PMMI, Vision 2030 Discovery Sessions, Pack Expo, Sept. 2023

Replacing Plastic with Paper: Challenges

- Equipment needs to be modified; Much research and new product development on barrier layers
- Six major companies -- Colgate-Palmolive, Mars, Nestlé, PepsiCo, Procter & Gamble, and Unilever -- formed the PaperFlex Consortium (September 2026) to develop sustainable paper-based alternatives to flexible plastic packaging. Recyclable and biodegradable solutions that meet performance, cost, and scale requirements.

Equipment Impact	Design Implications

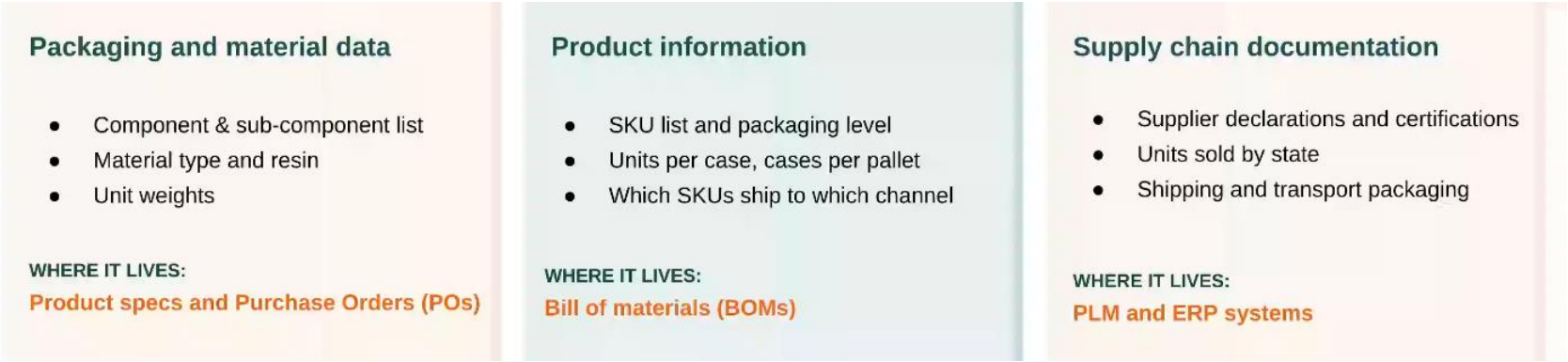
• Compatible with most existing equipment with minor adjustments
• Typical areas of modification:
  • Web path
  • Forming collars, forming boxes
  • Tension control
  • Sealing bars
• Paper is an insulator and will require more heat and dwell time to form seals
	• Paper has little to no barrier to oxygen, moisture, or grease
	• Hermetic seals are challenging in junction point areas
	  • Gusset on stand-up pouches
	  • Triple points on flow wrap (where the end seal and fin seal meet)
	• Different paper thickness are required for different packaging formats



Source: Scott Huffer, TOPPAN Packaging, Paper Challenges, Jan. 2026

EPR: Extensive, New Types of Data Needed

- Collecting and reporting on sustainability data is a huge challenge.
  - Requirements, framework, and terminology not clear and vary across states
  - Need better access to packaging data, particularly from suppliers. Can have 1,000s of suppliers.



- CAA is “harmonizing” but a number of organizations have evolved with frameworks and models:
  - GS1 (non-profit, global standards, UPC codes) developed a model working with 50+ companies
  - Sustainable Packaging Data Council founded by Costco, Tyson Foods, others, working with Specright

Source: rePurpose, “The Data Work is Now…”Webinar, Oct. 6, 2026

EPR Fees - What Drives Fees?

- Fees are based on the total volume of product (“covered materials”) sold in an EPR state.
- Fees vary based on the extent to which the package meets the state’s goals -- recyclability, PCR content, re-usable, source reduction, and others.
- Fees have changed from the first “illustrative” fees published to actual fees. Fees will change over time as states and CAA work through the details – and as producers improve their packaging.

A

The packaging materials you use

Each SKU must be broken down into:

- Components (bottle, cap, label, wrapper)
- Sub-components (especially in CA: adhesives, layers, closures)
- Material types (PET, PP, LDPE, aluminum, paper, glass, multilayer)

Each material has a per-pound fee rate.

B

State-specific sales volume

EPR fees are state-specific, so brands must know (or accurately estimate) how many units from each SKU were sold in each of these states.

If exact state-level data is unavailable, compliant estimation methods must be used.

C

Fee schedules (material-specific rates)

Each state publishes fee schedules assigning rates to different material categories. These fee schedules differ significantly across states.

Eco-modulation will expand in complexity from 2026 to 2028 as states refine criteria.

Source: rePurpose, “The Data Work is Now…”Webinar, Oct. 6, 2026

Example of How Fees are Calculated

Material Class	Material Category	Total Base Fee (cents/lb)	Reuse Investment Fee (cents per plastic component pound)	PPMF* Weight-based fee (cents per plastic component pound)	PPMF* Component-based fee (cents per plastic component)
Paper and Fiber	25_PF10P - Paper/Fiber - Paperboard - All Forms w/ plastic component	5	10	25	0.12

PPMF COMPONENT-based FEE

- Statutory PPMF – invoiced separately by CAA.
- **Applies only to the plastic component count (unit).**

What Counts as a Plastic Component?

Plastic component: As defined in PRC section 42041(u), "plastic component" means any single piece of covered material made partially or entirely of plastic. A plastic component may constitute the entirety of the covered material or a separate or separable piece of the covered material. A piece or subpart of covered material is counted as a plastic component if the piece or subpart is made partially or entirely of plastic.

Examples of plastic components include, but are not limited to: plastic label, plastic tape, plastic window, plastic handle, plastic safety seal, plastic utensil, plastic adhesive, plastic ink, plastic lining, plastic coating, plastic meat tray, plastic valve, plastic pizza saver, plastic squeezable tube, plastic straw, plastic stirrer, plastic bottle, plastic jug, plastic lid or cap, plastic bulb end, plastic zipper, plastic dispersion, plastic fastener, plastic hang tab, plastic hook and loop tape, plastic bag, synthetic fabric bag, plastic thread, plastic hanger, plastic cold end coating, plastic elastic loop, plastic barrier, plastic layer, and plastic film wrap.



*** Note: Plastic Pollution Mitigation Fund (PPMF)**

Source: Scott Huffer, TOPPAN Packaging, Recyclability & EPR, Aug. 2026

Cost of a Plastic Window

Pasta Box with a Plastic Window

Covered Material Category: **25_PF10P** (Paper/Fiber - Paperboard - All Forms w/ plastic component)

500,000 boxes at **~0.12lbs each = 60,000 lbs**

Plastic components: 500,000 plastic windows

1 each plastic window per box (**~8%** of total weight is plastic = **0.0096lbs** per plastic window)

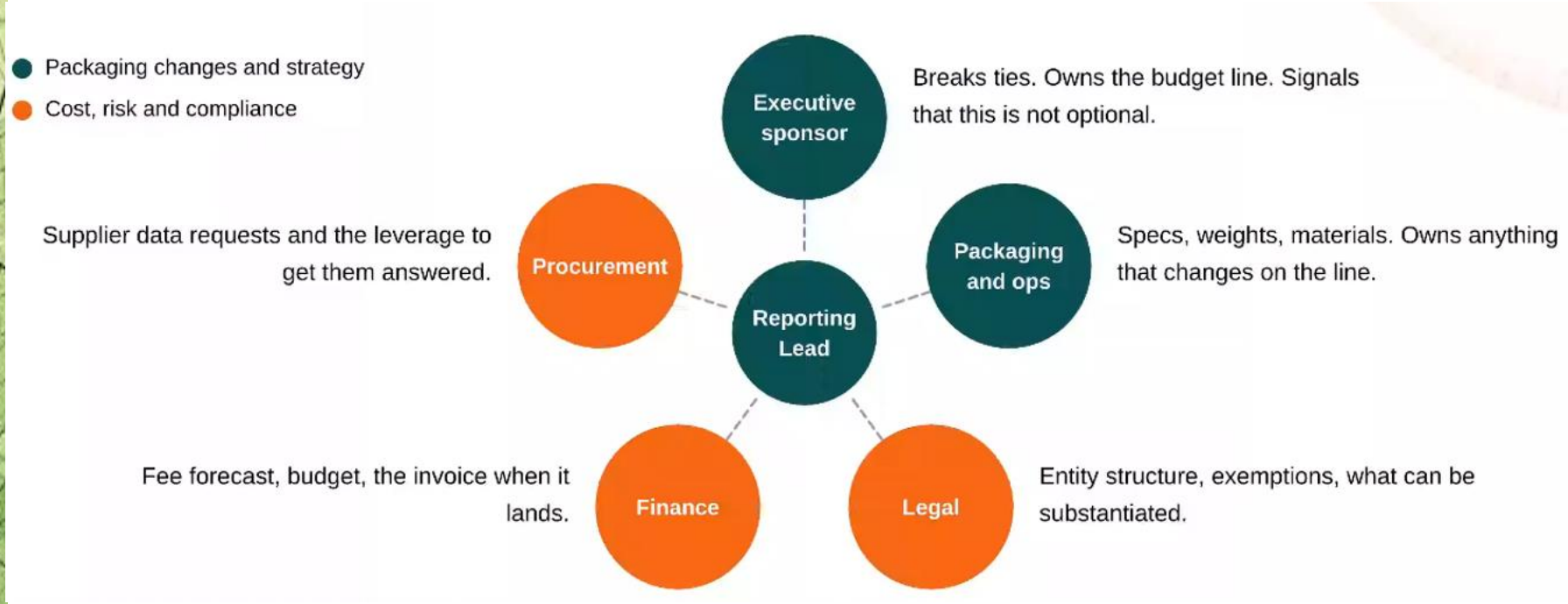
Total lbs of plastic windows (500,000 windows) = **4,800 lbs**



HIGH SCENARIO		
Base fee	5 cents x 60,000 lbs	$3,000
Reuse Investment fee	10 cents x 4,800 lbs	$480
PPMF Weight fee	25 cents x 4,800 lbs	$1,200
PPMF Component fee	0.12 cents x 500,000	$600
EST. TOTAL		**$5,280**

Source: Scott Huffer, TOPPAN Packaging, Recyclability & EPR, Aug. 2026

Who Needs to Get Involved in EPR Reporting



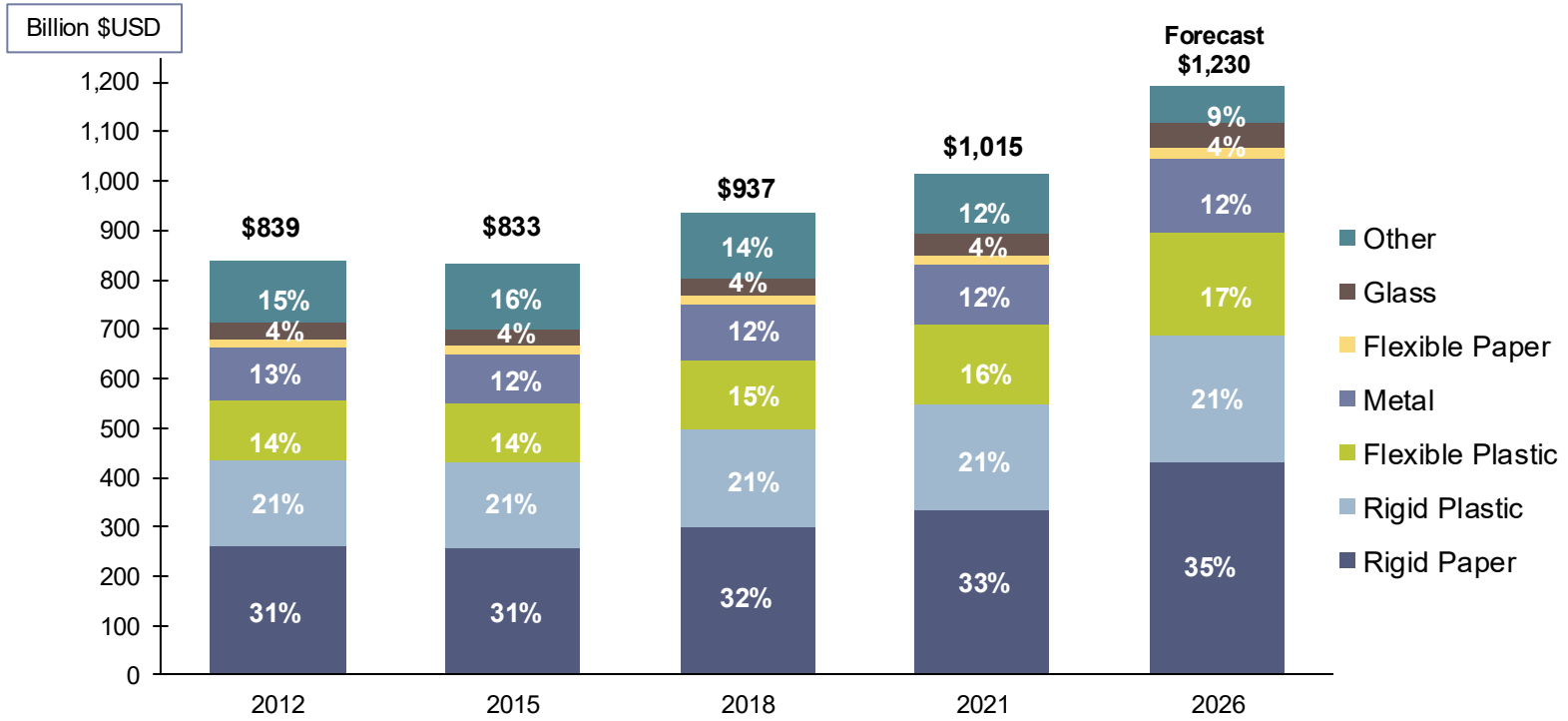
Source: rePurpose, "The Data Work is Now…"Webinar, Oct. 6, 2026

HOW PACKAGING HAS CHANGED



Global Packaging Market Size by Substrate, 2012-2026

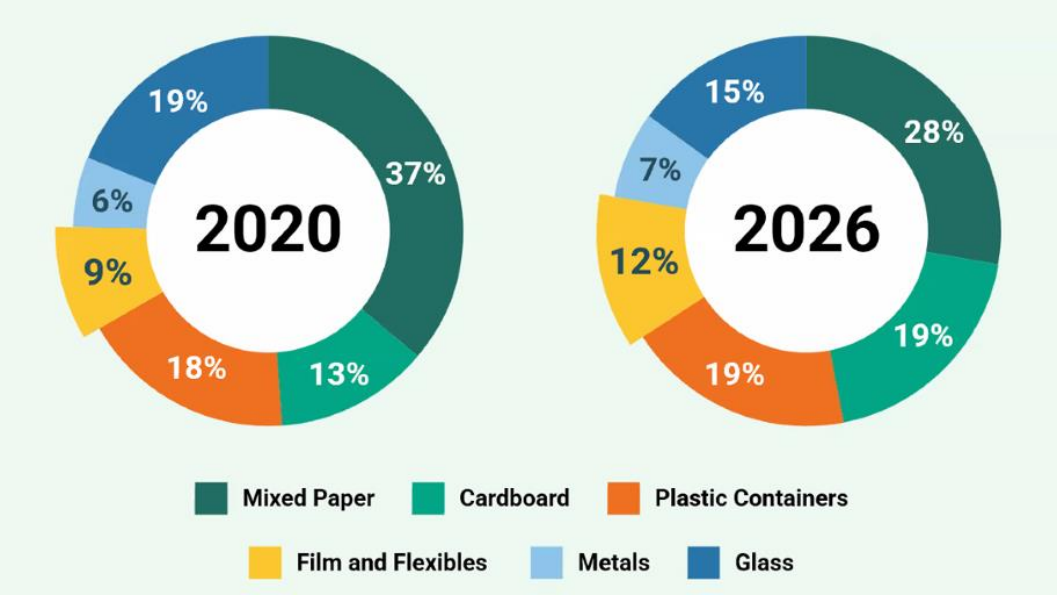
- Rigid paper and flexible plastic (pouches) are growth areas



NOTE: 'Other' includes other & flexible foil packaging. Flexible paper is 2% through all years.
Sources: Smithers (2021); Bain (2023)

Packaging has Changed: Has Recycling Infrastructure?

- From 2020 – 2026, total tonnage of recycled materials collected shrank by 8% while population grew by 3.1%. *Lightweighting is a major factor.*
- Declines in mixed paper and glass were the two biggest drivers of the overall tonnage decrease.

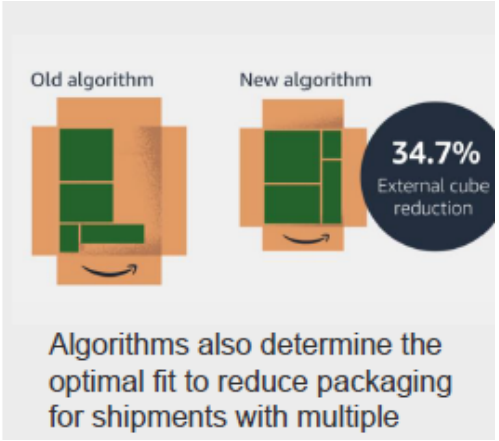


Source: The Recycling Partnership, "State of Recycling Part 2, The Evolving Ton", Sept. 2026

Evolution of Ecommerce Packaging

- For Amazon, AI is helping to identify which products can ship in which types of flexible packaging, and the optimal fit for multiple items.
- In the past 5 years, these algorithms have reduced corrugated use by more than 35%.





Amazon has reduced packaging volume by 4.2 million metric tons globally since 2015

Source: Fastmarkets Global Paper Packaging Trends, Q2 2024, Alejandro Mata

Dunnage – Plastic Alternatives Abound

- Microflute shipping envelope 2022: 50% less fiber than a corrugated box, SFI and FSC certified. Curbside recyclable.















Grocery Shopping Bags

- The brown paper grocery bag with flat, square bottoms and pleated sides was invented in 1883!
- A standard from the 1950s through 70s.
- Single-use plastic bags debuted in 1979.
- Plastic bags eventually captured over 80% of the US grocery bag market.
- In 2026,12 states have statewide bans on single-use plastic grocery and retail bags. Details vary.











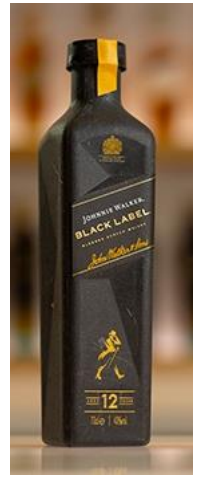
Paper Bottles

- Since 2015, 4 producers, outer shell is wood fiber or recycled paperboard, 90+% fiber. Inside a plastic (various) liner or a spray-on plastic barrier.
- L'Oreal, 2018, 70% less plastic.
- Spirits and beer: paper bottle improves carbon footprint by 60-80%. All still in trials and testing!
- From Diageo, Johnnie Walker Black Label scotch and Baileys Irish Cream (mini).
- From Pernod Ricard, Absolut vodka. Other smaller brands.
- April 2026, Frugalpac introduced a machine capable of producing 14 million bottles/year.
- October 2026, Pulpex building a plant in Scotland with capacity of 40 million bottles annually.

















Coffee

- Turkish – water, coffee, 1640
- Many methods using 2-3 pots, siphons
- Espresso machines, 1884
- First drip coffee, Melitta Bentz, 1908, used her son's blotting paper
- French press, 1929
- Percolators, 1950s and 60s
- Melitta cone, 1963
- Nespresso pods, 1986
- Keurig K-cups, 1998
- Nestle/Nespresso, first moved to aluminum pods, recyclable. Then paper-based pods, 2023 in Europe
- Keurig Alta-rounds, 2026, seaweed, home compostable















Chips & Cereal









- Walkers (PepsiCo UK) began testing flexible paper for crisp bags in 2022
- Fully recyclable at curbside but no longer on the market
- Currently offer crisps and rice cake multi-packs with an outside paper bag. Inside bags are still plastic.
- The outside bag is recyclable at curbside; inside plastic at stores.
- The British Crisp Co. does use a paper bag with a water-based polymer coating
- Recycled at curbside OR composted
- Kellanova UK, began testing a recyclable paper liner at UK supermarkets in 2022
- Production challenges: Filling and sealing process; freshness; product integrity

Will EPR Increase the Volume of Recycling?

> *"EPR will increase residential recycling rates as much as 48% relative to current US rates. For many states, rates could be as high as 75%."* (The Recycling Partnership, 2026)

Yes, it should due to…

Stable Funding:

- Shifts financial costs from local governments to product manufacturers, generating dedicated revenue for recycling programs.

Better Collection & Access:

- Expands residential recycling collection services and modernizes sorting facilities.

Eco-Design Incentives:

- Fee structure rewards companies for using more recyclable materials and PCR. What about reusables and source reduction?

Success will depend on:

Material Type:

- Increases will be much faster for materials like paper and metals where markets currently exist, vs. plastic film, multi-layer plastics.

Policy & Program Design:

- Clear performance targets and eco-modulated fees should drive better results than a fee-based model.

Implementation Challenges:

- Enforcement is required but compliance burdens can create friction or legal disputes for businesses.

Source: The Recycling Partnership, "State of Recycling Part 1: Setting the Stage", June 2026

Paper Industry Implications

- Paperboard demand expected to increase significantly
- Fisher estimate: If 10% of plastic beverage cups globally were replaced with paper, would require a 20% increase in global cup stock capacity
  - Enough fiber from sustainably-managed forests?
  - Would a rapid increase in demand for pulp increase the price so much that it would be a negative for conversion to paper?
  - How quickly will consumer behavior shift to renewable packaging materials?



Source: Fisher, "Plastic Replacements Create New Opportunities", Paper 360, Sept. 2021

Corporate Implications



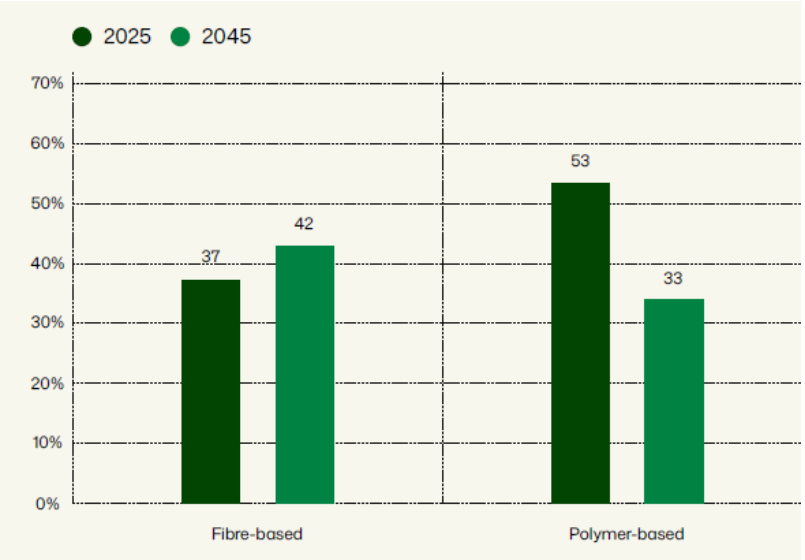
- “Recent history is littered with brands and retailers who believed consumers would accept sustainable products that compromised on performance and/or quality…
- Resulting in heavy losses in sales, brand equity, and consumer loyalty.”
  - Justin Coates, Global Head Market Research & Consumer Insights, Eastman, 2023

- “Many CPG executives report that a challenge to their ESG initiatives is the inability to generate sufficient consumer demand for these products.
- There are many stories of companies launching new products incorporating ESG-related claims only to find that sales fell short of expectations.
  - McKinsey, “Customers Care About Sustainability”, Feb. 2023

Key Packaging Trends Through 2045

- Sustainability will not be voluntary but a government mandate. Materials that fail environmental performance will go away. Recycling infrastructure will also evolve.
- EPR will continue to reward materials that are easiest to recycle (potentially compost), as well as source reduction.
- Plastics evolve but do not disappear. Will move toward mono-material formats.
- Fiber leads the way. Advances to barrier coatings will open up new applications.
- By market share, fiber is expected to increase by 5% while plastics decline by 20%.
- Consumers will continue to value sustainable packaging – as long as it comes at the same price as conventional and retains convenience, performance, and the like.

% Share of Food Packaging Market



** Metal, Glass, and Other account for 7%, 1%, and 2% in 2025*

Source: Smithers & UPM Specialty Materials "Sustainable food packaging to 2045", July 2025

THANK YOU FOR YOUR ATTENTION

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