Recyclability: Research, Regulation and Risk

Presented by:
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Our Speakers

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Recyclability: Research, Regulation and Risk

Research

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What is Plastic?

- Kindergarteners at play move according to their own rhythms; there are always several that are listening to a unique beat.
- At the end of recess, they all hold hands. This causes changes in the behavior.
- The behavior of the long chains of children is different than individuals.

Polymers/Plastics often pose lower ecotoxicity risks than the individual monomers from which they are synthesized
Example: Styrene versus Polystyrene

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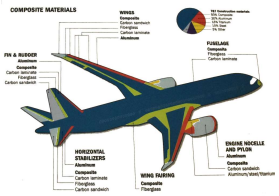
All Plastic is Long Chains of Repeating Units

How these long chains interact with each other gives rise to the unique properties

Stiff chains: Polymer composites - Airplanes

Polymer composites



Cooked oiled pasta

Chains slide against each other stretch, don't break - Trash bags can stretch to 800%

Not oiled pasta, solid mass

Rubbery solid networks, like rubber - Tires can withstand huge pressure and still be flexible

RAMBOLL Bright ideas. Sustainable change.

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Pasta Type, Sauce, and Additions Make the Dish

- Each dish is specifically crafted by the chef to the diner's individual tastes

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Modern Plastics are Not Only Polymers

- In addition to the polymer, a whole library of >13,000 functional additives give additional functionality to plastic formulations
- Examples of properties given to plastic by additives include:

Additive Type	Function / Property Added
Flame retardants	Reduce flammability by slowing ignition and flame spread
UV stabilizers	Prevent sunlight-driven degradation and fading
Antioxidants	Protect against thermal and oxidative breakdown
Plasticizers	Increase flexibility and softness
Colorants (pigments & dyes)	Provide stable, uniform color
Fillers (e.g., talc, calcium carbonate)	Improve stiffness, reduce cost, enhance heat resistance
Impact modifiers	Increase toughness and resistance to cracking
Antimicrobials	Inhibit bacterial and fungal growth
Antistatic agents	Reduce static charge buildup
Foaming agents	Create lightweight, insulating cellular structures

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Plastic Design has Been Focused on the Needs of the Primary Consumer

The result of polymer and functional additives is the wide diversity of high-performance plastic formulations in virtually every corner of the economy

Balance competing demands:

- Toughness, impact resistance, modulus, high use temperature, fatigue resistance, elasticity, strength, rheology, tack, adhesion, durability, foaming
- Properties are evaluated using standardized tests
- Always focused on cost

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Plastic is Often the Most Efficient Choice

Other Materials: Aluminum, glass, steel, ceramics - all are made with fire
Plastic is created with a catalyst - much lower energy

For a cold beverage, a PET bottle has a 40x smaller carbon budget than the equivalent packaged in glass

- Lower weight
- Lower embodied energy of production

Glass containers are mainly for alcohol

- Lower permeability to O_2 and CO_2

Material	Energy saved by recycling MJ/kg
Aluminum	207
PET (soda bottles)	87
HDPE (milk bottles)	60
Glass	10
Steel	46

RAMBOLL Bright ideas. Sustainable change.

Plastics packaging for the food and beverage industries: A case study in changing attitudes | IHS Markit

Rubens Camaratta, Tiago Moreno Volkmer, Alice Gonçalves Osorio, Embodied energy in beverage packaging, Journal of Environmental Management, Volume 260, 2020, 110172, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2020.110172.

Plastics packaging for the food and beverage industries: A case study in changing attitudes | IHS Markit

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Modern Lifestyle Requires Plastic Use

- Materials that are elastic, lightweight, tough, strong, durable, adhesive, inexpensive
- Properties can be tuned to meet specific performance properties

Think about:

- Light weighting of vehicles: plastic airframes A350, 787
- Electrical safety, data cables: wire insulation is plastic
- Electronics, computers
- Hygiene, medical sterilization
- Food and water safety
- Sealing a building to provide "inside" and controlled environment

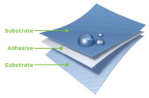

Photo by Jeremy Bishop on Unsplash
https://www.thomasnet.com/insights/single-use-plastic-scrutiny-reaches-the-medical-industry/

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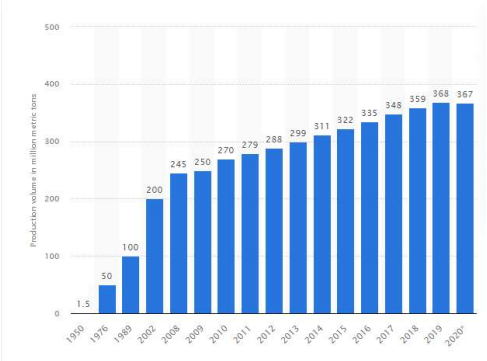
Plastic is Widely Produced, with Annual Production Exceeding 400MMT in 2026

Annual production of plastics worldwide from 1950 to 2020 *(in million metric tons)*



• Global plastic production 1950-2020 | Statista

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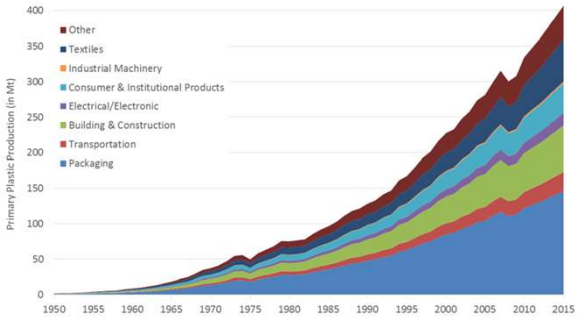
This Plastic Production is Focused Around Several Major Sectors:



- Packaging
- Building and Construction
- Transportation
- Electrical
- Textiles

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1970s Environmental Concerns included Plastic Waste

https://youtube/8Suu84khNGY

- Earth Day, Smog, Plastic Waste, Silent Spring, Cuyahoga River Fire
  - The creation of the recycling "chasing arrows" on plastic packaging
  - Municipalities created and paid for separate collection of recyclable materials
- The consumer or the municipality paid to create universal curbside recycling of materials including some plastic waste
- This condition persisted for 50+ years

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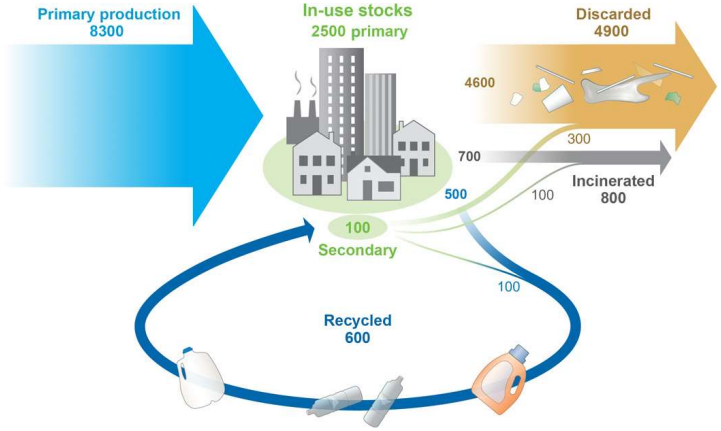
Global Production, Use, and Fate of Polymer Resins, Synthetic Fibers, and Additives (1950 to 2015; in million metric tons)



Roland Geyer et al. Sci Adv 2017;3:e1700782

ScienceAdvances AAAS

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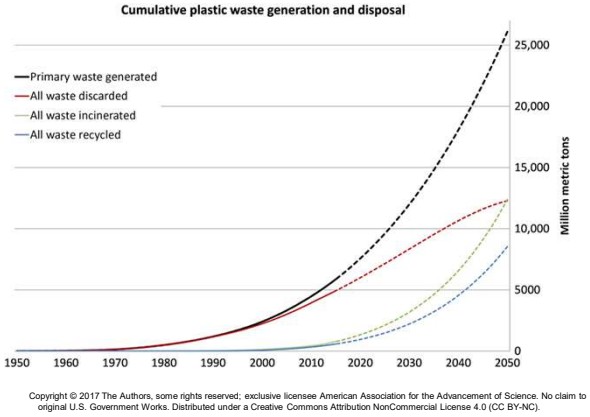
Accumulating Plastic Waste is Projected to Increase



The total amount of discarded plastic waste is projected to increase, even accounting for increases in recycling and incineration

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Long Held Fundamental Assumptions for Plastic Producers are Changing

1. Traditional focus is delivering performance for the customer
2. We are free to use any formulation or additive that increases performance
3. The additives will remain within the plastic
4. We sell the contents and the container
5. Post-Use is the responsibility of the consumer and municipality, not the producer

Our Disposable Planet: How Trillions Of Tons Of Waste Endangers Us All, Forbes, Dec 6, 2024

Microplastics are in our bodies. Here's why we don't know the health risks, Science News

Oceans littered with 171 trillion plastic pieces, BBC

Earth faces plastic pollution disaster unless we take drastic action, New Scientist

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2021: Survey of US and UK Perceptions on Plastic Packaging Revealed Negative Views of Single Use Plastic Packaging

- 88% of U.S. and U.K. consumers want brands to help them be more environmentally friendly in their daily lives[1]

- More than 80% of survey participants said they felt it was "important or extremely important" for companies to design **environmentally conscious products.** [2]
- Given nine industries to select from, 1 in 4 respondents said they felt the **chemical industry is the least concerned about the environment.**
- 77% of respondents said **plastic was the least environmentally responsible type of packaging** (Paper was deemed the most environmentally safe material.)

1. Blake Morgan, Customers Hate Plastic Packaging, So why Do Companies Keep Using it? Forbes, April 19, 2021
2. https://www.businessnewsdaily.com/15087-consumers-want-sustainable-products.html

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New Reality for Plastic

- Responsible for the entire lifetime
- Responsible for all the components of the plastic formulation
  - Responsible for all the actions, additives, of your supply chain
- There are FEES/COSTS associated with post consumer outcome
- Consumer sentiment can change your business reality in a moment
  - Redlining of a component or additive
  - Demand for changing composition and performance objectives

What are post-consumer options for plastic?

Perception is Important:

This New Reality is an opportunity to differentiate your products, company, and brands to produce higher margins

It requires:

- Funding/Risk
- New thinking, new solutions
- New formulations to meet new challenges

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Estimated Volume of Plastic Waste: 350MMT/Yr in 2025

Three options for post-use plastic:

- Mechanical recycling -50 MMT
- Chemical recycling- 3 MMT
- Degradation - <1MMT

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Mechanical Recycling:

Collected plastic is sorted, and melt reprocessed to produce a new plastic product. This often involves a combination of different plastics.

- **Advantages:**
  - 90% of plastic recycling, developed infrastructure
    - 55 M Tons/yr by 2030
  - Requires less energy
  - Value is improved with effective sorting and closed loop collection
- **Challenges:**
  - Compatability
  - Degradation of properties
  - Contamination
  - Additives

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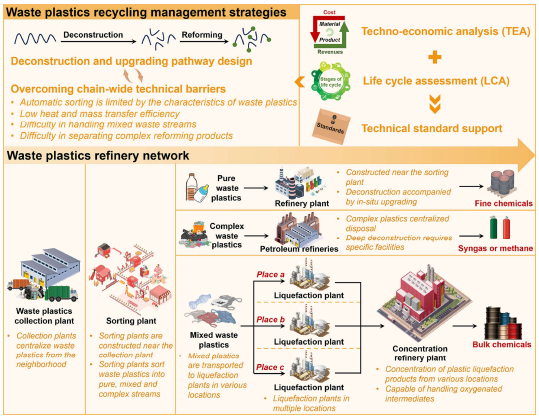
Chemical Recycling:

- Conversion of Plastic Waste into small molecules using deconstruction and then repolymerization

- **Advantages:**
  - Plastic to Plastic, return to original properties

Challenges:
- Requires considerable energy, low mass transfer
- Maintains high viscosity not suitable for existing infrastructure
- Sensitive to contaminates such as halogens and trace metals
- Oxygenated polymers (Ex: POX, Polyoxetane) cause problems
- No strong consensus that this technology will be economically or environmentally viable



Cheng et al. Chemical recycling of waste plastics: Current challenges and perspectives, Fundamental Research, 2024, ISSN 2667-3258, https://doi.org/10.1016/j.fmre.2023.12.023.

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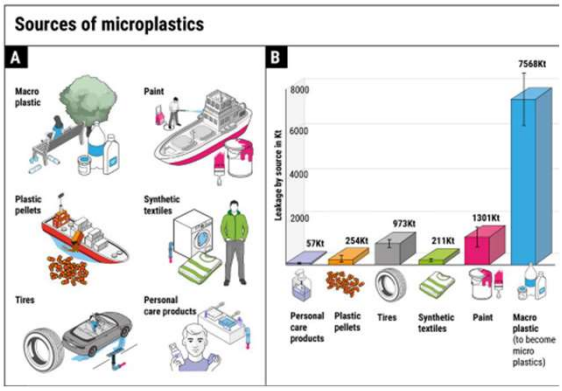
Another Concern for Plastics: Microplastics

Do the products we create degrade and produce microplastics?

Can reformulation mitigate this possibility?

- Surface oxidation of microplastics
- Fibers
- Mechanical abrasion
- Weathering

Recent publications link negative health outcomes to microplastics



R.C. Thompson et al. Science 10.1126/science.adl2746 (2024)

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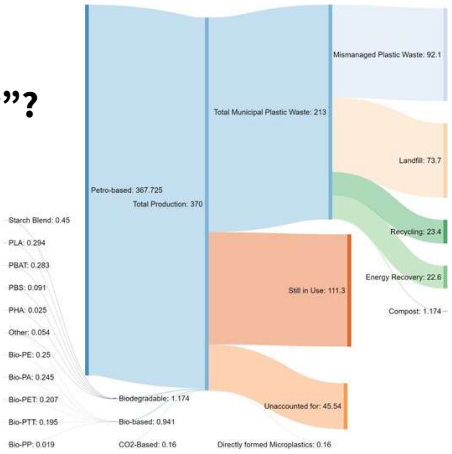
Degradation

Can Plastic Just "Go Away"?

- Bio-degradable Plastic
  - Bio-based or biodegradable (Plastics) are assimilated by bacteria or fungi to give environmentally friendly products
- More expensive than traditional plastics
- Less experience in developing high-performance formulations
- Niche products
- Not favored by municipalities



ChemSusChem. 2021 Jan 7; 14(1): 56–72.

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New Challenge to Formulators: Design for Degradation

- Create Formulations where Design Life = Service Life
  - Design for expected life cycle of the plastic product
    - Packaging should last only long enough to deliver the product
- Minimize the additives that could leach into ecosystem
- Incompatible with recycling
- Design for use, and reuse
  - New tool: additives that actively degrade the plastic after intended use

Banana Peel: "Perfect Package"
- Protects and Delivers the product
  - Just stable enough
  - Upon delivery, begins to rapidly degrade
  - No additional input of energy, non-toxic

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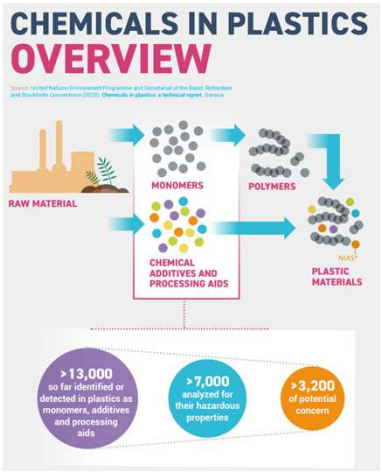
Additives: A Potential Source of Emerging Contaminants

- Currently 13k additives
- There are >7k for which hazards are known, ~5k are unknown
- There are >3.2k that are a potential Chemical of Concern

- As we create new pathways for our products to be recycled, we need to ask if all the additives are necessary
- Requires new creative thinking on all aspects of our products

In our examples, just one of these additives is enough to create an issue



UNEP, Chemicals in Plastics – A Technical Report, May 03, 2023
https://www.unep.org/resources/report/chemicals-plastics-technical-report

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Tradionally, Formulation Problems are Solved by Addition

- A relative is on 30+ medications. Every time we go see a doctor, they add a medication. No one steps back and looks at the whole picture
- Is that the way you solve problems with your formulations?
- For example, do you really need Hindered Amine Light Stabilizers (HALS) in single use plastic?

Before: Plastic entombs additives where they are not released
Now: Plastic formulations are temporary, all components are potentially released to environment

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What Have We Learned?

- Plastic is intentionally designed: Consists of long chains of repeating units and functional additives
- Intentionally designed plastic formulations exhibit a large range of unique high-performance solutions, in every corner of the economy
- The total production of plastic exceeds 400 MMT and is increasing, while less than 10% of these materials are recycled
- The accumulation of post-use plastic is generating negative impressions for plastics
- There are two dominate methods of recycling plastic:
  - Mechanical Recycling – melting and combining plastic ~50MMT/yr
  - Chemical Recycling – degrading the plastic and recreating it ~3 MMT/yr
  - Degrading (bio/chemical) is < 1MMT/yr

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Recyclability: Research, Regulation and Risk

Regulation

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Session Goals

- Understand the federal framework governing recyclability claims
- Review FTC Green Guides and deceptive marketing risk
- Examine emerging state regulation of recyclability labeling
- Identify enforcement trends
- Provide practical compliance strategies for companies

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Why Recyclability Claims Are Under Scrutiny

- Increased focus on plastic waste and circular economy
- Consumers rely heavily on recyclability labels
- Many materials labeled recyclable are not widely recycled
- Regulators and plaintiffs' attorneys are increasingly challenging marketing claims
- Growing overlap between environmental policy and consumer protection law

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Federal Landscape

- Federal Trade Commission Act (Section 5)
- Prohibits unfair or deceptive acts or practices
- Environmental marketing claims evaluated under deception standards
- FTC Green Guides provide interpretive guidance
- Federal oversight largely focused on advertising and labeling claims

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FTC Green Guides – Overview

- First issued in 1992; updated periodically
- Provide guidance on environmental marketing claims
- Address recyclability, recycled content, compostable claims, and more
- Not binding regulations but widely used by regulators and courts
- FTC currently considering updates to the Guides

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FTC Guidance on Recyclable Claims

- Unqualified "recyclable" claims may be deceptive
- Claims appropriate only if recycling facilities are available to a substantial majority of consumers
- FTC historically interprets "substantial majority" as ~60%
- If access is limited, claims must be qualified
- Qualifications must clearly communicate limitations

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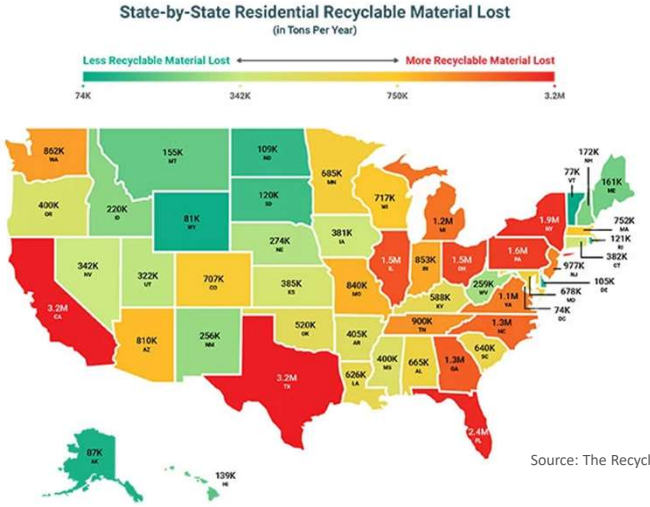
Gaps in U.S. Recycling Systems



Source: The Recycling Partnership

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Use of the Chasing Arrows Symbol

- Universally recognized recycling symbol
- FTC: symbol can imply recyclability if used on packaging
- Risk when packaging is not widely recyclable
- Resin Identification Codes (RIC) often confused with recyclability
- Regulators increasingly scrutinizing use of the symbol

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RICs Don't Equal Recyclability

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State Regulation is Expanding

- States increasingly regulating recyclability labeling directly
- Some states limiting use of recycling symbols
- Others creating extended producer responsibility (EPR) programs
- Requirements may differ significantly by state
- Companies must monitor a patchwork regulatory landscape

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Example: California Truth in Recycling Law (SB 343)

- Restricts when products can be labeled recyclable
- Requires statewide recyclability determinations
- Managed by California Department of Resources Recycling and Recovery (CalRecycle)
- Products must meet specific collection and sorting thresholds
- Significantly limits recyclability claims for many plastics

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State EPR Laws

States with Existing EPR Laws
2026 EPR Watch List
Source: Amcor

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State Labeling Laws (Examples)

- Washington – strict rules on recyclability labeling for packaging
- Oregon – EPR program and recyclability definitions
- Maine – first U.S. packaging EPR law
- Several states studying or proposing similar legislation
- Trend toward standardized labeling frameworks

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Extended Producer Responsibility (EPR)

- Requires producers to finance or manage recycling systems
- Often includes labeling or recyclability requirements
- Shifts cost burden from municipalities to producers
- Growing rapidly across U.S. states
- Compliance will require significant supply-chain coordination

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A Great Resource!

What's New in Packaging Policy? Packaging Policy Roundup

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Compliance Considerations for Companies

- Substantiate recyclability claims with current recycling data
- Evaluate claims under FTC Green Guides
- Monitor evolving state laws and EPR programs
- Review use of recycling symbols and RIC codes
- Coordinate marketing, legal, and sustainability teams

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Risk Mitigation Strategies

- Conduct periodic audits of packaging claims
- Track recyclability access across markets
- Use clear qualifying language when necessary
- Implement internal approval processes for environmental claims
- Monitor enforcement trends and litigation

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Key Takeaways

- Recyclability claims are under increasing regulatory scrutiny
- FTC Green Guides remain the core federal framework
- State laws are rapidly reshaping recyclability labeling
- Litigation risk is increasing for companies making broad claims
- Proactive compliance strategies are essential

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Recyclability: Research, Regulation and Risk

Risk

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Risks Considered—Business & Legal

- Webinar Objective—Cover Ongoing Risks to Businesses from Recycling
- Business Risks—Financial, Operational, & Reputational
- Legal Risks—Regulatory, Contractual, & Litigation
- Mitigating Risks—Coordination, Labeling, & Insurance

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Business Risks—Financial, Operational, & Reputational

- Financial
- Operational
- Reputational

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Legal Risks—Regulatory, Contractual, & Litigation

- Regulatory—Compliance & Coordination
- Contractual—Manufacturer, Transporter, Sorter, Supplier, & Franchise
- Litigation—Regulatory, Consumer, & Competitor

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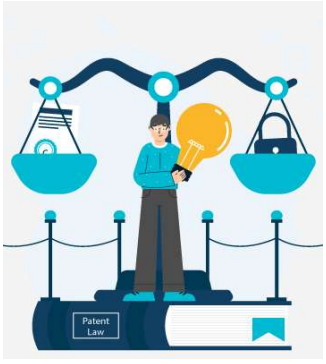
Legal Risks—Regulatory



- Compliance
- Coordination

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Legal Risks—Contractual

- Manufacturer
- Transporter
- Sorter
- Supplier
- Franchise

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Legal Risks—Litigation

- Regulatory—Federal, State, & Local
- Consumer—Class Action & Citizen Suit
- Competitor—Associational & In-Court

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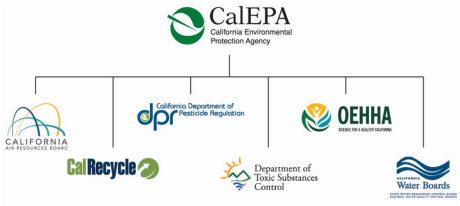
Legal Risks—Litigation—Regulatory

- Federal—
  - PACK Act
- State & Local—
  - California
  - Arizona
  - Philadelphia



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Legal Risks—Litigation—Consumer

- Consumer Class Action
- Citizen Suit
- Related Claims
  - Biodegradable
  - Compostable

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Legal Risks—Litigation—Competitor

- Associational—
  - Better Business Bureau, National Advertising Division
  - Bottled Water Association
- In-Court—
  - Moldex-Metric v. Protective Industrial Products

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Mitigating Risks—Coordination, Labeling, & Insurance

- Coordination—Responsible End Markets
- Labeling—Federal and State Laws
- Insurance—Litigation Liabilities

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