

# Advanced Recycling: Limitations and Potential Solutions



August 26, 2021



## RETAIL INDUSTRY LEADERS ASSOCIATION

The Retail Industry Leaders Association (RILA) is the US trade association for retailers that have earned leadership status by virtue of their sales volume, innovation or aspiration. We convene decision-makers to collaborate and gain from each other's experience. We advance the industry through public-policy advocacy and promote operational excellence and innovation. And through research and thought leadership, we propel developments that foster both economic growth and sustainability.

**Our aim is bold but simple:** to elevate a dynamic industry by transforming the environment in which retailers operate.

<https://www.rila.org>

# RETAIL COMPLIANCE CENTER

The Retail Compliance Center has a number of resources related to environmental compliance and sustainability that apply in retail including introductory information as well as detailed reviews of regulations and variations in state requirements.

[www.rila.org/rcc](http://www.rila.org/rcc)



Webinars



Fact Sheets



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Retail Advisor



Newsletters

# HOUSEKEEPING

## **Everyone is muted upon entry**

- This reduces background noise during the webinar.

## **Recording**

- The webinar is being recorded and will be housed on the RCC site for future views. The slide deck will also be posted to the RCC site.

## **Posing a question/commenting**

- Please use the Q&A box to pose questions or comments.
- Questions and comments posed will go directly to the speakers and moderators.
- Questions will be answered after the conclusion of the speakers' presentation.

## **Webinar Feedback Survey**

- Survey launched during Q&A as live poll

# ANTITRUST STATEMENT

RILA believes strongly in competition. Our antitrust laws are the rules under which our competitive system operates. It is RILA's policy to comply with both the letter and the spirit of antitrust laws. This Antitrust Statement has been adopted to avoid even the appearance of impropriety under the antitrust laws.

At any association meeting, participants must avoid any discussion of the following subjects in order to avoid even an appearance of impropriety:

- **Do not** discuss current or future prices, price quotations or bids, pricing policies, discounts, rebates, or credit terms.
- **Do not** discuss cost information such as production costs, operating costs, or wage and labor rates.
- **Do not** discuss profits or profit margins, including what is a "fair" profit margin.
- **Do not** discuss allocating markets, territories, or customers.
- **Do not** discuss current or future production or purchasing plans, including plans to take facility downtime, production quotas, or limits on output.
- **Do not** discuss refusing to deal with any suppliers, customers, or competitors (or any class or type of suppliers or customers).
- **Do not** require or pressure any supplier, customer, or competitor to adopt any particular actions or policies.
- Never agree on any aspect of future pricing or output.

Do not engage in prohibited discussions before a meeting or after a meeting is over. These antitrust guidelines apply not only in formal RILA meetings, but also in hallways, casual conversations, phone calls, emails, text messages, cocktail parties, golf outings, or any other setting that is related in any way to the RILA. If you have questions or concerns, or if you are uncertain about the propriety of any subject of discussion or proposed activity, you should stop the discussion immediately and bring the issue to the attention of RILA staff or consult your company's general counsel.

# WEBINAR OVERVIEW

- The diverse landscape of advanced recycling technologies
- The potential of advanced recycling technologies to advance a circular economy for plastics
- Key risks and current limitations facing the advanced recycling industry
- Considerations for recyclability and recycled content claims

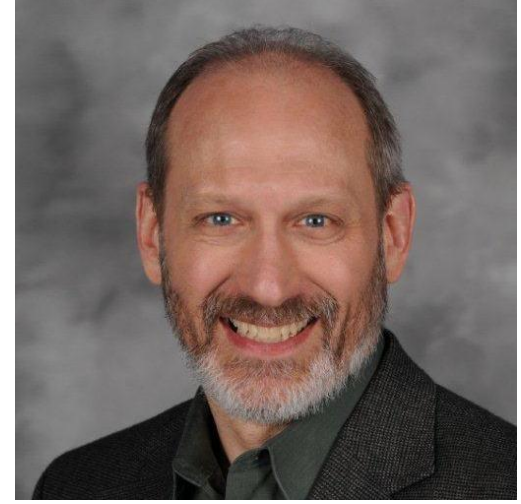
# TODAY'S SPEAKERS



**Paula Luu**  
Project Director,  
Center for the Circular  
Economy,  
Closed Loop Partners



**Anne Johnson**  
Principal and Vice President,  
Global Corporate  
Sustainability,  
Resource Recycling Systems



**Bill Hoffman**  
Ph.D,  
Corporate Fellow and  
Research Scientist & Advisory  
Services,  
UL

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# Advanced Recycling: Limitations and Potential Solutions

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# Our Business Model

INNOVATION CENTER	INVESTMENT FIRM			
<p>Center for the Circular Economy</p> <p>INNOVATION &amp; RESEARCH</p>	<p>Closed Loop Venture Fund (2017)</p> <p>Closed Loop Venture Fund II (2020)</p> <p>VENTURE CAPITAL</p>	<p>Closed Loop Fashion Fund (Est. 2021)</p> <p>GROWTH EQUITY</p>	<p>Closed Loop Infrastructure Fund (2015)</p> <p>Closed Loop Beverage Fund (2019)</p> <p>PROJECT FINANCE (DEBT)</p>	<p>Closed Loop Leadership Fund (2019)</p> <p>PRIVATE EQUITY</p>

## Research Led by Questions and Transparency

### Spring 2019 Report

- Defines the landscape and scope of advanced recycling technologies
- Market size for sector in the United States and Canada
- Profiles 62 companies in the sector

### 2021 Report Scope (October Release)



Technical-  
Economic  
Analysis



Supply Chain  
Analysis  
Feasibility



Environmental  
and Human Health  
Impact Assessment



Policy and  
Market  
Incentive  
Analysis

Read Our First Advanced Recycling  
Report:

<https://bit.ly/landscapeAR>

Register for Our Free Webinar with New  
Research:

<https://bit.ly/advancedrecycling>

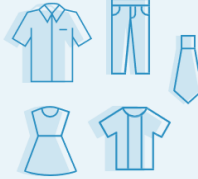
# Building a System that Addresses the Diversity of Plastics

The plastics waste crisis extends beyond packaging -- two-thirds of plastics produced are not single use plastics -- and will continue to exist unless we build recovery pathways for all types and uses of plastics.

We need to scale solutions that are safe, sustainable, and economically viable to keep materials in circulation if we are going to stop plastic waste.

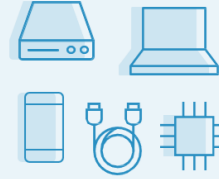
**60% of apparel produced annually is synthetic polyester fibers**

e.g. synthetic fibers like polyester and nylon



**20% of the 55 million tons of electronics sent to landfill annually is plastic**

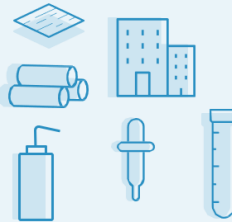
e.g. laptops, circuit boards, televisions, and hard drives



**Common plastics with limited or no end-of-life solutions**

**Nearly 100% of healthcare and construction plastic waste is landfilled today**

e.g. carpet, roofing, and floor tiles, irrigation bottles, flexible sterile barrier packaging



**Nearly 100% of all bulky rigid plastic is landfilled today**

e.g. laundry baskets, lawn furniture, auto parts

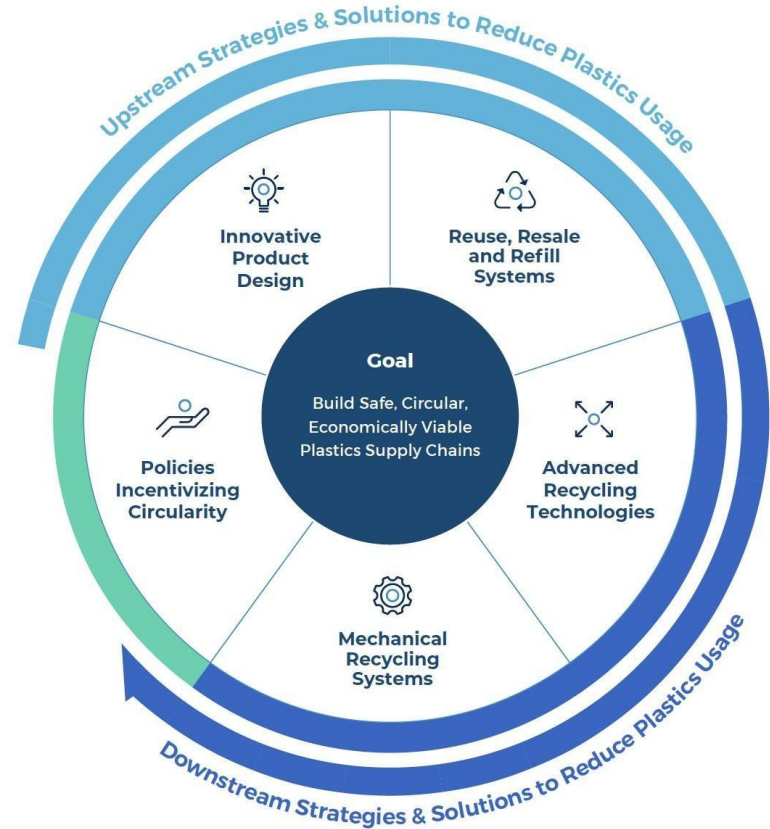


## Vision for a Waste-free Future for Plastics

Multiple tools need to be deployed simultaneously in order to accelerate systems change.

There is no panacea to solve complex global waste challenges. No one sector or single approach can solve the systemic challenge.

This **requires early upstream interventions and downstream interventions** related to the recovery infrastructure to recapture the value of plastics already in circulation.







# Advanced Recycling is a Diverse Sector

## LANDSCAPE OF ADVANCED RECYCLING

Advanced recycling is a nascent sector, encompassing dozens of different technology processes that take in a wide range of plastic feedstock and produce a wide range of outputs.

Purification, depolymerization, and conversion are each characterized by the outputs they produce.

	 Purification	 Depolymerization		 Conversion	
		Partial	Full	Partial	Full
Main Polymer Inputs	Polypropylene (PP), Polyethylene (PE), ABS, WEEE	<ul style="list-style-type: none"> <li>Polyethylene terephthalate (PET), Polypropylene (PP), Polyethylene (PE), Polystyrene (PS)</li> </ul>	<ul style="list-style-type: none"> <li>PET, Polyamide (PA), Polylactic acid (PLA), Poly (methyl methacrylate) (PMMA), PS</li> </ul>	<ul style="list-style-type: none"> <li>Mixed</li> </ul>	<ul style="list-style-type: none"> <li>Mixed</li> </ul>
Features of Reaction	Polymer bonds are not broken	<ul style="list-style-type: none"> <li>Limited chain scission</li> <li>Limited side reactions</li> </ul>	<ul style="list-style-type: none"> <li>Full chain scission</li> <li>Usually chain-end scission reactions (i.e. cutting off each monomer one by one), although mechanisms for PS and PMMA are complex</li> </ul>	<ul style="list-style-type: none"> <li>Random chain scission</li> <li>Side reactions including cyclisation</li> </ul>	<ul style="list-style-type: none"> <li>All bonds broken, including C-C and C-H</li> <li>Initial products are not hydrocarbons (usually syngas via gasification, or carbon via flash joule heating)</li> </ul>
Technology Outputs	Polymers (PP, PE)	<ul style="list-style-type: none"> <li>Oligomers: Polypropylene wax, Polyethylene waxstyrenic polymers</li> </ul>	<ul style="list-style-type: none"> <li>Monomers: Mono-ethylene glycol (MEG), Purified terephthalic acid (PTA)</li> <li>Solvents</li> </ul>	<ul style="list-style-type: none"> <li>Crude Oil</li> <li>Naphtha</li> <li>Paraffin wax</li> <li>Propylene</li> <li>Ethylene</li> <li>BTX</li> <li>Diesel and various fuels</li> </ul>	<ul style="list-style-type: none"> <li>Methanol</li> <li>Carbon monoxide</li> <li>Hydrogen</li> </ul>
Features of Products	Homopolymer	<ul style="list-style-type: none"> <li>Specific molecular products (oligomers, PET)</li> </ul>	<ul style="list-style-type: none"> <li>Specific molecular products (monomers)</li> </ul>	<ul style="list-style-type: none"> <li>Products consist of mixture of different molecule types, separated into fractions</li> <li>Large range of product molecular weights</li> </ul>	<ul style="list-style-type: none"> <li>Initial products are not hydrocarbon (although they may be subsequently reacted to form hydrocarbon products)</li> </ul>
Technology Type	Dissolution, De-inking	Enzymatic, Microorganism Degradation, Methanolysis, Glycolysis, Hydrolysis, Ammonolysis, Pyrolysis, Catalyst Initiated, Hydrothermal, Microwaves			Gasification, Ultrasonic



The technology processes themselves do not determine whether a company or a process is "circular." The stakeholders invested in creating circular systems do.

# Key Issues Facing the Sector

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## IMPACT OF TECHNOLOGY

- \_\_\_\_\_ **Misperceptions of Various Technologies**
- \_\_\_\_\_ **Supply Chain vs Technology Impacts**
- \_\_\_\_\_ **Community and Human Health Impacts**
- \_\_\_\_\_ **Comprehensive Metrics for Comparison** (i.e. Lifecycle Assessments)

## RIGHT-SIZING TECHNOLOGY

- \_\_\_\_\_ **Plastic Waste Volumes and Flows** (i.e. securing feedstock)
- \_\_\_\_\_ **Capacity to Meet Technology's Feedstock Requirements and the Investment Needed to Optimize Impacts**
- \_\_\_\_\_ **End Market Matching** (i.e. outputs from technology processes)

## ACCOUNTING TOOLS AND POLICY

- \_\_\_\_\_ **Consensus on mass balance and accounting certifications**
- \_\_\_\_\_ **Lack of policy stabilizing demand for recycled plastic content or material processing services** (i.e. PCR mandates, landfill bans)

# What's Needed to Scale Safe, Circular, and Viable Solutions?

The goal is to decarbonize our plastics economy and we will need several strategies and solutions to get there, including advanced recycling.

Many lessons to glean from solar and biofuels sectors. What we need now is a collective vision, the policy to use the tools in ways to meet our goals, and the investment and collaboration to commercialize and integrate solutions in ways that benefit the existing recycling system and our communities and ecosystems.

**MORE AND BETTER  
DATA ON PLASTIC  
WASTE AND THE  
SOLUTIONS TO IT**

**INVESTMENT IN  
TECHNOLOGY AND THE  
RECYCLING SYSTEM**

**SUPPORTIVE POLICY  
THAT DRIVES  
CIRCULARITY**

**UNPRECEDENTED  
TRANSPARENCY AND  
COLLABORATION**



# Thank you!

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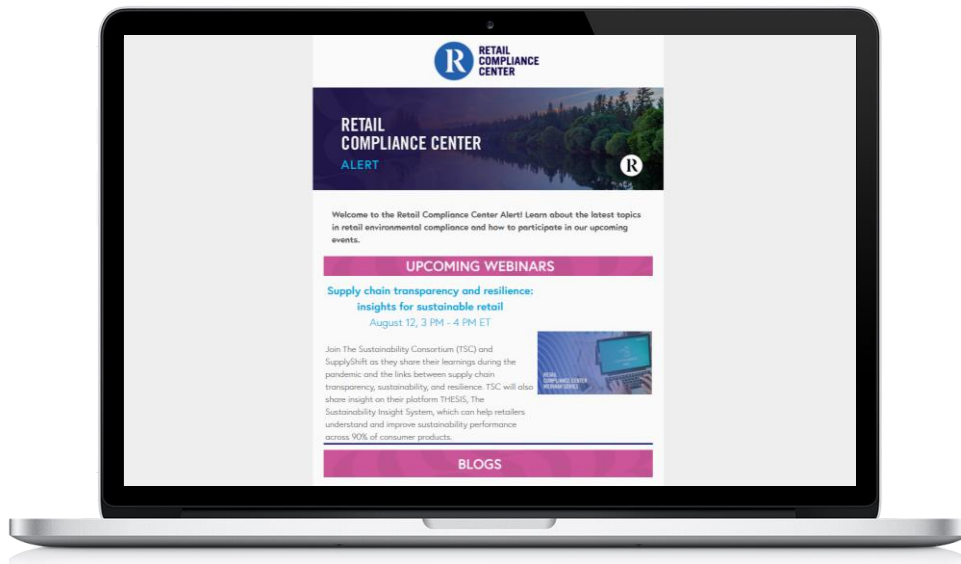


# QUESTIONS?

USE THE Q&A BOX TO SUBMIT YOUR QUESTIONS

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# RETAIL COMPLIANCE CENTER – CONTACT US

THANK YOU