U.S. House Committee on Energy and Commerce
Subcommittee on Environment
"Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth."
Documents for the Record
July 16, 2025

1. A letter from Association of Plastic Recyclers, addressed to Chairman Palmer and Ranking Member Pallone, submitted by the Majority.
2. A fact sheet from Mint Innovation titled "E-Waste Recycling for Critical Minerals and Economic Growth," submitted by the Majority.
3. A letter from the Coalition to Protect American Small Sellers, addressed to Chairman Palmer, submitted by the Majority.
4. A letter from the Paper Recycling Coalition addressed to Chairman Palmer and Ranking Member Tonko, submitted by the Majority.
5. A letter from the American Critical Minerals Association, addressed to Chairman Guthrie, Ranking Member Pallone, Chairman Palmer, and Ranking Member Tonko, submitted by the Majority.
6. A letter from the Recycled Materials Association, addressed to Chairman Guthrie, Ranking Member Pallone, Chairman Palmer, and Ranking Member Tonko, submitted by the Majority.
7. A letter from AMERIPEN addressed to Chairman Palmer and Ranking Member Tonko, submitted by the Majority.
8. A letter from the Solid Waste Association of North America, addressed to Chairman Guthrie, Chairman Palmer, and Ranking Member Tonko, submitted by the Majority.
9. A letter from the American Forest & Paper Association, addressed to Chairman Palmer and Ranking Member Pallone, submitted by the Majority.
10. A letter from NAPCOR, addressed to Chairman Palmer and Ranking Member Tonko, submitted by the Majority.
11. A fact sheet from Moms Clean Air Force entitled "Chemical Recycling 101," submitted by the Minority.
12. An article from the NRDC entitled, "More Recycling Lies: What the Plastics Industry Isn't Telling You About 'Chemical Recycling,'" submitted by the Minority.
13. An article from Politco entitled, "Trump Admin Opts for Tighter Air Rules on Plastics Recycling," submitted by the Minority.
14. A fact sheet from the Product Stewardship Institute entitled "Extended Producer Repsonsibiliy (EPR) For Packaging," submitted by the Minority.
15. A fact sheet from the Product Stewardship Institute entitled, "Packaging Extended Producer Responsibility (EPR) Rethinking Packaging Waste," submitted by the Minority.

16. A report from the Product Stewardship Institute entitled, “Making Sense of ‘Chemical Recycling’ Criteria for Assessing Plastics-to-Plastics and Plastics-to-Fuel Technologies,” submitted by the Minority.
17. A article from Plastics Today entitled, “Trump’s DOE Nixes $375M Eastman Grant,” submitted by the Minority.

July 15, 2025

The Honorable Gary Palmer
Chairman
Subcommittee on Environment
House Committee on Energy & Commerce
2125 Rayburn House Office Building
Washington, D.C. 20515

The Honorable Paul Tonko
Ranking Member
Subcommittee on Environment
House Committee on Energy & Commerce
2322 Rayburn House Office Building
Washington, D.C. 20515

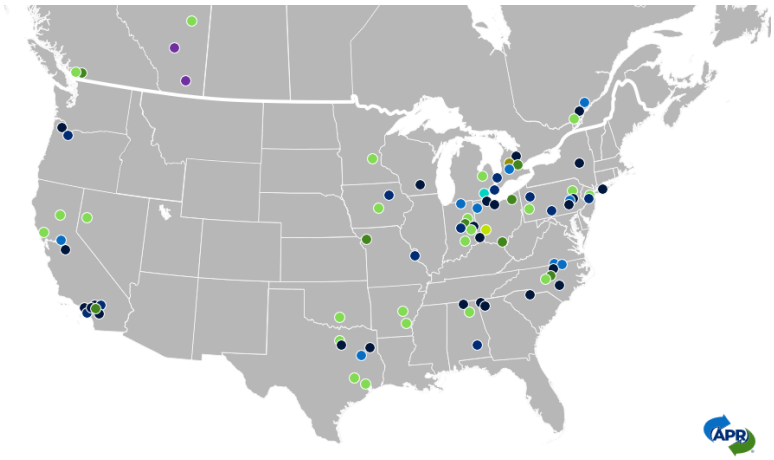
Dear Chairman Palmer, Ranking Member Tonko, and Members of the Subcommittee:

The Association of Plastic Recyclers (APR) sincerely appreciates the opportunity to provide comments regarding the July 16, 2025, hearing before the U.S. House of Representatives Committee on Energy and Commerce, Subcommittee on Environment, "Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth."

The APR is a U.S.-based, international non-profit association and the only North American organization focused exclusively on improving the recycling of plastics. APR members are the entirety of the plastics recycling industry from design to collection to recovery to remanufacturing. APR represents over 80% of the processing capacity for post-consumer plastic packaging in the U.S. and Canada. Plastics recycling is what APR does every day. APR understands the challenges facing the industry and the solutions needed to scale recycling effectively with the goals of reducing plastic pollution and supporting stronger domestic manufacturing.

There are over 80 facilities that recycle plastic packaging across 21 states. These facilities process recyclable plastic packaging from households and businesses generated by all 50 states, providing economic and environmental benefits across the country. The entire U.S. recycling and reuse industry accounts for over 680,000 jobs in the US, and is poised to exponentially grow over the coming years with new investments and policies to improve recycling.

Figure 1. Operating mechanical and physical plastics recycling facilities across US and Canada, 2025



Plastics recycling is an essential solution to ending plastic pollution, strengthening domestic supply chains, supporting U.S. manufacturing, and reducing climate pollution. APR believes the federal government plays a central role in facilitating greater action and coordination among states to improve and expand recycling.

APR offers the following recommendations with regard to federal policies to guide the Subcommittee's discussion:

1. Strong engagement in the U.N. Global Plastic Treaty to secure U.S. competitiveness
2. Enact a tariff on recycled PET to protect US recycling industry
3. Prioritize federal legislation to support the collection of more recyclable plastics
4. Reduce consumer confusion through national labeling and revised Green Guides from the Federal Trade Commission
5. Drive investment in the circular plastic economy through national recycled content requirements
6. Develop a data-driven national plan inclusive of existing federal agency work

Strong US engagement in the UN Global Plastic Treaty to secure US competitiveness

APR has been actively engaged with the UN negotiations and the US government delegation since early 2023, including as a featured speaker at several INC negotiations. APR urges the US to support a strong global plastics treaty to ensure

American leadership and innovation in the new circular plastics economy. Strong engagement in the UN process will provide these key benefits:

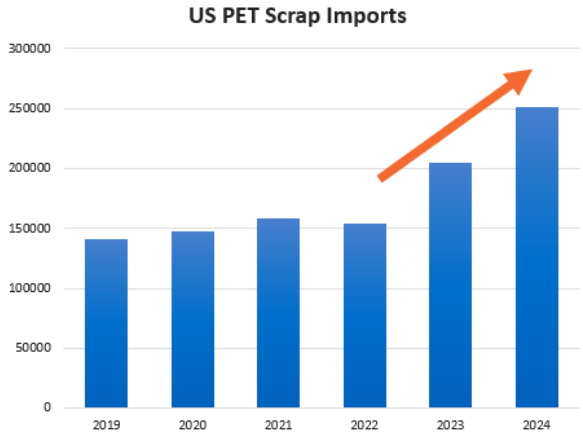
- Ensure US tools and standards are the foundation for future implementation. The APR Design® Guide for Plastics Recyclability, along with the APR recognition program, testing protocols, and training programs, have been used by many of the largest consumer goods companies for nearly 30 years and have influenced programs around the world. Similarly, U.S. federal agency initiatives including under the U.S. Department of Energy (DOE) and National Renewable Energy Lab (NREL) are leading the world in innovations around new recycling technologies, new packaging designs, and much more. U.S. leadership in the global treaty negotiations is essential to ensure that these and other U.S. tools, organizations, and initiatives are embedded into the implementation of the treaty and continue to shape the future of plastics recycling for decades to come. We cannot risk allowing other countries and organizations to set the standards and drive innovation without strong U.S. involvement.

- Reduce costs to U.S. businesses from current patchwork approach. APR is a member of the Business Coalition for a Global Plastics Treaty, which represents over 290 global businesses, financial institutions and NGOs. The Coalition supports harmonized global regulations because they provide the lowest cost option to effectively address plastic pollution. The current fragmented regulatory landscape results in increased costs and complexity. Global alignment across markets will provide much-needed certainty for businesses and investors, improving long-term decision-making and lowering the cost of capital. This will catalyze investment and innovation towards long-term value creation. In short, the U.S. will fall behind in the global economy if we do not invest in new policies and innovations to support circular plastics.

- Harmonize global actions with U.S.-state level policies. The recycling policies adopted by states are similar to those being discussed under the treaty and adopted in many regions of the world. U.S. businesses are struggling with this patchwork of existing state regulations, which is adding costs and regulatory burdens. American leadership in the global plastics treaty will help align efforts to reduce the burden on businesses and reduce the need for states to act independently of federal leadership.

Recommend protections for U.S. recyclers against imported recycled plastics

In the past two years, there has been an unprecedented surge of recycled plastics imported into the U.S., particularly from Asia. These imported recycled plastics are undermining domestic recyclers, forcing some facilities to cut production capacity, cancel expansion plans, and issue warnings of more drastic cuts if the situation is not addressed. The numbers are striking. In just two years, recycled PET (rPET) imports to the U.S. rose by over 65%, from 150,000 metric tons in 2022 to more than 250,000 metric tons in 2024. Imports from Asia now represent 44% of this volume, up from 20% in 2020.



Data source: ICIS

APR urges Congress to protect and strengthen the American recycling system by working with the Administration to implement a tariff on recycled PET plastics from outside North America. Both PET and rPET were placed on the initial exclusion list for reciprocal tariffs for reasons that remain unclear. APR supports the extension of tariffs to rPET to provide essential, substantive protection for the American recycling industry.

Accelerate immediate opportunities to improve plastics recycling through stronger collection programs

The U.S. has recycling markets for the most widely used consumer plastic packaging. In 2022, over five billion pounds of post-consumer plastics were recovered for recycling from U.S. sources. That is five billion pounds of post-consumer plastic that did not end up in a landfill or the ocean, and was instead reprocessed and made into new products.

Yet there is so much more plastic that can be recycled today using existing infrastructure and proven policies. Existing U.S. and Canadian plastics recycling facilities have the built capacity to recycle nearly two billion more pounds of plastics each year if more common plastics were collected for recycling. For example, the recycling rate of PET water and soda bottles alone, the most common type of plastic accepted in recycling programs, could improve by 30% today—using the plastic recycling facilities already running in the U.S. and Canada —if more bottles were put in the recycling bin at homes and businesses.

This data illustrates the immediate need for stronger collection programs across the U.S. to increase plastics recycling rates. While most recycling policies are determined at the state level, there is a need for targeted federal leadership to assist states and ensure a more effective, efficient national system. Specifically, APR recommends Congress focus on these three efforts to help improve recycling collection:

1. Cultivating Investment in Recycling and Circular Local Economies (CIRCLE) Act. APR encourages the members of the Subcommittee to support the Cultivating Investment in Recycling and Circular Local Economies (CIRCLE) Act. The CIRCLE Act would establish a recycling infrastructure investment tax credit to stimulate investment in the domestic recycling economy and reward those who make investments in American businesses and communities. The bipartisan Act will be introduced this week by Congressman Tom Suozzi (D-NY) and Congressman Brian Fitzpatrick (R-PA).

2. Recycling Infrastructure Accessibility Act (H.R.2145) and the Recycling and Composting Accountability Act (H.R.4109). APR encourages the Subcommittee to combine both bills with the Strategies to Eliminate Waste and Accelerate Recycling Development (STEWARD) Act (S.351), as has been done in previous sessions.

3. National packaging EPR framework: APR appreciates the leadership of Representative Tonko's office in drafting a national packaging EPR framework and the extensive work to gather stakeholder input. While states will continue to lead on recycling policies, national legislation is needed to streamline compliance and increase efficiency.

Reduce consumer confusion through national labeling and revised Green Guides from the Federal Trade Commission

Recycling needs to be easy for consumers. Right now, Americans are confused about what plastics to recycle. Clear, consistent labeling standards would increase household participation in recycling, supplying more recyclable plastics into the supply chain. A national standard would also eliminate the conflicting state laws and provide regulatory certainty for consumer goods companies who need to label primarily for national markets, not state by state.

Additionally, APR urges the Committee to direct the Federal Trade Commission to recommit staff to its 2023 review of the Federal Green Guides. These guidelines are the leading federal standards for companies on all environment labeling, including recyclability. In the absence of clear federal guidance, packaging companies are exposed to an increasing number of lawsuits around claims of recyclability, and conflicting state laws are adding unnecessary burden and cost.

Drive investment in the circular plastic economy through national recycled content requirements.

Around the U.S. and the world, consumers and businesses are demanding solutions to reduce plastic pollution. A 2024 University of California, Berkeley, study found that the most impactful policy to reduce plastic pollution is to require the use of more recycled plastics to make new products.

Additionally, the federal government has already recommended federal procurement of more recycled plastics as a key opportunity for federal leadership. A 2020 report from the Government Accountability Office (GAO) identifies the economic barriers facing U.S. recycling and the role of the U.S. government in stimulating market demand through the CPG and the U.S. Department of Commerce.

Five U.S. states currently require recycled content in some plastics packaging, but state by state approaches are not preferable because most plastic packaging and products are produced for the entire American marketplace and not on a state-by-state basis. Federal incentives and requirements for recycled content are more cost-effective than state by state approaches, minimize reporting and compliance requirements, and drive greater economic and environmental benefits.

APR recommends that the Subcommittee evaluate the creation of national recycled content targets, procurement goals, and legislative opportunities. Effective goals should target both food-grade and non-food-grade plastic packaging and products, with targets set by resin and product types to reflect the many different uses of plastics.

Develop a data-driven national plan inclusive of existing federal agency work.

Despite growing consensus for national action to improve recycling, the U.S. lacks a data-driven approach to help prioritize actions based on measurable impacts. Reports and documents to date are more qualitative in nature and lack the objective, data-driven rigor to make smart, targeted investments in proven policies. The APR urges Congress to commission a data-driven action plan focused on catalyzing the actions with the most economic and environmental benefits, and best done at the federal level. One example of a strong data-driven analysis is the PEW Charitable Trust's "Breaking the Plastic Wave," which qualifies the impacts of global action steps, similar to what is needed for the U.S. to prioritize actions. The U.S. Department of Energy (DOE) Strategy for Plastics Innovation is a strong model for setting clear and quantitative goals and priority action steps.

Moving Forward

APR is grateful to the Subcommittee for taking the time to hear from the recyclers and businesses in plastics recycling who help every day to grow U.S. manufacturing and support a clean, healthy environment. APR looks forward to continued engagement with the Subcommittee, with Congress, and with the many federal agencies who are working to accelerate recycling as an essential part of a national and global strategy to end plastic pollution and support domestic manufacturing. APR staff are available at your convenience to discuss these comments and share further technical, regulatory, and policy information.

Please contact Kate Bailey, Chief Policy Officer, at katebailey@plasticsrecycling.org.

Sincerely,

Kate Bailey, Chief Policy Officer, Association of Plastic Recyclers (APR)

mint

E-Waste recycling for critical minerals and economic growth

The growing e-waste opportunity

The U.S is one of the world's largest e-waste producers. However, lack of onshore processing means critical metals are exported to foreign countries for processing or end up in landfill. Despite making up less than 2% of the U.S. waste streams, e-waste is responsible for approximately 66% of heavy metals in landfills. With the Government's current focus on critical minerals and the value of metals in e-waste, recycling innovation and capability needs to improve.

10% of global e-waste is produced in the U.S

In 2022, 7.9m tons was produced, equal to 46lb p/capita and a total of USD10.6b economic value.

Limited regulation on e-waste collection

There are no federal recycling regulations, and only half of the States have restrictions on e-waste handling.

Metals in high demand contained within e-waste

Metals make up 50% of e-waste, most of which are critical or precious metals needed to service future industries.

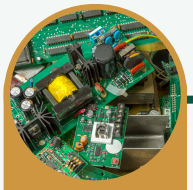
Economic value lost through e-waste

Inconsistent legislation drives cheap exports and landfill priority over metal recovery through recycling.

About Mint Innovation

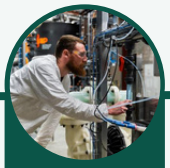
- Mint Innovation is a technology company transforming waste into circular green metals to power a better future.
- We have commercialized a world-leading process in Sydney, Australia to recover critical and valuable metals from printed circuit boards (PCBs).
- Our first U.S facility is opening in Longview, Texas in late 2026 and will recover copper, gold, silver, tin and palladium.
- We have ISO & AS/NZS certifications for our Sydney facility and will shortly acquire R2v3 certification for our U.S facility.

Our process



Printed circuit boards (PCBs)

PCBs ground to a coarse sand consistency



Base metals are dissolved and recovered

Valuable metals are selectively dissolved

Gold biosorption & copper electrowinning process

High value metal product refined

Pure metals

Key benefits to the U.S

Onshore Circular Supply

Local processing returns critical metals into local supply, powering local industries and minimizing supply chain vulnerabilities.

Low cost and easily scalable

Small, city-scale facilities designed for deployment in existing urban infrastructure, where waste is produced.

Military-grade data destruction

Complete destruction exceeding nominal 2mm NSA requirement leaving no trace of data or chip design, avoiding data and national security concerns.

Low carbon

Ambient temperatures used create significantly less carbon emissions than traditional methods like mining and smelting.

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The Coalition to Protect America's Small Sellers

July 15, 2025

The Honorable Gary Palmer
Chairman, Energy & Commerce Subcommittee on Environment
U.S. House of Representatives
Washington, D.C. 20515

Dear Chairman Palmer,

On behalf of the Coalition to Protect Small Sellers (PASS Coalition), a coalition comprised of eBay, Etsy, Poshmark, Mercari, OfferUp, Redbubble and Whatnot, and the millions of sellers and digital marketplace entrepreneurs on their platforms, we applaud the Committees for holding this hearing to examine the current state of America's recycling industry. As the hearing title acknowledges, recycling is more than just the blue bins that so many of us see around our neighborhoods and it is encouraging to see this Committee call attention to the many aspects of recycling including its role in shaping America's global economic competitiveness. The PASS Coalition appreciates the opportunity to submit this letter to be included in the official record to call attention to elements of recycling that dovetail with the transformative power of recommerce within America's circular economy, encouraging benefit and participation at the individual and small-business level beyond just large scale industrial enterprises.

One of the challenges facing the recycling industry is diverting products from landfills or incineration. According to an analysis, each US consumer discards over 100 lbs. of textiles annually, with only around 15% of that being sent to recycling facilities. Similarly, we continue to see massive increases in the total amount of electronic devices and components (so-called e-waste) that find their way to landfills rather than being resold or recycled.

As this hearing examines the broader elements of recycling from innovation in recycling technologies as well as barriers - both mechanical and chemical – recyclers encounter; to new challenges and opportunities within the industry, PASS hopes the committee also considers how recommerce can be a critical component of the broader recycling ecosystem.

Recommerce—the repair, refurbishment and resale of goods and products—is a multifaceted complement to traditional recycling and a powerful force for sustainability and economic opportunity. It is also a rapidly growing industry that is anticipated to grow more than 55% over the next four years to become a $291.6 billion dollar market. Digital platforms – like the companies that comprise the PASS coalition help drive this growth -- extend the lifecycle of countless products while simultaneously enabling sustainable entrepreneurship for millions of Americans.

As the Committee continues to examine the opportunities and benefits of the recycling industry, the PASS Coalition respectfully urges the Subcommittee to recognize that recommerce is a form

of recycling, with the added benefit of empowering individuals and entrepreneurs to earn extra income and acquire more affordable items, all while meeting the goals featured in this hearing. There is more than environmental impact from recycling, there are also significant economic considerations – both industrial and for individual entrepreneurs. Thank you for your leadership and commitment to these issues. The PASS Coalition is eager to collaborate with Congress to find solutions that marry small business growth with the environmental benefits of recycling and looks forward to working with this Committee in that endeavor.

Sincerely,

Chris Lamond

Chris Lamond
Executive Director
Coalition to Protect Small Sellers (PASS Coalition)

July 16, 2025

The Honorable Gary Palmer
U.S. House of Representatives
170 Cannon House Office Bldg.
Washington, DC 20510

The Honorable Paul Tonko
U.S. House of Representatives
2269 Rayburn House Office Bldg.
Washington, DC 20510

Re: Statement for the Record – Hearing on "Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth"

Dear Chairman Palmer and Ranking Member Tonko:

On behalf of the Paper Recycling Coalition (PRC) – an organization of eight member companies representing the interests of the 100 percent recycled paperboard and containerboard industries – we appreciate the opportunity to submit the following statement for the record regarding the Subcommittee's hearing, entitled "Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth."

The PRC commends the Subcommittee for evaluating the state of the nation's recycling system and considering various policy solutions. The PRC supports the Subcommittee's concern for, and assessment of, these issues. As you consider possible legislative policies affecting the recycling sector, the PRC encourages you to recognize that recycling commodities are not all equal. Recyclable materials such as paper have unique characteristics and face different challenges. Federal policy, therefore, should account for such differences rather than adopting a "one size fits all" approach to recycling infrastructure and system improvements.

I. About the Paper Recycling Coalition

The PRC's eight member companies represent the interests of the 100 percent recycled paperboard and containerboard industries. Our members operate over 500 facilities in 45 states and support over 65,000 well-paid jobs with competitive benefits throughout the United States. PRC members manufacture 100 percent recycled paper products that are ubiquitous in American commerce, such as cereal and pizza boxes, tubes and cores, Amazon cartons, and other shipping containers and packaging critical to today's growing e-commerce economy. The PRC's mission is to promote recycling education and to prevent market-distorting government programs and subsidies from diverting mill quality recycled fiber from the supply chain.

II. Federal Interventions in Recycling Markets Will Undermine Paper Recycling

The PRC shares congressional interest in reducing packaging pollution and ensuring that the nation's recycling system is robust, resilient, and – above all – a key component of creating a more circular and sustainable future. However, the PRC strongly believes any federal Extended Producer Responsibility (EPR) framework – or similar federal intervention – should be strategically tailored to address materials and products that have low recovery rates like plastic packaging. Potential overreach could undermine markets for other recyclable commodities – such as paper and paper-based packaging – which has a robust and well-functioning market and successful recycling track record.

To this end, any federal recycling policy, including an EPR framework, should:

- Address plastic pollution and other underperforming commodities by focusing on improving capacity and demand for materials with low-recovery rates.
- Avoid a one-size-fits all approach, recognizing instead the differences between commodities as measured by quantifiable utilization and recovery rates.
- Not pick winners and losers by disproportionately applying higher fees to highly recovered recycled commodities versus fees for lesser recovered materials.
- Preserve market-based principles to ensure a well-functioning market.
- Protect consumers from increased waste management and product costs.
- Reduce recycling challenges and barriers through education and outreach.

A. The Recycling System is Not Broken

A stated justification for greater federal intervention in recycling markets, including federal EPR and other top-down policies, is that the recycling system is broken. The PRC takes issue with this negative portrayal of the nation's recycling system and the implication that all recycled commodity sectors have failed to invest and innovate toward establishing a resilient recycling system. The 100 percent recycled paper sector has invested billions of dollars in modern recycling infrastructure over the last two decades and has worked to establish robust demand for paper and paper-based packaging. This has resulted in a 65-69 percent recovery rate of recyclable paper in 2023, marking the fourteenth consecutive year with rates above 60 percent.

B. Federal Policies Should Target Underperforming Commodities

In contrast to the paper sector's 60-plus percent recovery rate, other recyclable commodities have drastically underperformed. For instance, according to 2018 EPA data, the recycling rate for plastics is around 8.5 percent.[1] Other materials are in the double digits but the recovery rate for fiber dwarfs them all. Indeed, more paper by weight is recovered from MSW streams than plastic, glass, steel, and aluminum combined. In short, recycling commodities are not equal. Federal policy, therefore, should account for such differences rather than adopting a "one size fits all" approach to recycling infrastructure and system improvements.

C. Policies Like EPR May Undermine Recycling's Economic Impact

As the recycling sector continues to grow, especially the 100 percent recycled paperboard and containerboard industries, sound and consistent policies are critical to preserving and expanding recycling. The PRC's eight member companies, for instance, employ over 65,000 Americans across 45 states, representing $150 billion in economic impact. Short-sighted federal policies could lead to outcomes that discourage private sector investment, hinder economic growth and job creation, and hurt consumers. For instance, EPR fees will discourage the use of recyclable materials where the fee is higher and encourage the use of materials with lower fees. The fee structures in some EPR models being discussed to date would have a net increase on the cost of recycled paper packaging as compared to other packaging materials.

D. Allow Markets to Work

The PRC supports well-functioning markets and urges caution against any federal intervention to artificially create markets or pick winners or losers. Markets work best when traditional forces of supply and demand are permitted to operate free of government intervention. This is true of recycling commodities, as demand for 100 percent recycled paperboard and containerboard products and packaging has triggered billions of dollars in private capital to develop, sustain, and grow these markets.

To be sure, the domestic paper recycling sector has completed or announced nearly $7 billion in manufacturing investments through 2026 (2019-2026). These investments will add 9 million tons of additional U.S. manufacturing capacity in the form of new mills, new paper machines, paper machine conversions, and the re-starting of idle mills. Further, the investments will increase efficiency of recycled paper mills and have a positive impact on the industry's environmental profile. This is a true testament to the circular and well-functioning paper recycling market. Investments in end-user capacity and capabilities encourage supply chain investment and innovation to support that demand.

[1] U.S. EPA, "Advancing Sustainable Materials Management," (December 2020).

E. Education is the Key to Reducing Recycling Barriers

Policies that support the availability of a separate, clean stream of recyclable materials is vital to sustaining and growing the recycling sector. This can be achieved through improved recycling education and outreach. Federal programs and funding can help educate the public about not only how to recycle properly but also drive consumer engagement by stressing the many benefits – both economic and environmental – of recycling. Using the resources and reach of the federal government to educate the public is a more cost-effective strategy than a government market intervention through EPR. Recycling education can reap immediate recycling-related rewards and have a significant return on investment for taxpayers.

F. EPR and Other Fee-Based Policies Penalize Consumers

Proponents of EPR allege that producers will absorb the costs and prevent those costs from being passed onto consumers. Such arguments fail to understand how manufacturers and producers manage input costs. Consumers will pay more for products affected by EPR and these costs will not be outweighed by the purported benefits of an EPR regime. In fact, consumers often end up paying twice, both as taxpayers (as a result of increased waste management costs) and as consumers. The burden of this double payment falls most heavily on low-income consumers. Indeed, at least one study of British Columbia's EPR program demonstrated that "costs increased by approximately 26 percent from program inception in 2015 to 2018 while program performance increased by only one percent."[2]

G. EPR Does Not Address End Use Markets

End use markets are an essential part of the recycled value chain. EPR proponents suggest that addressing the recycling infrastructure and increasing supply will eventually generate demand for certain commodities, like plastic. Economic theory would suggest that end use markets must be established first. This demand will encourage investment and innovation in the recycling system to support that demand. With the low recovery rates of several materials, the current recycling infrastructure can accommodate the demands of an emerging end use market.

III. Perspectives on Chemical Recycling

The PRC shares the goal of finding solutions to address the plastics pollution challenge. We support efforts to divert plastic waste from landfills, responsible materials management, and innovative methods to convert waste into usable products with end market demand. Doing so provides important economic value and environmental protection. However, the PRC fundamentally opposes redefining chemical processes that convert plastic waste into energy and fuel as recycling. <u>This is energy recovery, not recycling</u>.

[2] Resource Recycling, "The Whole Package?" (October 26, 2020).

The paper recycling sector has worked for many decades to invest in and promote recycling to the public as a circular and sustainable alternative to landfilling. Conflating recycling with energy recovery from gasification, pyrolysis, and similar chemical processes and technologies undermines this public trust. Tens of millions of American households put their recyclables in the "blue bin" expecting these materials to be recycled into new products, not burned for energy or converted into fuel substitutes. We urge the Subcommittee to uphold the integrity of recycling and protect consumers by rejecting the misleading concept of "advanced recycling."

Moreover, Congress should avoid providing federal support to the plastics sector to aid with the construction of chemical recycling facilities, regardless of whether designed for plastics-to-energy or plastics-to-plastics. Such facilities can be permitted and built today under existing state and federal law. Federal regulatory carveouts, mandates, tax credits, definitional changes, R&D funding, and other federal interventions are not necessary to support these projects. In fact, they would distort recycling markets and undermine state and local control over solid waste management.

The plastics industry's efforts to promote chemical recycling will undermine EPA's waste management hierarchy by defining "advanced recycling" to include converting plastics and other recyclable materials into chemical feedstocks, fuels, and energy recovery. The PRC opposes such efforts. To this end, the PRC recommends that any recycling legislation developed by this Subcommittee should expressly exclude such end products from the bill's definition of recycling. To do otherwise would be to overturn decades of recycling law and policy, skew "real" recycling rates, disadvantage true recyclers, and destabilize the recycling economy.

IV. Proper Role of the Federal Government in Recycling

Despite challenges for less recycled commodities, the PRC would caution against federal interventions that distort recycling markets. But there are a handful of areas where the federal government can certainly play a role:

- Recycling Education: The federal government is well-suited to help educate the public about the benefits – both economic and environmental – of recycling. Educating communities and consumers about the importance of recycling, what is recyclable, and how to recycle properly is essential to increasing recycling rates and reducing contamination. Therefore, we were pleased to see the RECYCLE Act included in the enacted bipartisan infrastructure bill and the subsequent awarding of grants from EPA to dozens of communities. The Subcommittee should encourage EPA to continue these cost-effective grants to deserving communities across the country.

- Data Collection to Inform Recycling Policymaking: As Congress considers other recycling-related policies, it is important to have accurate and complete baseline data. Such data across the recycling supply chain is lacking. That is why the PRC supports both S. 351, the "Strategies to Eliminate Waste and Accelerate Recycling Deployment (STEWARD) Act" and H.R. 4109, the "Recycling and Composting Accountability Act." These bills provide a first step to gathering more data related to MRF inputs and outputs, landfill and waste-to-energy diversion, and other data that can inform investment decisions, as well as future policymaking.

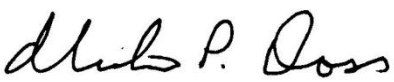
- Recycling Access: Equally important is providing communities with access to recycling, which is why the PRC supports both the STEWARD Act and H.R.2145, the "Recycling Infrastructure and Accessibility Act." The PRC supports the objective of expanding access to recycling in communities that have historically had limited access to recycling collection programs. Fortunately, access to paper recycling is readily available: the latest data from the American Forest & Paper Association, shows that 94 percent of Americans have access to community paper and paperboard recycling programs. These two bills will help close the remaining gap, while helping other recycled commodities increase their own recycling access rates.

- Protecting Recyclable Feedstocks: The federal government can also ensure a level playing field for recycled paper manufacturers by protecting our raw material – recovered fiber. In the past, the tax code has provided subsidies to the waste-to-energy sector that incentivizes the burning and contamination of paper. Financial incentives that would subsidize the destruction of another sector's raw material or otherwise distort recycling markets should be avoided by Congress.

V. Conclusion

We thank you for your leadership and we look forward to working with you and your staff as the Committee continues considering policies in furtherance of establishing a more circular, sustainable future. The PRC would be pleased to provide testimony before the Subcommittee should future opportunities arise.

Sincerely,



Brian McPheely
Chairman, Paper Recycling Coalition, Inc.
Global CEO, Pratt Industries

Michael P. Doss
Vice Chairman, Paper Recycling Coalition, Inc.
President/CEO, Graphic Packaging Int'l, LLC

Terese Colling
President, Paper Recycling Coalition, Inc.

July 16, 2025

Congressman Brett Guthrie
Chairman
Committee on Energy & Commerce
U.S. House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

Congress Frank Pallone
Ranking Member
Committee on Energy & Commerce
U.S. House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

Congressman Gary Palmer
Chairman
Subcommittee on Environment
Committee on Energy & Commerce
U.S. House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

Congressman Paul Tonko
Ranking Member
Subcommittee on Environment
Committee on Energy & Commerce
U.S. House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

Dear Chairman Guthrie, Ranking Member Pallone, Chairman Palmer and Ranking Member Tonko,

We write today in support of the Committee's efforts to advance recycling policies that will strengthen the independence and reliability of U.S. supply chains. In particular, the American Critical Minerals Association (ACMA) applauds your leadership in holding a hearing that examines the potential to reclaim materials from e-waste. These discussions are critical to ensure our critical minerals sector can access key resources as discussed below.

The mission of ACMA and its members is to support the growth of the United States' critical mineral supply chain. ACMA is an industry association that welcomes members from across the critical minerals supply chain, including raw material producers, processors, recyclers, suppliers, manufacturers, and end users, as well as academic institutions and other stakeholders. Our organization serves as a unified voice to advance U.S.-based critical mineral processing and recycling capacity for the benefit of multiple sectors, including but not limited to, the defense, transportation, aerospace, energy, and manufacturing sectors.

ACMA supports critical minerals resourcing from advanced mining, seabed extraction, innovative materials production, separation from waste streams, and recycling. All resources are essential. Perhaps more importantly though, ACMA believes that without diversification of the midstream (processing and refining) element, China's monopoly will continue to dominate these global markets. In fact, the International Energy Agency (IEA) notes that "The average market share of the top three refining nations of key energy minerals rose from around 82% in 2020 to 86% in 2024 as some 90% of supply growth came from the top single supplier alone: Indonesia for nickel and China for cobalt, graphite and rare earths."[1] The story is not much different for recycling capacity. In 2023, China accounted for 80% of global capacity for pretreatment and material recovery – the key steps in recycling minerals from end-of-life batteries.[2]

The IEA[3] regularly stresses the importance of expanding recycling globally. Whether reclaiming lithium, cobalt, and nickel from EV batteries or scaling up traditional metal recycling – recycling minerals is less emissions-intensive

[1] International Energy Agency. "Global Critical Minerals Outlook 2025." Available at https://iea.blob.core.windows.net/assets/ef5e9b70-3374-4caa-ba9d-19c72253bfc4/GlobalCriticalMineralsOutlook2025.pdf, pg 6. Last accessed July 14, 2025.
[2] International Energy Agency. "Recycling of Critical Minerals: Strategies to scale up recycling and urban mining." Available at https://iea.blob.core.windows.net/assets/3af7fda6-8fd9-46b7-bede-395f7f8f9943/RecyclingofCriticalMinerals.pdf. Pg. Last accessed July 14, 2025. Pg. 10.
[3] *Id.*

and reduces supply chain pressures on critical minerals, including key metals like copper and aluminum. The national security and environmental benefits[4] of critical minerals recycling are meaningful, but they are benefits that China is currently best positioned to capture. By securing these feedstocks and building out additional capacity to pre-treat, recover, and recycle key minerals, the United States can reduce exports to China that consequently support the growth of China's recycling sector.

While global battery recycling capacity is growing, a few glaring issues remain: (1) the buildout may not keep pace with consumption supply over the longer term, (2) available feedstock remains limited due to insufficient collection infrastructure and policies, and (3) the majority of capacity is in China.[5] In fact, "China is on track to retain 80% of global pretreatment capacity and 75% of material recovery capacity in 2030."[6] Therefore, U.S. policymakers must consider policies to address the key challenges facing this sector, underwhelming collection levels, extended producer responsibility (EPR), need for financial support, trade policy that incentivizes recycling, and the burdensome permitting regime for new capacity.

It is also important to keep in mind that recycling alone will not counter China's monopoly over critical minerals nor meaningfully reduce the need for production from more conventional sources. Projected demand for materials continues to grow at a rapid pace. Since 2017, lithium demand has tripled and, under the IEA's Net Zero Emissions by 2050 Scenario, is expected to grow tenfold. The Cobalt Institute argues that "Cumulatively, batteries for EVs, consumer electronics and stationary storage will require at least 5.5 million tons of cobalt – one of the key battery elements ensuring range, safety and durability – by 2050 to power these critical energy transition industries."[7] Meeting that demand will require investment in mines and recycling infrastructure.

ACMA advocates for comprehensive policy solutions intended to derisk U.S. investment in processing and recycling because the buildout of U.S. recycling infrastructure alone will not counter China's monopoly over the critical minerals supply chain. In addition to the above, we must advance predictable tax policy, targeted trade agreements, price support measures, and permitting legislation that includes common-sense judicial reform. All of these policies are critical to ensuring the U.S. reduces its reliance on China in the very near term.

Fortunately, each of these policy imperatives can serve to support the numerous means by which we access mineral resources – whether mining, seabed extraction, separation from waste streams, or recycling. We believe your efforts are essential to protecting and growing U.S. and allied investments in the production, processing, and recycling of critical minerals. ACMA looks forward to working with you to advance common-sense policies for the benefit of our nation's national and economic security.

Sincerely,

Sarah Venuto
Executive Director
American Critical Minerals Association

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[4] In fact, "recycled energy transition minerals such as nickel, cobalt and lithium incur 80% less greenhouse gas emissions than primary materials produced from mining". *Id at 10.*

[5] *Id.*

[6] *Id* at 10.

[7] The Cobalt Institute. Available at https://www.cobaltinstitute.org/resource/cobalt-2050-unlocking-potential-for-a-net-zero-future/#:~:text=The%20demand%20for%20cobalt%20in,focuses%20on%20three%20main%20areas: Last accessed July 14, 2025.

Recycled Materials Association

Sustainable. Resilient. Essential.

recycledmaterials.org

Via Electronic Mail

July 15, 2025

The Honorable Brett Guthrie
Chair, House Energy & Commerce Committee
2125 Rayburn House Office Building
Washington, D.C. 20515

The Honorable Frank Pallone
Ranking Member, House Energy & Commerce Committee
2125 Rayburn House Office Building
Washington, D.C. 20515

The Honorable Gary Palmer
Chairman, Subcommittee on Environment
2125 Rayburn House Office Building
Washington, D.C. 20515

The Honorable Paul Tonko
Ranking Member, Subcommittee on Environment
2125 Rayburn House Office Building
Washington, D.C. 20515

Dear Chairman Guthrie, Ranking Member Pallone, Chairman Palmer, and Ranking Member Tonko,

The Recycled Materials Association (ReMA) – the leading organization dedicated to promoting safe, economically sustainable, and environmentally responsible recycling through education, networking, and advocacy – commends the House of Representatives Energy and Commerce Environment Subcommittee for its commitment to examining both the opportunities and challenges that exist within the nation's recycled materials industry at the upcoming hearing, *Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth*.

ReMA – formerly the Institute of Scrap Recycling Industries (ISRI) – represents 1,700 companies that play a critical role in supplying recycled materials to America's manufacturing supply chain. The recycled materials industry is integral to the U.S. economy, transforming surplus and end-of-life materials into essential components of daily life and providing high-quality renewable resources for everything from national infrastructure to consumer products. America is Made with Recycled Materials. The roads we drive on and the cars we drive in, the rebar that strengthens our buildings, the wires that bring electricity and communications into our homes and offices, and the boxes that bring consumer goods and food to our homes are all made with recycled materials. In 2024 alone, the recycled materials industry generated nearly $170 billion in economic impact and supported over 600,000 direct and indirect jobs across the nation. Our industry is **Sustainable**, **Resilient** and **Essential**, producing materials that conserve and protect the environment, grow the economy, and stabilize supply chains critical to America's growth.

While ReMA is currently updating its 2025 Yearbook to reflect updated economic figures, in 2022, the U.S. recycled materials industry processed 137 million metric tons of recycled materials, including nearly 70 million tons of recycled iron and steel, 45 million tons of recovered paper and fiber, 9 million tons of nonferrous metals, and more than 5 million tons of recycled and reused electronics. Over 70% of all the recycled material processed in the United States was consumed by domestic manufacturers who rely on recycled materials to produce everything from steel beams to

cardboard boxes, vehicles and batteries, household appliances, cell phones, computers, and electronics. In a time of growing uncertainty around global trade and increasing interest in near-shoring, recycled materials represent a ready-made solution to domestic supply chain insecurity. To highlight that reliance:

- The U.S. steel industry relies on recycled materials, with over 70% of the steel manufactured in the U.S. being made with recycled ferrous metals;
- Over 75% of U.S. paper mills depend on recycled paper for daily production needs; and
- In the U.S., 80% of aluminum production comes from recycled aluminum.

To strengthen the nation's recycled materials industry and support our essential role in the supply chain, we respectfully urge the Committee to consider the following policy priorities:

Support Innovation & Investment in Recycling Infrastructure
Recycling is a capital-intensive industry. Fostering the growth of the recycled materials industry – including collection and processing – is critical to increasing material recovery, reducing pressure on the nation's overburdened landfills, and strengthening domestic supply chains. Targeted tax policy is essential to scaling and modernizing the recycled materials industry, and as such ReMA has endorsed the proposed *Cultivating Investment in Recycling and Circular Local Economies (CIRCLE) Act*, which would not only incentivize investment in new infrastructure but would also support improving existing equipment and facilities. Such a credit would help to unlock private-sector investment, increase material recovery rates, and expand domestic material processing – allowing the industry to drive progress, create new jobs, and increase supply chain resilience.

Recycling Technology Equity - Chemical and Mechanical Recycling
Innovation is at the core of our industry's success. We strongly support public and private efforts aimed at developing new recycling processes and technologies and encouraging manufacturers to adopt Design for Recycling® principles in their operations. Robotics, artificial intelligence, optical scanners, laser separation and other sophisticated technologies are now commonly found in recycled materials operations, allowing recycling to continue to be an essential part of the solution to creating a more resilient planet. For instance, significant investments are currently being made in researching non-mechanical processes (variously called "molecular", "advanced", or "chemical" processes) to convert end of life plastics back into recycled resin, resin precursors (i.e., monomers), and petrochemical intermediates and fuels.

Certain non-mechanical processes are recycling, and others are not. Plastics recycling is a series of activities that processes end of life plastic materials into marketable commodities that are subsequently consumed in lieu of virgin materials as feedstock in the manufacture of material products and not in the production of energy or fuels. Non-mechanical processes that convert plastics at the end of life into recycled resins and monomers are recycling as they are producing materials to be "consumed in lieu of virgin materials as feedstock in the manufacture of material products and not in the production of energy or fuels". Non-mechanical processes that convert plastics at the end of life into petrochemical products that are fuels or used to make fuels are not recycling.

Additionally, ReMA does not support the label of "advanced recycling" for non-mechanical recycling, as doing so creates an inappropriate and untruthful distinction between mechanical and non-mechanical recycling processes, and fully supports recognition in policy of the distinction between recycling (inclusive of both mechanical and non-mechanical recycling) and solid waste management.

Battery & Electronics Recycling – Securing Material for the Future

The battery-powered future is here now. From phones and laptops to e-bikes, scooters, and electric vehicles, batteries are present in nearly every aspect of modern life. ReMA's members are at the forefront of addressing the opportunities and challenges presented by our battery-powered future.

Over the next 10 years, the volume of batteries available for recycling is projected to triple, exceeding 700,000 tons and 962 million units per year in 2034. Of these, 845 million of those batteries will be small, loose batteries or batteries in small electronic devices, while another 84 million will be found embedded in devices. Lithium-ion battery recycling has the potential to secure a critical domestic supply chain for minerals such as lithium, nickel, cobalt, and manganese. However, several key safety, technical, logistical, regulatory and economic hurdles must be addressed to unlock that potential.

If these batteries do not reach proper recycling streams, they move from a potential valuable resource of critical minerals and other recyclable materials to a risk to the public, to first responders, and to recycling and waste employees and infrastructure. The recycled materials industry is committed to building a secure manufacturing supply chain for these materials, but doing so will require detailed understanding, and support from policymakers to address the challenges that accompany a battery-powered world and ensure the materials are recovered safely.

As the association representing those companies ensuring our manufacturing sectors have resilient supply chains, we appreciate the opportunity to provide feedback and offer both ReMA and our members to serve as a resource as needed moving forward. On behalf of ReMA, I thank you again for your work on this issue, we stand ready to support the Subcommittee's efforts to bolster recycling and welcome additional dialogue and opportunity to discuss these comments further. To continue that dialogue, please contact our VP of Government Relations and Public Policy, Kristen Hildreth at khildreth@recycledmaterials.org.

Sincerely,

Robin Wiener
President, Recycled Materials Association

AMERIPEN®

July 15, 2025

The Honorable Gary Palmer
Chairman
Subcommittee on Environment
House Energy & Commerce Committee
2125 Rayburn House Office Building
Washington, DC 20515

The Honorable Paul Tonko
Ranking Member
Subcommittee on Environment
House Energy & Commerce Committee
2322A Rayburn House Office Building
Washington, DC 20515

Dear Chairman Palmer and Ranking Member Tonko,

We are pleased to provide a statement for the record of the Subcommittee hearing on "Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth." Thank you for convening this hearing to discuss emerging policy issues, technological developments, and economic opportunities impacting recycling in the United States and globally.

The American Institute for Packaging and the Environment (AMERIPEN) represents the entire packaging value chain, advocating for responsible packaging policies that drive meaningful progress in packaging sustainability while supporting industry growth and consumer needs. Our members include material suppliers, packaging manufacturers, consumer packaged goods companies, retailers, and end-of-life materials managers.[1] Our membership also includes a robust array of industry, material, and product-specific trade associations.[2]

Packaging plays a vital role in the United States, ensuring the quality of consumer goods as they are manufactured, shipped, stored, and consumed, protecting the health and safety of U.S. citizens who consume, use, and handle those products. Packaging has value and none of it belongs in landfills, roadsides, or waterways. We need to recover it to be recycled and reused, and no one knows better how to do that than the AMERIPEN members who design, supply, produce, distribute, collect, and process packaging products. Our members are driving innovation and designing packaging for better environmental performance to boost recycling and evolve the recycling infrastructure.

The U.S. packaging industry contributes $537.91 billion in total economic output to the national economy and is responsible for nearly 1.7 million jobs. These workers earn over $117.73 billion in

[1] AMERIPEN Company Members
[2] AMERIPEN Associate Members

wages and benefits, and members of the industry and their employees pay $43.46 billion in direct federal, state, and local taxes.

As the leading voice for packaging policy in the United States, AMERIPEN works with legislators, regulators, and stakeholders to develop science-based, data-driven solutions that enhance packaging's role in product protection and circularity. AMERIPEN is leading an effort at the federal level to address a patchwork of state laws on recyclable, compostable, and reusable claims on packaging. We also support recycling bills introduced in the House and Senate, as we discuss further below.

Packaging Claims

Retailers, consumer packaged goods companies, and their suppliers are facing a patchwork of laws at the state level related to making recyclable, compostable, and reusable claims on packaging. This is leading to interstate commerce challenges for businesses and promoting consumer confusion on how to dispose of packaging. This dynamic exists because the Federal Trade Commission (FTC), which regulates advertising claims under federal law, currently lacks the authority to preempt state laws regulating these claims. While the FTC has issued the "Green Guides," these are merely "guides" that are not independently enforceable, without the force and effect of law.

The packaging value chain supports the introduction and passage of the Packaging and Claims Knowledge Act (PACK Act), which will establish a new framework for compostable, recyclable, and reusable claims for consumer product packaging under the FTC Act. The PACK Act will create a uniform federal structure specifying when compostable, recyclable, and reusable claims can be made for packaging and will preempt state laws that attempt to regulate these types of claims in an inconsistent manner. The legislation calls on the FTC to work with and consider input from the Environmental Protection Agency (EPA) to administer the new scheme. The key elements of this framework include:

- State Preemption – States will be preempted from establishing, enforcing, or continuing in effect any legal requirement unless it is identical with any requirement imposed under the PACK Act. This approach will: (1) ensure that a truly national and consistent framework for compostable, recyclable, and reusable claims for packaging is achieved to eliminate interstate commerce challenges; (2) to the extent possible, eliminate consumer confusion and mistrust regarding packaging claims; and (3) help assure that packaging is handled correctly.
- Mandatory Third-party Certification Scheme for Consumer Product Packaging – The PACK Act establishes a mandatory third-party certification program, based on existing industry-recognized standards, for claims that consumer product packaging is compostable,

recyclable, or reusable. This allows independent third parties to certify that product packaging meets industry standards and follows the FTC's guidance to avoid deceptive claims.

- Focus on Consumer Product Packaging – The certification programs will address how compostable, recyclable, and reusable claims can be made for different types, shapes, sizes, and colors of consumer product packaging. Non-consumer product packaging will not be subject to the mandatory third-party certification requirement.

Recycling Infrastructure and Accessibility Act

AMERIPEN supports passage of the Recycling Infrastructure and Accessibility Act (RIAA) of 2025 (H.R. 2145) that would require EPA to create a grant program to improve recycling programs in underserved areas. This federal funding will play a critical role in increasing recycling access and rates. The U.S. must improve material recycling and recovery systems, especially in rural and underserved communities, to reuse more materials and achieve a more circular economy.

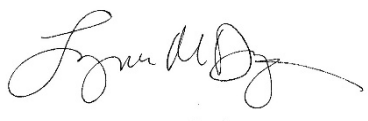
Recycling and Composting Accountability Act

AMERIPEN supports passage of the Recycling and Composting Accountability Act (RCAA) (H.R. 4109) that would require EPA to collect, maintain, and publish data on recycling and composting rates across the country— information that will be critical to improving recycling and composting programs and evaluating future policies. AMERIPEN also appreciates that the RCAA includes a report on recyclable material and compost end market sales as our members strongly support end market development.

CONCLUSION

Thank you for the opportunity to submit this statement for the hearing record. AMERIPEN is looking forward to working with you on these important federal policy issues that impact packaging, recycling, and composting.

Sincerely,



Lynn Dyer
AMERIPEN Executive Director

SWANA
SOLID WASTE ASSOCIATION OF NORTH AMERICA

July 16, 2025

U.S. House of Representatives Committee on Energy and Commerce
Subcommittee on Environment
2125 Rayburn House Office Building
Washington, D.C. 20515

RE: Hearing on *Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth*

Dear Chairman Guthrie, Chairman Palmer, Ranking Member Tonko, and Members of the Subcommittee,

The Solid Waste Association of North America (SWANA) commends the House Committee on Energy and Commerce, Subcommittee on Environment for holding a hearing on the landscape for improving recycling innovation and fostering economic growth. This is a timely and critical discussion. Strengthening recycling systems through federal action is essential to building resilient domestic supply chains, supporting resource management, and driving long-term economic development.

SWANA is committed to advancing from waste management to resource management. Our members — recognized experts across the fields of recycling, organics management, collections, workforce safety, landfills, PFAS mitigation, waste-to-energy, and more — are deeply invested in the outcomes of this hearing.

As a leading professional association in the waste and resource management sector, SWANA serves industry professionals through technical conferences, certifications, publications, and a large offering of technical training courses. We serve as a trusted source of information for both our members and the media on industry trends and emerging opportunities. We are building a stronger waste and resource management industry, empowering our members to deliver essential services to communities today and anticipate their needs for tomorrow.

SWANA supports the use of domestic renewable resources to create high-quality materials for essential infrastructure and consumer goods. The recycling of packaging and products into new materials, and the processing of organic material into compost and energy are key for supporting supply chains. Our industry plays a key role in the recycling supply chain, enabling the use of recycled content in producing millions of products and packaging that Americans rely on daily.

Federal investment through the Solid Waste Infrastructure for Recycling (SWIFR) Grants has already made a meaningful impact, enabling communities, states, and territories to launch or expand reduction, reuse, and recycling programs that might otherwise remain unattainable. SWANA encourages the continuation of SWIFR grants and the dedication of additional funding mechanisms. While this support is historic and significant, the demand for infrastructure investment still far exceeds available resources.

SWANA endorses the proposed Cultivating Investment in Recycling and Circular Local Economies (CIRCLE) Act, a creative solution to the challenge of funding recycling systems. The CIRCLE Act would establish a federal recycling infrastructure investment tax credit to incentivize recycling infrastructure development in the US. We encourage the Committee to support this bipartisan legislation which is supported by diverse stakeholders. Many SWANA members are eager to expand recycling operations but face financial barriers. The CIRCLE Act

would provide a much-needed catalyst for investment in this critical sector, and SWANA urges its prompt passage.

On the international front, the upcoming United Nations Intergovernmental Negotiating Committee meeting at INC-5.2 may have significant implications on US recycling, particularly related to plastic production, design, and available end markets for recycled content. The outcomes may provide changes to financing mechanisms; policies related to extended producer responsibility, product design, and limits on plastic production; and the structure of the implementation. SWANA encourages the US to play an active role in the treaty negotiations and to support an outcome that will support strong, holistic waste and resource management systems.

To support informed dialogue at INC-5.2, SWANA is hosting a stakeholder event in Washington DC on July 29th, ahead of the start of INC-5.2. This gathering of stakeholders will serve to raise awareness of the critical importance of the waste and resource management sectors and to align on key points going into the negotiations. We respectfully invite the members of the Committee on Energy and Commerce and colleagues to attend and engage with industry leaders on these pressing topics. Please contact Kristyn Oldendorf at koldendorf@swana.org for additional details.

Battery and electronics recycling (e-waste) is another urgent priority. Recovering critical minerals, preventing hazardous materials from entering landfills, and reducing fire risks are essential goals in many industries. Fires caused by lithium-ion batteries are increasingly common in solid waste and recycling facilities and collection vehicles, creating a major safety risk and causing costly damage. Insurance rates for waste and recycling facilities have been increasing due to the risk of fires, an additional cost for businesses and organizations that may force them to go out of business. This has become an emergency in our industry. We urge the Subcommittee to support policy solutions that promote safe collection of batteries and electronics, in order to prevent fires and to promote the recovery of materials, reducing reliance on foreign sources for critical minerals.

Above all, the safety of our workers is our highest priority. Policy solutions should include a lens of worker safety. We encourage the Subcommittee to support workforce development programs that properly train individuals for the wide range of trades and professions essential to modern waste and resource management. Our sector supports a diverse and skilled workforce, creating local jobs and strengthening regional economies.

SWANA welcomes collaboration and stands ready to support the Subcommittee's efforts to advance recycling, protect workers, and build a more sustainable and resilient future. Thank you for your work on these important issues. We welcome you to contact the undersigned at koldendorf@swana.org for additional conversation and engagement.

Sincerely,

Kristyn Oldendorf
Senior Director of Public Policy and Communications

American Forest & Paper Association
Statement for the Record
House Committee on Energy and Commerce, Subcommittee on Environment
Hearing on *"Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth"*
July 16, 2025
2322 Rayburn House Office Building

The Honorable Gary Palmer
170 Cannon House Office Building
Washington DC 20515

The Honorable Paul Tonko
2269 Rayburn House Office Building
Washington DC 20515

Dear Subcommittee Chairman Palmer and Ranking Member Tonko,

We are writing regarding the Subcommittee on Environment's hearing on "Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth" on July 16. The American Forest & Paper Association (AF&PA) appreciates the opportunity to share our recycling story on behalf of our members and their employees who manufacture recycled products every day as part of the circular economy.

The American Forest & Paper Association (AF&PA) serves to advance public policies that foster economic growth, job creation and global competitiveness for a vital sector that makes the essential paper and packaging products Americans use every day. The U.S. forest products industry employs more than 925,000 people, largely in rural America, and is among the top 10 manufacturing sector employers in 44 states. Our industry accounts for approximately 4.7% of the total U.S. manufacturing GDP, manufacturing more than $435 billion in products annually. AF&PA member companies are significant producers and users of renewable biomass energy and are committed to making sustainable products for a sustainable future through the industry's decades-long initiative — *Better Practices, Better Planet 2030*.

Paper Recycling Works

Paper recycling is a model that works. The paper and paper-based packaging industry has a demonstrated, measurable record of success in making paper products more circular and sustainable through market-based approaches. The paper industry recycles nearly 60% more paper today than it did in 1990. In 2023, our recycling rate for cardboard was 71-76% and our recycling rate for paper was 65-69%.

Paper recycling is well integrated within our industry – AF&PA members own and operate more than 100 materials recovery facilities (MRFs) nationwide. In addition, our industry has planned or announced nearly $7 billion in manufacturing infrastructure investments (2019-2025), which will use more than 9 million tons of recycled fiber in our products. The forest

products industry has also set a goal to increase the use of secondary materials like recycled paper in new paper products to 50% by 2030.

Our industry prioritizes data collection to improve recycling rates and we have long invested in research into the state of paper recycling and how we can improve. The 2021 AF&PA Access to Recycling Study shows that 94 percent of Americans have access to community paper and paperboard recycling programs. In addition, AF&PA's Design Guidance for Recyclability provides data for packaging designers and consumer brands interested in improving the recyclability of their packaging on how non-fiber elements impact the recyclability of paper-based packaging.

AF&PA Supports Recycling Solutions

AF&PA supports several pieces of legislation that will help improve data collection and accessibility. AF&PA supports H.R. 4109, the Recycling and Composting Accountability Act (RCAA), which will help further increase and improve recycling and composting in the U.S. by helping the Environmental Protection Agency to improve measurement, data and reporting tools. AF&PA also supports H.R. 2145, the Recycling Infrastructure and Accessibility Act of 2025 (RIAA), which will improve recycling accessibility in underserved communities. AF&PA also supported previous iterations of the RCAA and RIAA (H.R. 4040/S. 1194 and H.R. 6159/S. 1189, respectively) that were introduced in the previous Congress. In addition, AF&PA supports the STEWARD Act of 2025 (S. 351), which combines many of the important provisions contained in the RCAA and RIAA into one bill that would establish a pilot grant program to improve recycling accessibility and require EPA to collect and disseminate data on recycling and composting programs.

AF&PA believes that these pieces of legislation are important tools that will help generate the necessary data to improve the accessibility of recycling, particularly in rural and underserved communities. We look forward to working with the Committee to help advance these important bills and other policies to strengthen the recycling system.

AF&PA Supports Free and Fair Recycling Markets

The free market makes it possible for paper to be collected, processed, and utilized in the most efficient and highest-value way in recycled products. Government interventions in recycling markets through policies such as extended producer responsibility (EPR) or by supporting chemical recycling results in subsidizing materials with low recycling rates at the expense of materials with high recycling rates, such as paper.

Federal aid to the plastics sector to help sbuild their recycling infrastructure via regulatory carveouts, definitional changes, grant provisions, and other interventions is unnecessary. Moreover, it can distort recycling markets and undermine state and local control of recycling programs and waste management.

There has been an effort at the federal and state levels to expand the definition of "recycling" to include processes that produce fuel or fuel substitutes for use in energy production. This is energy recovery, not recycling, and AF&PA opposes such efforts.

Advanced recycling is being used to create a new term that equates "recycling" and "energy recovery" and seeks to create new permitting and tax requirements for processes under this term. There are several issues with this:

- **Creates a competitive advantage for certain industries over others.** Using a term so similar to "recycling" that includes producing fuels for use in energy production creates a risk they could be equated or diminish the efforts of other industries to increase their recycling rates.
- **Allows consumer brands to meet their recycling goals by turning post-use packaging into fuels used for energy production.** This is disingenuous and would mislead the American public, who often base purchasing decisions on such goals.
- **Allows for fuel manufacturing to qualify for recycling tax credits.** This policy opens the door to those energy recovery technologies converting post-use materials into fuels or fuel ingredients to also qualify for manufacturing tax incentives reserved for recycling facilities in some states.
- **Creates precedent to use commonly recycled paper for energy recovery and call it "recycling."** The paper industry does not want to create a system that puts burning paper on par with recycling.

Paper recycling has enjoyed decades of success because of the industry's private investments, our consumer education initiatives, the wide availability of recycling programs, and the efforts of millions of Americans who recycle at home, work, and school every day. The paper products industry is proud to be part of the recycling solution by providing renewable, sustainable, and highly recycled products for consumers. We look forward to continuing our work with the Committee, and your staff may contact Elizabeth Olds, Senior Manager of AF&PA Government Affairs, at Elizabeth_Olds@afandpa.org for further information.

NAPCOR
National Association for PET Container Resources

July 16, 2025

The Honorable Gary Palmer
Chair-Designate
House Energy and Commerce Committee
Subcommittee on Environment
U.S. House of Representatives
Washington, D.C. 20515

The Honorable Paul Tonko
Ranking Member
House Energy and Commerce Committee
Subcommittee on Environment
U.S. House of Representatives
Washington, D.C. 20515

Dear Chairman-Designate Palmer and Ranking Member Tonko:

The National Association for PET Container Resources (NAPCOR) submits the following comments regarding the House Committee on Energy and Commerce, Subcommittee on Environment hearing titled, "Beyond the Blue Bin: Forging a Federal Landscape for Recycling Innovation and Economic Growth." Thank you for holding a hearing on this important topic.

About NAPCOR

NAPCOR is the industry association for the polyethylene terephthalate (PET) plastic packaging industry in the United States, Canada, and Mexico. We represent the entire PET supply chain, including recyclers, raw material suppliers, container producers, and equipment suppliers. Our members supply consumers with safe, durable, versatile, and sustainable materials used in a wide range of products, including beverage bottles, food packaging, household items, clothing, medical supplies, toys, and automotive parts. PET plastic waste is a valuable asset that can be transformed into new products when effectively recycled, at a lower cost and using less energy than alternatives such as aluminum and glass.

PET Plastic Recyclability

PET plastic, universally recognized by the number 1 resin identification code, is the most widely recycled plastic in the world. More than three billion pounds of used PET bottles and containers are collected annually in North America (the US, Canada, and Mexico) for recycling. More than 1.9 billion pounds of used PET bottles and containers are recovered in the US each year alone. PET plastic bottles and jars are accepted in virtually all US recycling programs and are recycled at higher rates than any other type of plastic. A PET plastic bottle can be recycled repeatedly and can be made with up to 100 percent post-consumer recycled material; it's made to be remade.

Our latest research shows that the US PET bottle collection rate was 33 percent in 2023, up four percentage points from 29 percent in 2022; the highest recycling rate in the US since 1996. The average amount of post-consumer recycled PET used in US bottles and jars was 16.2 percent in 2023, up three percentage points from 13.2 percent in 2022. This is the highest level, demonstrating a significant increase in demand for recycled PET nationwide.

PET's Sustainability

Research shows that ultra-lightweight PET plastic is more sustainable than alternatives, as it requires less energy for production and transportation, ultimately resulting in significantly fewer greenhouse gas emissions. For example, compared to a 12 oz. aluminum can and a 12 oz. glass bottle, a 16.9 oz. PET plastic water bottle requires 80 percent less energy during production, creates 80 percent less solid waste, uses 53 percent less water during production, has a 74 percent lower global warming potential, and generates 68-83 percent fewer emissions. Please refer to the infographics at the end of this document for more details on the advantages of PET water and soft drink containers.

Recycling Infrastructure, Methods, and Innovation

PET has an established, robust recycling infrastructure in the US. The US collected 1,962 million pounds of PET bottles for recycling in 2023, 87 percent of which were reclaimed domestically. Mechanical recycling is well-developed and utilizes readily available technology. Chemical recycling, or depolymerization, complements mechanical recycling, enhancing the recovery of all PET packaging, including some challenging-to-recycle packages. The PET industry has a history of innovating with sustainable practices in mind while meeting the requirements of consumers who rely on PET. Currently, PET reclaimers utilize AI, automation, and advanced sorting technologies, among other technological advancements, to capture more PET packaging for recycling.

Domestic Supply

Currently, there is a limited domestic supply of recycled PET, which forces our members to rely on suppliers outside of North America for materials, even as minimum recycled content mandates and commitments increase. Investing in domestic PET collection and recycling infrastructure will increase the domestic supply of recycled PET, enabling our industry to become less dependent on imports and maintain a healthy domestic PET reclamation business.

Bottle Redemption Programs

NAPCOR supports well-designed and implemented bottle redemption policies as a means of increasing the supply of post-consumer PET feedstock. Our data shows that a well-designed redemption system can deliver 2.5 times greater per-capita PET bottle recovery than curbside collection alone in the United States. A well-designed redemption system can be efficient, fair, and cost-effective, complementing single-stream recycling programs while providing the highest quality and quantity of recycled PET.

Thank you again for holding a hearing on this important matter. Please do not hesitate to contact us if you require further information about the PET industry.

Sincerely,
Laura Stewart
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Chemical Recycling 101

Turning plastic trash into air pollution

In recent years, plastics industry lobbyists have been promoting an old incineration method as a new way to solve the plastic pollution crisis. They are calling the process "chemical recycling" and "advanced recycling," even though it is not "advanced" and nothing gets recycled. These misleading terms were created by the plastics industry to greenwash plastics incineration technologies. The plastic trash that enters a so-called "chemical recycling" facility is burned, creating harmful air pollution, contaminated oil, and toxic ash.

By deceptively presenting plastics incineration as an environmentally sound solution, the plastics industry seeks to justify its plans to triple plastics production by 2050.

This misleading practice is greenwashing at its worst

What is "chemical recycling?"

The terms "chemical recycling" and "advanced recycling" generally refer to technologies that seek to break down or "deconstruct" plastic into its chemical building blocks. Most facilities use what are called "pyrolysis and gasification," processes that burn plastic trash and turn it into harmful air pollution and chemical wastes.

Some of the outputs created by "chemical recycling" facilities are burned again later as hazardous waste or as heavily contaminated industrial fuels, releasing additional toxic air pollution. **This is not recycling.**

The plastics industry lobby is trying to convince state and federal lawmakers, as well as the Environmental Protection Agency (EPA), that burning plastics in "chemical recycling" facilities should not count as incineration.

They want to change the classification of "chemical recycling" from incineration to "manufacturing" or "recycling," or to redefine plastic trash as "not solid waste," as a way to evade air pollution controls.

Such a determination would leave companies free to emit unlimited amounts of harmful air pollution without any monitoring, reporting, or control technologies.

In addition, if reclassified, many of these facilities would qualify for subsidies and tax breaks. Already more than two dozen states have passed laws promoting "chemical recycling."

What are the health impacts of burning plastic?

Plastics are the biggest category of "petrochemicals." They are made by combining fossil fuels (oil, gas, and coal) with hundreds of toxic chemicals.

Incinerating plastic creates climate-warming gases and releases toxic pollution that can impact health. These pollutants include dioxins, benzene, formaldehyde, particulate matter, and heavy metals, such as mercury and arsenic.

Exposure to this pollution increases the risk of cancer, birth defects, reproductive system damage, developmental issues, cardiovascular problems, respiratory impairment, hormonal irregularities, and neurological problems.

MOMS clean air FORCE

The mission of Moms Clean Air Force is to protect children from air pollution and climate change. We envision a safe, stable, and equitable future where all children breathe clean air. We fight for Justice in Every Breath, recognizing the importance of equitable solutions in addressing air pollution and climate change. www.momscleanairforce.org

CHEMICAL RECYCLING 101

How does "chemical recycling" harm communities?

Many "chemical recycling" incinerators are located in communities of color and in low-income neighborhoods that are already overburdened by other sources of air pollution. Changing the laws so that these incinerators can emit harmful pollution without limits in disproportionately impacted communities is environmental racism.

In addition to air pollution and toxic waste, "chemical recycling" incinerators produce large amounts of heavily contaminated pyrolysis oils, which can be made into highly toxic fuels. A 2023 investigation showed just how dangerous these fuels really are: A Chevron refinery in Pascagoula, Mississippi, received EPA approval to use the pyrolysis oils derived from incinerating plastic as ingredients to make jet and boat fuel. Air pollution produced from burning the jet fuel is *expected to cause cancer in one in every four people* exposed over a lifetime. The boat fuel ingredient is even more toxic: *every person exposed over a lifetime* would be expected to get cancer. This risk level is one million times higher than what EPA usually considers acceptable for new chemicals and six times higher than the chances of lung cancer from a lifetime of smoking.

What can EPA and Congress do to protect us?

For nearly three decades, EPA has required the same pollution-control standards for pyrolysis and gasification incinerators as it has for other incinerators. **This must continue.**

Since these "chemical recycling" facilities burn plastic trash, which is solid waste, they meet the legal definition of incinerators under the Clean Air Act. There is no reason to reclassify these incinerators. We are pleased that in 2023 EPA withdrew a 2020 proposal that sought to remove these facilities from federal incinerator rules. We urge EPA to take the next logical steps: Affirm that pyrolysis and gasification "chemical recycling" incinerators are indeed incinerators, and begin to enforce the Clean Air Act rules at noncompliant facilities.

In addition, EPA and Congress must not fall for the false distinction between "chemical recycling" that is "plastics-to-fuel" (burning plastic trash in an incinerator, and then burning the outputs again as a fuel) and that which is "plastic-to-plastic" (using some of the incinerated plastic as feedstock for new chemicals or plastics). No matter what is produced at the end of the process, "chemical recycling" pyrolysis is a heavily polluting incineration technology that needs to remain under Clean Air Act incinerator rules.

Photo right: Brightmark "advanced recycling" facility in Ashley, Indiana. May 2022. Credit: The Last Beach Cleanup

We urge EPA and Congress:

- Do not exempt "chemical recycling" from air pollution rules. Do not reclassify "chemical recycling" technologies as "recycling" or "manufacturing." Do not reclassify plastic trash as "not solid waste."
- Affirm that "chemical recycling" pyrolysis and gasification will remain classified as solid waste incineration and thus subject to clean air requirements.
- Enforce Clean Air Act incinerator rules at all "chemical recycling" facilities.
- Support policies that reduce plastic production and waste.

Turning plastic trash into hazardous waste and air pollution is not a solution to the plastics crisis. Please join us in saying no to this plastics industry greenwashing.

Learn more and take action: **www.momscleanairforce.org/issues/plastics**

Full list of sources: momscleanairforce.org/sources-chemical-recycling

MOMS *clean air* FORCE

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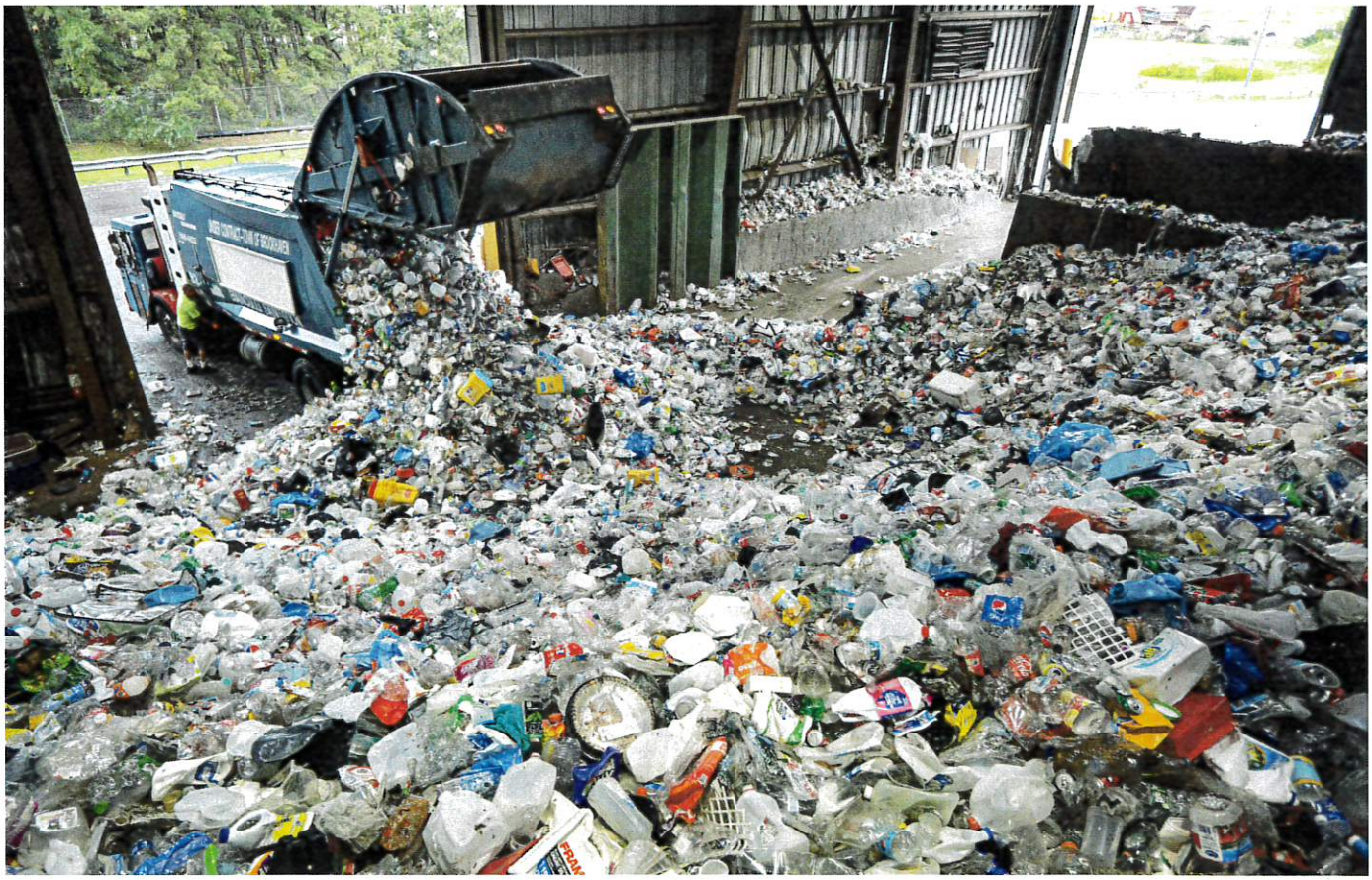
ISSUE BRIEF

MORE RECYCLING LIES:

WHAT THE PLASTICS INDUSTRY ISN'T TELLING YOU ABOUT "CHEMICAL RECYCLING"

Plastic is polluting our bodies, trashing our cities, and fouling the oceans. For decades, the plastic industry has promised that recycling would solve the problem of plastic waste, yet the plastic crisis continues to grow. A definitive report from the National Academy of Sciences found that the United States is the largest generator of plastic waste in the world.[1] Yet the dismal U.S. plastic recycling rate continues to hover around 5 percent.[2] Globally, plastic use is projected to almost *triple* by 2060, relative to a 2019 baseline.[3]



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PYROLYSIS ACCOUNTS FOR 80 PERCENT OF ALL PROPOSED AND OPERATING "CHEMICAL RECYCLING" FACILITIES

The term "chemical recycling" is used by the plastic industry to refer to a range of technologies that include pyrolysis, gasification, solvolysis, and solvent-based purification (Table 1). The plastic industry, however, is pushing one of these technologies above all others: pyrolysis. This single technology accounts for 80 percent of all currently operating and proposed "chemical recycling" facilities in the United States (Table 2). Pyrolysis (along with gasification) is a form of incineration with serious toxic impacts and is regulated as such under the federal Clean Air Act.[10]

Of course, just because a facility is proposed doesn't mean it will be built, and just because a facility is currently operating doesn't mean it will continue to run. In fact, during 2024, the Agilyx/AmSty (Regenyx) pyrolysis plant in Oregon, the Fulcrum Bioenergy (Sierra Biofuels) gasification plant in Nevada, and the New Hope (Trinity Oaks Tyler) pyrolysis plant in Texas all closed due to technical and financial difficulties.[11] The Prima America (Groveton) pyrolysis plant in New Hampshire also appears to be closed.[12] This is a significant number given that only eight "chemical recycling" facilities appear to be currently operating in the United States as of January 1, 2025.[13] Four proposed pyrolysis and gasification plants

TABLE 2: "CHEMICAL RECYCLING" FACILITIES BY TECHNOLOGY TYPE AND OPERATING STATUS

Data compiled by NRDC and Oil and Gas Watch; full list of facilities and detailed methods available in the Appendix. Asterisk (*) indicates that one operating facility (Eastman (Kingsport)) uses both solvolysis and gasification methods and therefore is listed in this table twice but is otherwise counted as a single facility in this report. Data current as of January 15, 2025.

Technology Type	Number of Facilities				Percentage of Total (excluding closed and canceled facilities)
	Operating or Partially Operating	Closed or Canceled	Proposed	Proposed, Under Moratorium	
Pyrolysis	6	5	24	2	80%
Gasification	1*	3	1	0	5%
Solvolysis	1*	0	3	0	10%
Solvent-based purification	1	0	1	0	5%

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Local resident, Conrad Whyne, stands on a hill overlooking the site where Texas firm, Encina, plans to build a pyrolysis "chemical recycling" facility, in Point Township, Pennsylvania, on October 30, 2023.

Although only partial-year reporting was available for 2024 at the time of this writing, EPA data indicate that both Alterra (Akron) and Braven (Zebulon) had already generated far more hazardous waste in that year than in any previous year. For example, in the first 9.5 months of 2024, the Alterra (Akron) facility had shipped 172,653 pounds of hazardous waste off-site for disposal as compared with 113,337 pounds for the entire previous year; during that same 9.5-month period, the Braven (Zebulon) facility had shipped 384,962 pounds of hazardous waste off-site as compared with 115,072 pounds in 2023.[25]

The chemicals contained in hazardous waste produced by the Agilyx/AmSty (Regenyx), Alterra (Akron), and Braven (Zebulon) pyrolysis facilities are associated with a wide range of health hazards including cancer; reproductive and developmental harm; and impacts on the brain, liver, and cardiovascular and respiratory systems (Table 4).

Pyrolysis facilities also emit "hazardous air pollutants" (HAPs) such as benzene, formaldehyde, toluene, and vinyl chloride, as well as "criteria air pollutants" such as carbon monoxide and nitrogen dioxide. HAPs (also known as air toxics) are a group of air pollutants that are "known or suspected to cause cancer or other serious health effects, such as reproductive harm or birth defects, or adverse environmental effects."[26] Criteria air pollutants are six common air pollutants that are regulated by the federal government and can harm your health and the environment; some criteria pollutants can also damage crops and buildings.[27]

Table 5 shows selected HAPs and criteria air pollutants that have been released or are permitted to be released by one or more of the following six pyrolysis facilities: Agylix/AmSty (Regenyx), Alterra (Akron), Braven (Zebulon), Brightmark (Ashley), New Hope (Trinity Oaks Tyler), and Nexus (Atlanta).

TABLE 4: HEALTH HAZARDS OF CHEMICALS CONTAINED IN THE HAZARDOUS WASTE GENERATED BY PYROLYSIS FACILITIES

Reflects hazardous waste generated in 2021 by the Agilyx/AmSty (Regenyx), Alterra (Akron), and Braven (Zebulon) facilities, as reported in the EPA's Biennial Hazardous Waste Report (2021 is the most recent year for which such data are available).[28] Data on hazard traits from the California Safer Consumer Products Candidate Chemicals list.[29]

	Carcinogen	Reproductive toxicant	Developmental toxicant	Neurotoxicant	Persistent	Bioaccumulative	Liver toxicant	Cardiovascular toxicant	Respiratory toxicant	Kidney toxicant	Skin toxicant	Eye toxicant
Barium				X			X	X		X		
Benzene	X	X	X	X				X	X			
Cadmium	X	X	X		X	X			X	X		
Carbon disulfide		X	X	X								
Chlorobenzene		X		X			X			X		
Dichloroethane	X			X			X	X		X	X	
Ethyl benzene	X		X	X			X		X	X		X
Methanol			X	X								
Methyl ethyl ketone			X	X					X		X	X
Methyl isobutyl ketone	X		X	X			X			X		X
Methylene chloride	X			X			X	X	X			
Pyridine	X			X								
Tetrachloroethylene	X			X			X	X	X	X		X
Toluene			X	X			X	X	X			X
Trichloroethylene	X	X	X	X			X	X	X	X		X
Xylene				X					X			X
I,I,I-trichloroethane	X			X			X	X		X		
I,I,2-trichloro-I,2,2-trifluoroethane				X			X					
I,I,2, trichloroethane	X			X			X	X		X	X	
2-ethoxyethanol		X	X									
2-nitropropane	X			X			X			X		

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Emissions rising from a petroleum refinery in Corpus Christi, Texas.

In addition to the hazardous waste and hazardous air pollutants created during the pyrolysis process, it is becoming increasingly clear that the fuel products produced by plastic pyrolysis are also highly toxic. In 2023, ProPublica reported that the EPA had approved 18 new chemical mixtures derived from plastic waste processed for use as fuels with no restrictions or limitations on environmental releases, even though EPA scientists had also determined that these chemicals posed astronomically high risks for cancer and other non-cancer health effects.[33]

One of these chemical mixtures, intended to be used as jet fuel, was estimated to pose a 1 in 4 cancer risk (meaning that 1 in every 4 people regularly exposed to it throughout their life would be likely to develop cancer). A second chemical mixture derived from plastic waste, approved to be used as a boat fuel, posed a 1 in 1 cancer risk—meaning that *every* person regularly exposed to it throughout their life would be likely to develop cancer.[34] In September 2024, after being sued by a citizen group living near the Chevron refinery where the plastic-derived fuels were to be produced, the EPA announced that it would at least temporarily withdraw its approval for these 18 plastic-based fuels while the agency reassesses them.[35]

CHEMICAL AND SOLVENT-BASED "CHEMICAL RECYCLING" PROCESSES ALSO POSE SERIOUS TOXIC CONCERNS

While chemical and solvent-based methods of "chemical recycling" are more likely than pyrolysis to actually recycle some amount of plastic (as opposed to burning it or turning it into fuels), these processes also pose serious health and environmental concerns. Not only do they often use toxic solvents and chemical agents (Table 6), but in some cases they can also generate significant quantities of hazardous waste.

Solvent-based purification and solvolysis, for example, use chemicals linked to neurotoxicity and respiratory toxicity; Chemicals linked to cancer, developmental harm, and other health hazards are also commonly used. There is still much we don't know about the solvents and chemicals being used in these processes, so the chemicals listed below may be only the tip of the iceberg.

FIGURE 1: GEOGRAPHIC DISTRIBUTION OF OPERATING, PROPOSED, CLOSED, AND CANCELED "CHEMICAL RECYCLING" FACILITIES

Data compiled by NRDC and Oil and Gas Watch; full list of facilities and detailed methods is available in Appendix.

TABLE 8: DEMOGRAPHIC ANALYSIS OF COMMUNITIES WITH OPERATING AND PROPOSED FACILITIES

Based on the demographics of the population living within three miles of the facility, with demographic data obtained from EPA's Environmental Justice Screening and Mapping Tool. In the EPA data, "People of Color" is defined as individuals who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino. "Low-income population" is defined as individuals in households where the household income is less than or equal to twice the federal "poverty level."[41] The "proposed or under construction" category includes facilities that have been proposed but are currently not moving forward because the local community has adopted a moratorium on construction.

Operating Status	Percentage of facilities in areas with above-average populations of people of color	Percentage of facilities in areas with above-average low-income population
Currently operating or partially operating	45%	100%
Proposed or under construction	55%	72%

Luckily, while the industry is pushing to expand "chemical recycling," other forces are countering this effort. Georgia, Indiana, and Pennsylvania have had facilities proposed and then later canceled due to community opposition.[42] In addition, four operating facilities in Oregon, Nevada, Texas, and New Hampshire shut down in 2024, and a proposed facility in Texas was canceled due to bankruptcy.[43] Two other proposed plants, in Ohio and Massachusetts, are also on hold after the communities where they were to be sited passed ordinances that placed moratoriums on the building of such facilities.[44]

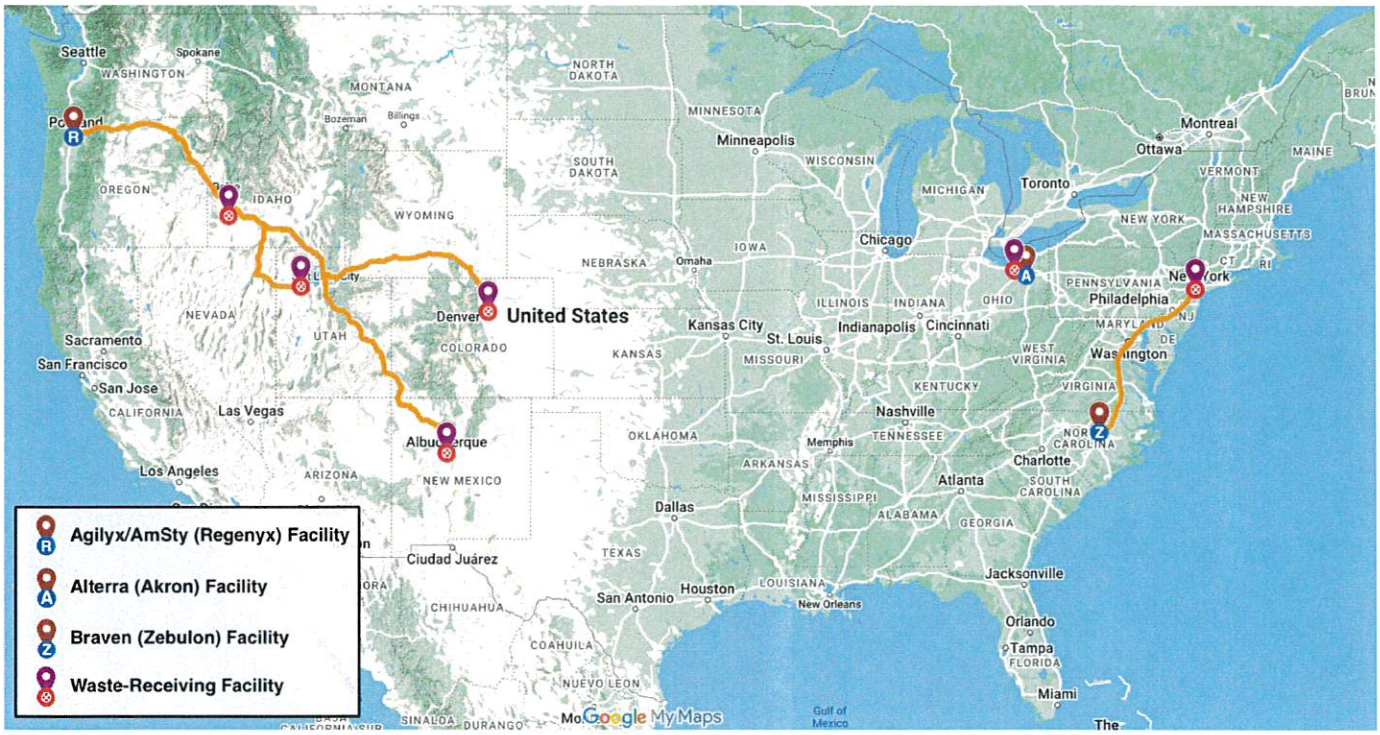
LONG-DISTANCE TRANSPORTATION OF HAZARDOUS WASTE MEANS MANY MORE COMMUNITIES COULD BE ENDANGERED

In addition to impacting local communities through the emission of harmful pollutants, "chemical recycling" facilities also send hazardous waste to management sites in other locations, endangering the communities that live along the transportation routes as well as people who live near the disposal facilities.

As discussed above, "chemical recycling" facilities can generate tens of thousands or even hundreds of thousands of pounds of hazardous waste every year. This waste can take the form of solids, liquids, or sludge and may be classified by the EPA as ignitable, reactive, or corrosive.[45] This waste

FIGURE 2: HAZARDOUS WASTE FROM THREE PYROLYSIS FACILITIES LIKELY TRAVELED THROUGH 13 STATES ON ITS WAY TO DISPOSAL

Reflects hazardous waste data from three pyrolysis facilities: Agilyx/AmSty (Regenyx), Alterra (Akron), and Braven (Zebulon). Hazardous waste disposal information and location obtained from EPA's RCRAInfo website.[62] NRDC used Google Maps to identify likely routes that the hazardous waste traveled from the "chemical recycling" facility to the final disposal site(s).



U.S. GOVERNMENT SCIENTISTS EXPOSE FLAWS IN INDUSTRY'S FALSE NARRATIVE ON THE PROMISE OF "CHEMICAL RECYCLING" FOR PLASTIC-TO-PLASTIC RECYCLING

When it comes to creating recycled plastic, "chemical recycling" technologies are more expensive and have significantly higher environmental impacts than mechanical recycling. Some of them even perform worse than making plastic out of virgin fossil fuels.

In 2023 scientists from the DOE's National Renewable Energy Laboratory (NREL) published a peer-reviewed study that compared the technical, economic, and environmental metrics for mechanical recycling and "chemical recycling" when attempting to recycle waste plastic into new plastic.[63] The study concluded that "mechanical recycling offers energy use and [greenhouse gas] emissions an order of magnitude lower than the other recycling technologies for all plastics, as well as low [energy usage], land use, toxicity, and water use" (Table 9). The study authors also found that mechanical recycling "economically outcompetes all other options."[64]

TABLE 9: MECHANICAL RECYCLING PRODUCES FAR FEWER GREENHOUSE GAS EMISSIONS AND USES FAR LESS WATER THAN "CHEMICAL RECYCLING" TECHNOLOGIES

Using mechanical recycling as the baseline, this table shows how many times greater the greenhouse gas (GHG) emissions and water usage rates are for "chemical recycling" technologies during plastic-to-plastic recycling. Data adapted from supplemental information (Table S27) provided by the Uekert et al. (2023) study and averaged across different polymer types.[65]

"Chemical recycling" technology	GHG emissions (number of times higher than mechanical recycling)	Water use (number of times higher than mechanical recycling)
Pyrolysis	55x	1,694x
Gasification	238x	2,598x
Solvolysis	11x	84x
Solvent-based purification	2x	46x

APPENDIX: SURVEY OF OPERATING, PROPOSED, CANCELED AND CLOSED "CHEMICAL RECYCLING" FACILITIES IN THE U.S.

	Company/Facility name	State	City or County	Technology Used	Operating Status
1	Agilyx and AmSty Louisiana Chemical Recycling Plant	LA	St. James Parish	Pyrolysis	Proposed
2	Agilyx and AmSty Regenyx Chemical Recycling Facility	OR	Tigard	Pyrolysis	Closed
3	Agilyx and INEOS Styrolution TruStyrenyx Channahon Plant	IL	Channahon	Pyrolysis	Proposed
4	Alterra Akron Plastic Recycling Facility	OH	Akron	Pyrolysis	Operating (Pilot)
5	ARCH2 Empire Green Follansbee Plant	WV	Follansbee	Pyrolysis	Proposed
6	BASF/Total Port Arthur Olefins Complex - TOTAL ChemCycling Unit	TX	Port Arthur	Pyrolysis	Operating
7	Braven Environmental Texarkana Chemical Recycling Plant	TX	Texarkana	Pyrolysis	Proposed
8	Braven Environmental Zebulon Chemical Recycling Plant	NC	Zebulon	Pyrolysis	Operating
9	Brightmark Macon-Bibb Plastics Renewal Facility	GA	Macon	Pyrolysis	Canceled
10	Brightmark Plastics Renewal IN - Ashley Facility	IN	Ashley	Pyrolysis	Partially Operating
11	Brightmark Plastics Renewal TX - Dayton Yard Facility	TX	Dayton	Pyrolysis	Proposed
12	Brightmark Thomaston Plastics Renewal Facility	GA	Thomaston	Pyrolysis	Proposed
13	Chevron Pascagoula Refinery	MS	Pascagoula	Pyrolysis	Proposed
14	Clean-Seas Newaygo Chemical Recycling Facility	MI	Newaygo	Pyrolysis	Proposed
15	Clean-Seas Phoenix Chemical Recycling Facility	AZ	Phoenix	Pyrolysis	Proposed
16	Clean-Seas Quincy Chemical Recycling Facility	WV	Quincy	Pyrolysis	Proposed
17	Clean-Seas Templeton Chemical Recycling Facility	MA	Templeton	Pyrolysis	Proposed (Under Moratorium)
18	Eastman Chemical Longview Operations	TX	Longview	Solvolysis (Methanolysis)	Proposed
19	Eastman Chemical Tennessee Operations	TN	Kingsport	Gasification, Solvolysis (Glycolysis, Methanolysis)	Operating
20	Encina Point Township Circular Manufacturing Facility	PA	Point Township	Pyrolysis	Canceled
21	ExxonMobil Baton Rouge Polyolefins Plant	LA	Baton Rouge	Pyrolysis	Proposed
22	ExxonMobil Baytown Chemical Plant	TX	Baytown	Pyrolysis	Operating
23	Freepoint Eloy Chemical Recycling Plant	AZ	Eloy	Pyrolysis	Proposed
24	Freepoint Gulf Coast Chemical Recycling Facility	LA	Ascension Parish	Pyrolysis	Proposed
25	Freepoint Hebron Chemical Recycling Plant	OH	Hebron	Pyrolysis	Under Construction
26	Fulcrum Bioenergy Centerpoint BioFuels Plant	IN	Gary	Gasification	Canceled
27	Fulcrum Bioenergy Sierra BioFuels Plant	NV	McCarran	Gasification	Closed
28	Fulcrum Bioenergy Trinity Fuels Biorefinery	TX	Baytown	Gasification	Canceled
29	FusionOne New Iberia Hydrogen Plant	LA	New Iberia	Pyrolysis*	Proposed
30	FusionOne New Orleans Hydrogen Plant	LA	New Orleans	Pyrolysis	Proposed
31	Greeley Project Energy	CO	Greeley	Pyrolysis	Proposed
32	H Cycle Pittsburg Hydrogen Project	CA	Pittsburg	Gasification	Proposed
33	Honeywell Upcycle Plant	TX	Waller	Pyrolysis	Proposed
34	Mura Cascade ELP	WA	Arlington	Solvolysis (Hydrolysis)	Proposed
35	New Hope Trinity Oaks Tyler Facility	TX	Tyler	Pyrolysis	Closed
36	Nexus Circular Chicago Plant	IL	Cook County	Pyrolysis	Proposed
37	Nexus Circular Dallas Chemical Recycling Plant	TX	Dallas County	Pyrolysis	Proposed
38	Nexus Circular Fuels Atlanta Plant	GA	Atlanta	Pyrolysis	Partially Operating

ENDNOTES

1 National Academies of Sciences, Engineering, and Medicine, *Reckoning with the U.S. Role in Global Ocean Plastic Waste* (Washington, D.C.: National Academies Press, 2022), https://doi.org/10.17226/26132.

2 Anelia Milbrandt et al., "Quantification and Evaluation of Plastic Waste in the United States," *Resources, Conservation and Recycling* 183 (August 2022): 106363, https://doi.org/10.1016/j.resconrec.2022.106363; Beyond Plastics and the Last Beach Cleanup, "The Real Truth About the U.S. Plastics Recycling Rate," May 4, 2022, https://www.beyondplastics.org/reports/the-real-truth-about-the-us-plastics-recycling-rate. Note: The plastic industry is highly intertwined with the chemical industry, but we use the term *plastic industry* for the sake of simplicity here.

3 Organization for Economic Cooperation and Development, *Global Plastics Outlook: Policy Scenarios to 2060*, June 2022, https://doi.org/10.1787/aaledf33-en.

4 Laura Paddison, "The Plastics Industry Says This Technology Could Help Banish Pollution. It's 'an Illusion,' Critics Say," CNN, May 31, 2024, https://www.cnn.com/2024/05/30/climate/chemical-recycling-plastic-pollution-climate/index.html#; American Chemistry Council, "Advanced Recycling," 2024, https://www.americanchemistry.com/better-policy-regulation/plastics/advanced-recycling.

5 Veena Singla and Tessa Wardle, "Recycling Lies: 'Chemical Recycling' of Plastic Is Just Greenwashing Incineration," NRDC, September 7, 2022, https://www.nrdc.org/sites/default/files/chemical-recycling-greenwashing-incineration-ib.pdf.

6 Tariq Maqsood et al., "Pyrolysis of Plastic Species: A Review of Resources and Products," *Journal of Analytical and Applied Pyrolysis* 159 (October 2021): 105295, https://doi.org/10.1016/j.jaap.2021.105295; Simon Hann and Toby Connock, "Chemical Recycling: State of Play," Eunomia, December 8, 2020, https://chemtrust.org/wp-content/uploads/Chemical-Recycling-Eunomia.pdf.

7 S. A. Salaudeen, P. Arku, and Animesh Dutta, "Gasification of Plastic Solid Waste and Competitive Technologies," chapter 10 in *Plastics to Energy*, Sultan al-Salem, ed. (New York: Elsevier, 2019), 269–93, https://doi.org/10.1016/B978-0-12-813140-4.00010-8; Hann and Connock, "Chemical Recycling: State of Play."

8 Dominik Triebert et al., "Solvent-Based Recycling," in *ACS Symposium Series*, Dimitris I. Collias, Martin I. James, and John M. Layman, eds. (Washington, D.C.: American Chemical Society, 2021) 1391:33–59, https://doi.org/10.1021/bk-2021-1391.ch003.

9 Hann and Connock, "Chemical Recycling: State of Play."

10 Jacob Wallace, "EPA Withdraws Proposal to Drop Pyrolysis from Regulation Following Criticism," *WasteDive* (blog), June 6, 2023, https://www.wastedive.com/news/epa-pyrolysis-emissions-clean-air-act-decision/652153/.

11 In the text of this report, we identify facilities with the company name first and the plant name in parentheses. Jacob Wallace, "Fulcrum BioEnergy Shutters Nevada Waste-to-SAF Facility, CEO Departs," *WasteDive* (blog), June 5, 2024, https://www.wastedive.com/news/fulcrum-bioenergy-sierra-biofuels-reno-nevada-shutdown-eric-pryor/717916/; Ben Seal, "Latest Chemical Recycling Plant Closing Spurs Concern over the Industry's Viability," *EHN* (blog), April 8, 2024, https://www.ehn.org/chemical-recycling-plant-closing-2667655935.html; Oil & Gas Watch, "Despite Big Growth Plans, Chemical Plastics Recycling Plant in East Texas Unexpectedly Stops Operating," October 29, 2024, https://news.oilandgaswatch.org/template/brief/despite-big-growth-plans-chemical-plastics-recycling-plant-in-east-texas-unexpectedly-stops-operating.

12 In early December 2024, NRDC noted that Google Maps included a "permanently closed" label on the Prima America facility. On December 10, 2024, we conducted a business record search on the New Hampshire secretary of state's website and sent an email to the contact listed there asking if the facility was still operating but received no response as of January 13, 2025. NRDC also left a voicemail message on the listed phone line on December 10 and also received no response as of January 13, 2025. We thus concluded that the facility does indeed appear to be closed.

13 As noted in Table 2, one operating facility uses both solvolysis and gasification methods. It therefore is listed in this table twice but is otherwise counted as a single facility in this report.

14 Jacob Wallace, "Fulcrum BioEnergy Files for Chapter 11 Bankruptcy Protection," *WasteDive* (blog), September 10, 2024, https://www.wastedive.com/news/fulcrum-bioenergy-chapter-11-bankruptcy-nevada/726555/; James Bruggers, "A Giant Plastics Chemical Recycling Plant Planned for Pennsylvania Died After Two Years. What Happened?" *Inside Climate News*, April 26, 2024, https://insideclimatenews.org/news/26042024/encina-pennsylvania-chemical-recycling-plant-canceled/; *Recycling Today*, "Brightmark Scraps Plans for Georgia Plant," April 12, 2022, https://www.recyclingtoday.com/news/brightmark-georgia-advanced-plastic-recycling-plant-discussions-end/; Haley Rischar, "Clean Fuels Company Verges on Collapse After Financial Troubles, Layoffs," *Waste Today*, June 5, 2024, https://www.wastetodaymagazine.com/news/clean-fuels-company-verges-on-collapse-after-financial-troubles-layoffs-fulcrum-bionergy/; Violet Comber-Wilen, "Waste-to-Jet Fuel Company Likely Won't Place Plant in Gary, After Years of Plans," WFYI Indianapolis, June 21, 2024, https://www.wfyi.org/news/articles/waste-to-jet-fuel-company-likely-wont-place-plant-in-gary-after-years-of-plans; Stan Boney, "Council Votes to Extend Moratorium Preventing SOBE's Pyrolysis Process," WKBN 27, November 21, 2024, https://www.wkbn.com/news/local-news/sharon-news/council-votes-to-extend-moratorium-preventing-sobes-pyrolysis-process/; Oil & Gas Watch, "Massachusetts Town Targeted for Waste Plastics Processing Plant Passes One-Year Moratorium," December 11, 2024, https://news.oilandgaswatch.org/template/brief/massachusetts-town-targeted-for-waste-plastics-processing-plant-passes-one-year-moratorium.

15 Taylor Uekert et al., "Technical, Economic, and Environmental Comparison of Closed-Loop Recycling Technologies for Common Plastics," *ACS Sustainable Chemistry & Engineering* 11, no. 3 (January 23, 2023): 965–78, https://doi.org/10.1021/acssuschemeng.2c05497. See Table S29 in the "supporting information" file associated with the paper, available at https://pubs.acs.org/doi/suppl/10.1021/acssuschemeng.2c05497/suppl_file/sc2c05497_si_001.pdf.

16 Singla and Wardle, "Recycling Lies."

17 U.S. Environmental Protection Agency (hereinafter EPA), Office of Resource Conservation and Recovery, *Draft National Strategy to Prevent Plastic Pollution*, EPA 530-R-23-006, April 2023, https://www.epa.gov/system/files/documents/2023-04/Draft_National_Strategy_to_Prevent_Plastic_Pollution.pdf; European Parliament and Council of the European Union, "Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives," *Official Journal of the European Union*, November 22, 2008, https://eur-lex.europa.eu/eli/dir/2008/98/oj; California Department of Tax and Fee Administration, "Laws, Regulations and Annotations," 2024, https://www.cdtfa.ca.gov/lawguides/vol4/iwmfl/iwmfl-40180.html#:~:text=Chapter%202.&text=40180.,Section%204020l%20or%20EMSW%20conversion.

18 Renee Sharp and Veena Singla, "The Plastics Industry's Latest Deception: 'Mass Balance.'" NRDC *Expert Blog*, September 9, 2024, https://www.nrdc.org/bio/renee-sharp/plastics-industrys-latest-deception-mass-balance.

19 Hazardous waste data for the other four operating pyrolysis facilities either are obscured by the fact that they are part of larger chemical plants that also produce hazardous waste (in the case of ExxonMobil (Baytown) and BASF/Total (Port Arthur)), or are not reported to the EPA (in the case of Brightmark (Ashley) and Nexus (Atlanta)), likely because they are not processing much plastic. See EPA, "Enforcement and Compliance History Online," 2024, https://echo.epa.gov/.; Beyond Plastics and IPEN. "Chemical Recycling: A Dangerous Deception," October 2023. https://static1.squarespace.com/static/5eda91260bbb7e7a4bf528d8/t/655791f76ad9bb07d10e1290/1700237880522/10-30-23_Chemical-Recycling-Report_web.pdf.; James Bruggers, "Inside Indiana's 'Advanced' Plastics Recycling Plant: Dangerous Vapors, Oil Spills and Life-Threatening Fires," *Inside Climate News*, June 16, 2023, https://insideclimatenews.org/news/16062023/indiana-advanced-plastics-recycling-vapors-spills-fires/.

20 Beyond Plastics and IPEN, "Chemical Recycling."

45 EPA, "RCRAInfo Search," accessed November 7, 2024, https://enviro.epa.gov/envirofacts/rcrainfo/search.

46 EPA, "Hazardous Waste Transportation," EPA, May 9, 2024, https://www.epa.gov/hw/hazardous-waste-transportation; U.S. Department of Transportation (hereinafter DOT), Bureau of Transportation Statistics, "U.S. Hazardous Materials Shipments by Transportation Mode, 2017," 2017, https://www.bts.gov/content/us-hazardous-materials-shipments-transportation-mode-2007.

47 The three facilities are Agilyx/AmSty (Regenyx), Alterra (Akron), and Braven (Zebulon). EPA, "RCRAInfo Search," accessed November 15, 2024, https://enviro.epa.gov/envirofacts/rcrainfo/search.

48 Ibid.; EPA, "EJScreen."

49 EPA, "EJScreen," accessed November 7, 2024, https://ejscreen.epa.gov/mapper/.

50 EPA, "RCRAInfo Search," accessed November 7, 2024; Singla and Wardle, "Recycling Lies."

51 Singla and Wardle, "Recycling Lies."

52 Ibid.

53 P. W. Tait et al., "The Health Impacts of Waste Incineration: A Systematic Review," *Australian and New Zealand Journal of Public Health* 44, no. 1 (February 2020): 40-48, https://www.sciencedirect.com/science/article/pii/S132602002300732X.

54 EPA, "RCRAInfo Search," accessed November 7, 2024.

55 Excludes hazardous materials transported through pipelines since this is not a method used to transport hazardous waste. DOT, Bureau of Transportation Statistics, "U.S. Hazardous Materials Shipments."

56 California Department of Toxic Substances Control, "Managing Hazardous Waste," August 2007, https://dtsc.ca.gov/hazardous-waste-transporter-requirements-fact-sheet/.

57 DOT, Pipeline and Hazardous Materials Safety Administration, "Incident Statistics, 10 Year Incident Summary Reports, Hazardous Waste Incidents, https://www.phmsa.dot.gov/hazmat-program-management-data-and-statistics/data-operations/incident-statistics.

58 Ibid.

59 Ibid.

60 EPA, "East Palestine, Ohio Train Derailment," accessed August 23, 2024, https://www.epa.gov/east-palestine-oh-train-derailment; David A. Gay et al., "Widespread Impacts to Precipitation of the East Palestine Ohio Train Accident," *Environmental Research Letters* 19, no. 7 (July 1, 2024): 074022, https://doi.org/10.1088/1748-9326/ad52ac.

61 Artemis Moshtaghian, Melissa Alonso, and Taylor Romine, "Residents of Ohio Community Allowed to Return After Chemical Leak from Railroad Car Forced Evacuations." CNN, September 25, 2024, https://www.cnn.com/2024/09/24/us/ohio-train-chemical-leak-evacuation-order/index.html.

62 EPA, "RCRAInfo Search."

63 Uekert et al., "Comparison of Closed-Loop Recycling Technologies."

64 Ibid.

65 Ibid.

66 Ibid.

67 Ibid.

68 Ibid.

69 Ibid.

70 For information on "mass balance" credit approaches, see Renee Sharp and Veena Singla, "The Plastics Industry's Latest Deception: 'Mass Balance.'" NRDC *Expert Blog*, September 9, 2024, https://www.nrdc.org/bio/renee-sharp/plastics-industrys-latest-deception-mass-balance.

71 Oil & Gas Watch, "Search the Oil & Gas Watch Database," 2024, https://oilandgaswatch.org/search.

72 Bea Miñana, "Global Directory of Molecular Recycling Technologies," Closed Loop Partners, 2021, https://www.closedlooppartners.com/wp-content/uploads/2021/11/CLP_Molecular-Recycling-Directory-2021.pdf; Beyond Plastics and IPEN, "Chemical Recycling"; Kate Ringler and Josh Want, "AmSty and Agilyx Announce Collaboration to Build Advanced Recycling Facility," Agilyx, April 8, 2021, https://www.agilyx.com/amsty-and-agilyx-announce-collaboration-to-build-advanced-recycling-facility/; Kate Ringler and April Ludwikoski, "Agilyx and INEOS Styrolution Advance Development of Large Scale TruStyrenyxTM Plant," Agilyx, March 27, 2023, https://www.agilyx.com/agilyx-and-ineos-styrolution-advance-development-of-large-scale-trustyronyx-plant/; Marissa Heffernan, "Illinois Chemical Recycling Plant Moving Forward," *Plastics Recycling Update*, April 18, 2023, https://resource-recycling.com/plastics/2023/04/18/illinois-chemical-recycling-plant-moving-forward/; Brightmark, "Plastics: Frequently Asked Questions (FAQs)," July 3, 2024, https://www.brightmark.com/plastics-renewal/faq; Emily Friedman, "ExxonMobil's Commercial-Scale Chemical Recycling Facility Begins Production," Independent Commodity Intelligence Services, December 14, 2022, https://www.icis.com/explore/resources/news/2022/12/14/10835695/exxonmobil-s-commercial-scale-chemical-recycling-facility-begins-production/; H Cycle, "H Cycle FAQ," 2024, https://hcycle.com/faq/; SOBE Energy Solutions LLC, "SOBE Energy Solutions (SES)," 2017, https://www.sobeenergysolns.com/; WR Grace & Company, "Maryland Department of the Environment Air and Radiation Administration Application for a Permit to Construct: Docket #16-23," Maryland Department of the Environment, 2023, https://mde.maryland.gov/programs/permits/AirManagementPermits/Documents/Public-Review/new%20public%20review%20documents/WR%20Grace%20Combined%20init%20and%20Sub%201%20and%202%2016-23.pdf; EIN Presswire, "Braven Environmental and W. R. Grace & Co. Collaborate on Renewable and Recyclable Feedstock from Advanced Recycling," KGET.com, July 18, 2024, https://www.kget.com/business/press-releases/ein-presswire/728608760/braven-environmental-and-w-r-grace-co-collaborate-on-renewable-and-recyclable-feedstock-from-advanced-recycling/; Stefan Brandt and Rafael Gonzalez, "Navigating the Energy Transition—Co-Processing of Chemical Recycling Products in Fluid Catalytic Cracking Units," *Asian Downstream Insights*, September 23, 2024, https://asiandownstreaminsights.com/energy-transition/navigating-the-energy-transition-co-processing-of-chemical-recycling-products-in-fluid-catalytic-cracking-units/.

73 Kate Ringler and April Ludwikoski, "Agilyx and INEOS Styrolution Advance Development of Large Scale TruStyrenyx™ Plant," Agilyx, March 27, 2023, https://www.agilyx.com/agilyx-and-ineos-styrolution-advance-development-of-large-scale-trustyrenyx-plant/.

74 Gregg Nudd, "Draft Environmental Impact Report for the H Cycle Pittsburg Renewable Hydrogen Project," Bay Area Air Quality Management District, March 18, 2024, https://www.baaqmd.gov/~/media/files/planning-and-research/ceqa-letters/2024/h-cycle-pitts-hydro-project-deir-air-district-ltr-pdf.pdf?rev=5a05cdb4b3804645b566cf9a68769bc0.

75 Aquafil, "Locations," 2022, https://www.aquafil.com/locations/.

GREENWIRE

Trump admin opts for tighter air rules on plastics recycling

In a U-turn from President Donald Trump's first term, an updated EPA rule calls for more protective limits on chemical recycling.

BY: **SEAN REILLY**, **ELLIE BORST** | 06/24/2025 01:41 PM EDT

Emissions rise from a smokestack. A new rule pertaining to incinerators will require more protective air rules on a chemical recycling process known as pyrolysis.| Ritzau Scanpix/AFP via Getty Images

GREENWIRE | A controversial chemical recycling process will remain under more protective air regulations — a reversal from the first Trump administration's attempts to weaken standards in line with industry pleas.

EPA on Tuesday posted its final rule outlining changes to the performance standards for what are technically known as "other solid waste incinerators," a category covering about 60 trash-burning operations used by prisons, nursing homes and other facilities.

But the agency "will not be taking additional action related to pyrolysis/combustion units in this action," leaving pyrolysis as a "municipal waste combustion unit" under the Clean Air Act.

It's a change of course from President Donald Trump's first term, which in 2020 proposed to remove pyrolysis from its emission guidelines for incineration and recategorize it under the less-protective manufacturing standards — a change chemicals and plastics groups have pushed for. The Biden administration withdrew Trump's proposal in 2023.

Industry groups have pushed development of pyrolysis, one of the technologies under the "chemical" or "advanced" recycling umbrella, over recent years as the innovative new solution for hard-to-recycle plastics that traditional recovery facilities can't handle. The

billions of dollars in investments have come in response to growing public scrutiny over pollution from single-use plastics.

But green groups have criticized pyrolysis, which uses high heat to break plastics down to their chemical building blocks for future reuse, as an evasive, "dangerous and dirty" process with ambiguous efficacy.

The American Chemistry Council, an influential trade association lobbying for a majority of the nation's biggest names in plastics production, has spearheaded the push to categorize all chemical recycling processes — primarily pyrolysis and gasification — under manufacturing instead of incineration regulations.

ACC's lobbying push has been successful in at least half of U.S. states, which have enacted laws to regulate the new recycling technologies under less restrictive air quality rules.

Ross Eisenberg, head of plastics at ACC and president of America's Plastic Makers, said the trade association does "not believe the classification of pyrolysis discussed in the OSWI rule is applicable to the type of pyrolysis used in advanced recycling of plastics."

"We urge EPA to clarify that advanced recycling is a manufacturing process, not a form of solid waste incineration, and should be regulated accordingly," he continued.

The updated rule posted Tuesday comes almost five years after the agency released the initial proposal containing the pyrolysis exemption.

In dropping the planned carveout after receiving what were described as "significant adverse comments," EPA in 2023 said it would be inappropriate for those facilities "to become unregulated emissions sources during the time required for our analysis of pyrolysis/combustion units to be completed, particularly if the Agency ultimately concludes that regulation is needed."

The new rule follows a 2016 Sierra Club lawsuit alleging that EPA was long past statutory deadlines for updating the incinerator regulations. Under the final settlement terms to the suit, brought in U.S. District Court for the District of Columbia, EPA had to sign off on the final version by the end of the month.

Jim Pew, an Earthjustice attorney involved in the litigation, had previously said it would be illegal for EPA to reinstate the pyrolysis exemption. He declined further comment on the issue Tuesday.

In the updated regulations, the agency found no new "cost-effective" pollution controls for the approximately 60 plants now included in the "other solid waste incinerators" category. but took other steps — such as eliminating an exemption for unpermitted emissions stemming from startups, shutdowns and equipment breakdowns — expected to reduce pollution relative to an earlier baseline.

But under its complex classification framework for different types of trash-burning operations, the agency also opted to shift 29 plants that had previously been covered by more stringent regulations for commercial and industrial incinerators into the "other" category.

The change will lead to about 11 tons of added annual emissions, according to an EPA estimate included in the rule. Most of that will be the particulates often dubbed soot, but the total also includes the toxic metals mercury and cadmium.

Overall, the new rule will save industry about $12 million per year, a summary says.

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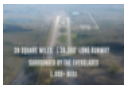
BY MICHAEL DOYLE, MIRANDA WILLSON



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EXTENDED PRODUCER RESPONSIBILITY (EPR) FOR PACKAGING

EPR is a producer-funded system to increase recycling of packaging and paper products, promote reuse, and ensure accountability for single-use products and packaging. It builds on existing recycling infrastructure while providing sustainable funding to cover the costs of collection and processing, expand end-markets, and shift producers to more reusable and sustainable packaging.

CHEMICAL RECYCLING

The term “chemical recycling” refers to a wide range of technologies that process recovered plastic products (including packaging) into new plastic, as well as energy and/or fuel. These technologies generate heated discussion: Producers promise an ability to process plastics that can't be mechanically recycled, and environmental groups point to creation of hazardous wastes, emissions, and enabling of wasteful unneeded plastic products.

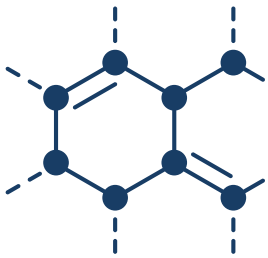
Government policy makers tasked with passing legislation or issuing permits for chemical recycling projects lack criteria to assess their economic, environmental, and human health impacts. Yet as of 2021, more than 40 companies are working to develop or manage chemical recycling projects in the United States.

PSI's model legislation for packaging EPR, which informed laws enacted in Maine, Oregon, Colorado, and California, specifies that incineration and “waste to fuel” or “waste to energy” technologies, which burn material for energy, should be considered disposal, not recycling. The only laws to address chemical recycling specifically are Colorado (packaging) and New York (carpet), which stipulate that the technologies must meet environmental standards. New York's carpet law also specifies that chemical recycling technologies such as pyrolysis and gasification do not count towards recycling.

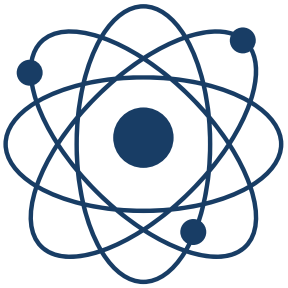
The outputs of each technology type are key to their identity. If the final products are fuels, the process is often referred to as plastics-to-fuel and considered energy recovery and disposal rather than recycling. If marketable plastics are the final products, the process is referred to as plastics-to-plastics and is often seen as a type of recycling. Most U.S. governments and a growing number of international standards do not consider energy recovery technologies (including plastics-to-fuel) to be recycling.

EXISTING AND EMERGING TECHNOLOGIES

Purification is a process by which plastics are dissolved in chemicalsolvents to recovervirgin-grade plastic resins that are free from additives and dyes.



Depolymerization processes break the molecular bonds of plastics to recover building blocks (monomers) that can be reconstructed into “like-new” resins.



Conversion technologies convertplastics into refined hydrocarbons and petrochemicals. Pyrolysis and gasification technologies generally produce fuel or fuel intermediaries.

LEARN MORE: www.productstewardship.us

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PSI PRODUCT STEWARDSHIP INSTITUTE

PACKAGING EXTENDED PRODUCER RESPONSIBILITY (EPR)

RETHINKING PACKAGING WASTE

A fully producer-funded system to reduce packaging and single-use plastic waste, make recycling easier and disincentivize problematic packaging, and lower taxpayer costs for managing waste.

WASTE CHALLENGES:

- E-commerce and the delivery economy has led to a dramatic increase in packaging waste. Packaging waste and printed paper now account for 40% of our waste stream.
- Despite increasing public pressure plastic production is expected to double in the next 20 years, according to the World Economic Forum. Consumer brands have little incentive to choose more sustainable materials or reduce the amount of packaging they put into the waste stream.
- The burden of dealing with these ever-growing mountains of packaging waste falls on local governments and taxpayers.

THE SOLUTION:

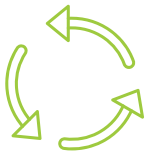
To solve this problem, states are requiring producers to take responsibility for their packaging throughout its lifecycle – from design to disposal. Producer responsibility laws shift the costs of recycling from taxpayers to producers and incentivize the use of more sustainable packaging.

Shifting the costs of recycling to producers through producer responsibility has multiple benefits:

- Producers have an incentive to reduce waste and stop using materials that are hard to recycle.
- Local governments and taxpayers save millions of dollars of costs in managing packaging waste.
- Reducing, reusing, and recycling packaging waste saves energy and has climate benefits. It takes 90% less energy to make a can from recycled aluminum compared to virgin material, 50% less energy to recycle glass, and 75% less to recycle paper.

Under Packaging EPR, best practices include:

Materials must be **source reduced**.



Support a packaging **reuse system.**

Materials must be **recycled or composted**.

Postconsumer recycled content targets established

PSI PRODUCT STEWARDSHIP INSTITUTE

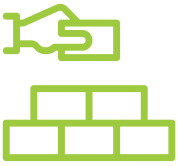
PACKAGING EXTENDED PRODUCER RESPONSIBILITY (EPR)

WHAT DOES THIS LEGISLATION DO?

OVERSIGHT

The state department is responsible for enforcement and oversight. The department will appoint a multistakeholder advisory committee to provide ongoing program input and recommendations. The Producer Responsibility Organization (PRO) must submit annual reports and five-year plans to the advisory committee for review and to the state department for approval.

BUILD ON A STRONG FOUNDATION



The program must protect and leverage public and private investments already made in each state's infrastructure. The PRO must work with existing haulers and material recovery facilities to ensure recycling services are as conveniently available to all state residents as trash collection.

SIMPLIFIED RECYCLING

The PRO will fund and develop outreach and consumer education materials that are consistent across the entire state, building on existing educational efforts. There will be a single, universal baseline list of recyclable materials statewide to reduce confusion and contamination.

Proven EPR Success

Packaging EPR has passed in seven states within the U.S. EPR for packaging and paper products has been successfully implemented for decades around the world, and as a result in these places consumer recycling rates have tripled. Recycling rates have reached 83% in Belgium and 78% in British Columbia, and research on existing programs has found no increase in the price of consumer goods.

Contact Us: Darla Arians | darla.arians@productstewardship.us

PRODUCT STEWARDSHIP INSTITUTE

Making Sense of "Chemical Recycling"

Criteria for Assessing Plastics-to-Plastics and Plastics-to-Fuel Technologies

November 17, 2022

Prepared by the Product Stewardship Institute, Inc.

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The Product Stewardship Institute

The Product Stewardship Institute (PSI) is a policy advocate and consulting nonprofit that powers the emerging circular economy to ensure products are responsibly managed from design to end of life. In 2000, PSI pioneered product stewardship in the United States by convening diverse stakeholders to build extended producer responsibility (EPR) policies, programs, and laws. Our Members include state, local, and tribal governments in 48 states, and we partner with businesses, academic institutions, environmental nonprofits, and international governments. Together, we advance scalable solutions that protect people and the planet.

Since 2000, PSI has helped enact 130 EPR laws across 16 product categories in 33 states — and all of them began with a background paper, which established the foundation for dialogue. As such, the purpose of this report is to provide baseline information for a robust multi-stakeholder dialogue that PSI intends to facilitate with governments, NGOs, and companies running or planning chemical recycling facilities. We feel that a dialogue on this issue is desperately needed so that all stakeholders can present their interests and perspectives. It is through such a dialogue that PSI plans to develop specific recommendations for how EPR can be applied to emerging chemical recycling technologies.

The purpose of this report is to provide baseline information as a precursor to a robust multi-stakeholder dialogue that PSI intends to facilitate with governments, NGOs, and companies running or planning chemical recycling facilities.

Context

Concerns about chemical recycling are increasingly high-profile. In July 2022, U.S. Senator Cory Booker of New Jersey, along with U.S. Representatives Jared Huffman and Alan Lowenthal of California, published a letter to the Environmental Protection Agency (EPA)[1] requesting that pyrolysis and gasification continue to be regulated as "municipal waste combustion units" under the Clean Air Act. The letter was signed by 35 other members of Congress and endorsed by over 45 environmental organizations.

Critics of chemical recycling projects point out that they are typically situated in low-income communities of color and that they do not yet operate "at scale," i.e., at the required size to solve the problem. Both criticisms are true. However, waste management facilities, including

[1] "Booker, Huffman, Lowenthal Lead 35 Colleagues in Letter Raising Concerns Over Climate & Environmental Justice Risks of Chemical Recycling of Plastics" *CoryBooker.com* July 14, 2022. https://www.booker.senate.gov/news/press/booker-huffman-lowenthal-lead-35-colleagues-in-letter-raising-concerns-over-climate-and-environmental-justice-risks-of-chemical-recycling-of-plastics

mechanical recycling plants,[2] are also typically situated in low-income communities of color and are also not operating at a scale to solve the problem: In the United States, only about 30% of the nearly 300 million tons of municipal solid waste generated each year is mechanically recycled.[3] PSI and our Members agree that the siting of any facility that produces emissions and pollutants is a priority environmental justice concern. It is critical that we reduce – and ultimately eliminate – disproportionate harm to historically oppressed and overburdened communities.

Circular Economy

America has failed to address the plastic pollution crisis: The majority is currently landfilled, incinerated, exported, or leaked into the environment.[4] It is also evident that the best way to address this crisis – as well as the linked climate emergency – is to eliminate the overproduction of plastics, with strong emphasis on waste prevention systems such as reuse and refill. At the same time, we acknowledge that production is unlikely to stop in the near- or mid-term. While source reduction remains critical, strong recycling and waste management policies are also necessary to achieve a sustainable circular economy.

Also, we can't ignore the fact that chemical recycling increasingly dominates the discussion of waste management, especially for plastics. More than 40 companies are currently working to develop or manage chemical recycling projects in the United States, and 20 states — including, most recently, Missouri and New Hampshire[5] — have enacted laws that allow chemical recycling facilities to be permitted as manufacturing facilities, which reduces regulatory burdens and incentivizes companies to invest in these technologies[6] (see "Considerations for Public Entities" section).

This is antithetical to PSI's EPR model legislation for packaging, which informed laws enacted in California, Colorado, Maine, and Oregon and specifies that incineration and "waste to fuel" or "waste to energy" technologies, which burn material for energy, should be considered disposal.

The truth is: Government policy makers tasked with passing legislation or issuing permits lack criteria to assess their economic, environmental, and human health impacts. This report aims to begin to fill that gap.

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[2] EPA *National Recycling Strategy* November 15, 2021. https://www.epa.gov/system/files/documents/2021-11/final-national-recycling-strategy.pdf

[3] EPA *Frequent Questions Regarding EPA's Facts and Figures About Materials, Waste, and Recycling* July 9, 2022. https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/frequent-questions-regarding-epas-facts-and

[4] Ibid.

[5] Megan Smalley, "Two states pass advanced recycling legislation" *Recycling Today* July 5, 2022. https://www.recyclingtoday.com/article/missouri-new-hampshire-pass-advanced-recycling-legislation/.

[6] Cheryl Hogue, "Chemical recycling of plastic gets a boost in 18 US states—but environmentalists question whether it really is recycling" *Chemical & Engineering News* May 15, 2022. https://cen.acs.org/environment/recycling/plastic-recycling-chemical-advanced-fuel-pyrolysis-state-laws/100/i17

Process

To develop the report, we first researched existing technology types. Then, we convened our Members to draft a set of criteria through which governments might assess chemical recycling technology permits and legislation. Finally, we solicited feedback.

The report is designed to provide guidance to government policy makers and is *not* an endorsement of any company or technology. All companies mentioned by name are used as examples to provide more clarity and were selected solely on the basis of readily available information. Our hope is that this report will inspire constructive dialogue among a range of stakeholders.

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*This report is designed to provide guidance to government policy makers considering chemical recycling technology permits and legislation and is **not** an endorsement of any company or technology. Our hope is that it will inspire constructive dialogue among a range of stakeholders.*

Acknowledgements

PSI works with state, local, and tribal government members in 48 states and we partner with businesses, academic institutions, international governments, and environmental nonprofits around the world. We reached out to stakeholders in all of these categories to provide feedback on this report and received a tremendous amount of valuable input.

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This report was funded by PSI Members and Partners. Both groups are aligned with PSI's mission to ensure that products are responsibly managed from design to end of life; all are supportive of our principles of EPR. Our board of directors is made up of state and local government officials who helped to identify the need for the criteria presented in the report.

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Introduction

The Problem: We are facing a global plastics crisis,[7] with plastic production and related pollution continuing to increase.[8] In response, consumer brands, recyclers, governments, and environmentalists have sought solutions that will reduce waste, greenhouse gas emissions, and pollution. Plastics producers and other industry stakeholders have advocated for "advanced" or "chemical" recycling; however, these technologies have raised questions and concerns among environmental advocates and many government agencies.

Confusing Terms: The terms "advanced recycling," "chemical recycling," and even "molecular recycling," are used interchangeably to refer to a wide range of technologies – not all of which are necessarily considered recycling. This report does refer to "chemical recycling" as it is the most commonly used term, but we prefer to identify technologies in more specific terms whenever possible.

Policy Questions: In trying to determine how to regulate these emerging technologies, policymakers and other stakeholders — including consumer brands, plastics production companies, recyclers, environmental advocacy organizations, government officials, and others — need a better understanding of them, especially as industry advocates seek investments into their development. Meanwhile, debates continue among policymakers and advocates who are crafting EPR legislation about whether resources should be invested into chemical recycling facilities under EPR programs. Some advocate for banning these technologies outright or prohibiting their use from being classified as recycling. In Europe, where EPR has been active for decades, there is still widespread skepticism about whether and how chemical recycling might be used to achieve program targets, but there are examples of producer responsibility organizations (PROs) investing in research and development of various chemical recycling technologies.[9]

Plastic vs. Fuel Outputs: From the perspective of PSI's state and local government Members, the outputs of each technology type are key to their identity. If the final products are fuels, the process is often referred to as plastics-to-fuel and considered energy recovery rather than recycling. If marketable plastics are the final products, the process is referred to as plastics-to-plastics, or material-to-material, and typically seen as a type of recycling. Most U.S. governments and a growing number of international standards do not consider energy recovery technologies

[7] UNEP, "What you need to know about the plastic pollution resolution" *UNEP.org* March 2, 2022. https://www.unep.org/news-and-stories/story/what-you-need-know-about-plastic-pollution-resolution
[8] UNEP *Drowning in Plastics: Marine Litter and Plastic Waste Vital Graphics* October 2021. https://www.unep.org/resources/report/drowning-plastics-marine-litter-and-plastic-waste-vital-graphics
[9] Federica Tiefenthaler, "Circular Resources' Acquisition of Der Grüne Punkt" *Global Legal Chronicle* August 24, 2022. https://globallegalchronicle.com/circular-resources-acquisition-of-der-grune-punkt/
"Cross-industry consortium to study plastic chemical recycling in France" *Plastics News* December 10, 2019. https://www.plasticsnews.com/news/cross-industry-consortium-study-plastic-chemical-recycling-france.

(including plastics-to-fuel) to be recycling.[10] Therefore, the distinction between plastics-to-plastics and plastics-to-fuel technologies is seen by PSI's state and local government Members as critical to clear communication and policy design.

The distinction between plastics-to-plastics and plastics-to-fuel technologies is critical to clear communication and policy design.

Potential for Greater Plastics Circularity: One of the central questions facing policymakers is whether the investments, energy, and resources needed to scale up these technologies will result in a more sustainable economy with reduced environmental impacts. Brands and plastics production companies are investing millions of dollars into the development of these technologies, claiming that they expand end-of-life options for plastics and exceed the capabilities of traditional mechanical recycling. One of the arguments made for chemical recycling technologies is that they enable repeated processing without loss of quality.[11] By contrast, mechanical recycling of plastics results in approximately 10% material quality loss with each cycle of processing and degrades materials over their lifetime – with current mechanical recycling technologies, plastics can only be recycled up to seven times before the polymers are too degraded for further use.[12]

As demand for post-consumer recycled resins increases, especially in light of new policies enacting post-consumer recycled content requirements for certain types of plastics such as food-grade and bottle-grade packaging,[13] companies struggling to source recycled content see tremendous

[10] International Organization for Standardization (Europe) *ISO/TR 23891:2020 Plastics – Recycling and recovery – Necessity of standards* September 2020. https://www.iso.org/standard/77294.html
"Definitions – Material recycling" *The U.S. Plastics Pact Roadmap to 2025* 2022. https://usplasticspact.org/roadmap-reader/
"Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives" *The European Waste Directive* May 7, 2018. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098

[11] Alexander H. Tullo, "Companies are placing big bets on plastics recycling. Are the odds in their favor?" *Chemical & Engineering News* October 11, 2020. https://cen.acs.org/environment/sustainability/Companies-placing-big-bets-plastics/98/i39

[12] Martyna Solis and Semida Silveria, "Technologies for chemical recycling of household plastics – a technical review and TRL assessment" *Waste Management Vol 105* March 15, 2020 https://doi.org/10.1016/j.wasman.2020.01.038

[13] There are three U.S. state laws establishing post-consumer recycled (PCR) content requirements for plastics – in California (AB 793, 2020), Washington (RCW Chapter 70A.245), and New Jersey (S 2515, 2022) – all of which include requirements for plastic beverage containers. In Europe, the Single-Use Plastics Directive (https://eur-lex.europa.eu/eli/dir/2019/904/oj), which sets minimum PCR content rates for PET beverage bottles by 2025 and expands to all beverage bottles by 2030, was enacted in 2019. Additionally, the European Commission enacted a *Circular Economy Action Plan* in 2020 (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN), in which it states an intention to

potential in the reprocessing capacity of chemical recycling.[14] Many industry stakeholders argue that chemical recycling is the only way to meet both post-consumer recycled content requirements and state and federal health and safety requirements for food-grade applications.[15]

Brands and industry associations continue to seek investments into infrastructure — including public funding at the federal, state, and local levels — to accelerate the pace of these developments.[16]

Potential Greenwashing, Environmental Impacts: However, many environmentalists, recyclers, and others decry these technologies as distracting, greenwashing, and false solutions – a way for the plastics industry to continue expanding and to undermine arguments for eliminating single-use plastics.[17] These groups argue that investments into chemical recycling infrastructure — including purification, depolymerization, or conversion facilities and the expansion or alteration of infrastructure to collect feedstocks for such facilities — are a misuse of funds that could otherwise be spent on ready-to-implement improvements to mechanical recycling as well as upstream waste prevention (such as reuse systems) and product or packaging redesign.[18] They have also raised significant environmental justice concerns regarding the potential hazardous waste, hazardous air pollutants, and GHG emissions from these facilities, which are overwhelmingly sited (or proposed to be sited) in low-income communities, communities of color, and other marginalized communities.[19]

The Bottom Line: Caught in the middle between industry and environmentalists are federal, state, and local government officials who must work to support the public good but often lack sufficient information or resources to assess and regulate these emerging and rapidly evolving technologies. They know that to truly curb the global climate change and plastic pollution crises, a comprehensive suite of policies and voluntary actions is critical. PSI's state and local government Members agree that reduced material use and a robust reuse economy are central to any strategy – and must retain their place at the forefront of the classic materials-management hierarchy. But they also recognize that a circular economy will not function without recycling.

"propose mandatory requirements for recycled content and waste reduction measures for key products such as packaging, construction materials and vehicles." The Commission's requirements are expected to include PCR content mandates for food-grade plastic packaging.

[14] Megan Quinn, "Progress report: State waste and recycling policies gain notable traction this year" *Waste Dive* July 19, 2021. https://www.wastedive.com/news/2021-waste-recycling-state-policy-progress-epr-pcr-plastic/603457/

[15] Environment & Climate Change Canada/STINA, *Assessing the State of Food Grade Recycled Resin in Canada & the United States* 2021. https://www.plasticsmarkets.org/jsfcontent/ECCC_Food_Grade_Report_Oct_2021_jsf_1.pdf

[16] Plastics Industry Association *RECOVER ACT: Realizing the Economic Opportunities and Value of Expanding Recycling* 2019. https://www.plasticsindustry.org/sites/default/files/2019%20Recover%20Act%20Flyer.pdf

[17] Association of Mission Based Recyclers (AMBR), "'Chemical recycling' will not solve our plastics problem" September 15, 2022. https://ambr-recyclers.org/our_work/refuting-false-solutions/

[18] Natural Resources Defense Council (NRDC), *Recycling Lies: "Chemical Recycling" of Plastic is just Greenwashing Incineration* February 2022. https://www.nrdc.org/sites/default/files/chemical-recycling-greenwashing-incineration-ib.pdf

[19] Ibid.

Our Aim: This report provides a set of draft criteria by which policymakers can assess chemical recycling technologies to determine which, if any, can support a sustainable economy, prevent waste and pollution, and curb greenhouse gas emissions alongside other upstream solutions to prevent plastic pollution and waste. It is intended to provide basic clarification on the suite of emerging chemical recycling technology types, and our hope is that it can be used to inform a structured dialogue with key stakeholders on how to address these technologies through EPR or other types of policies, as well as how to regulate and permit them.

Existing & Emerging Technologies

Chemical recycling refers to a wide range of processes that use one of three technology types: purification, depolymerization, or conversion.

- **Purification** is a process by which plastics are dissolved in chemical solvents to recover virgin-grade plastic resins that are free from additives and dyes.
- **Depolymerization** processes break the molecular bonds of plastics to recover building blocks (monomers) that can be reconstructed into "like-new" resins.
- **Conversion** technologies (e.g., pyrolysis and gasification) convert plastics into refined hydrocarbons and petrochemicals. Pyrolysis and gasification technologies produce fuel or fuel intermediaries, but these outputs may be reprocessed into plastics.

Given the widespread confusion over the terms "chemical," "advanced," and "molecular" recycling, in this report we refer to each technology type (purification, depolymerization, conversion), plastics-to-plastics (recycling), and plastics-to-fuel (energy recovery) technologies, using these specific terms.

According to the investment firm Closed Loop Partners, at least 40 companies using one or more of these technologies are currently in either development or commercial stages in North America.[20] Closed Loop Partners outlines 10 levels of "technology readiness," from concept (level 0) to full commercial application (level 9).[21] Existing purification, depolymerization, and conversion companies fall across this spectrum, with some in the concept phase, conducting lab research, or undertaking pilot projects for proof of concept, and others in early commercial or full-growth stages (see Fig. 1).[22]

[20] Closed Loop Partners, *Accelerating Circular Supply Chains for Plastics: A Landscape of Transformational Technologies that Stop Plastic Waste, Keep Materials in Play and Grow Markets* 2019. https://www.closedlooppartners.com/wp-content/uploads/2021/01/CLP_Circular_Supply_Chains_for_Plastics_Updated.pdf
[21] Closed Loop Partners, *Transitioning to a Circular System for Plastics* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/AR-report-V23_final7.pdf
[22] Ibid.

Closed Loop Partners states that the average time for chemical recycling facilities to reach full commercial operation is 17 years, and this timeline may be longer for plastics-to-plastics technologies that produce polymers rather than plastics-to-fuel techniques, which produce petrochemicals and other fuels.[23] In its 2021 report, the firm encouraged investors and policy makers to focus on scaling plastics-to-plastics technologies that meaningfully decarbonize the status-quo plastics supply chains to support a more rapid transition to a circular economy.[24] However, the significant time that it takes to scale to early commercial or full-growth stages, as well as the overall commercial viability of these companies, has been of major concern. The National Academies of Sciences recently characterized chemical recycling technologies as "unproven to handle the current plastic waste stream and existing high-production plastics."[25] Investigative reporters for Reuters have emphasized that "at least four high-profile projects have been dropped or indefinitely delayed over the last two years because they weren't commercially viable."[26] Opponents cite such examples of failed investments and a lack of fully operational, commercial-scale facilities as proof that the technologies are inherently flawed.[27]

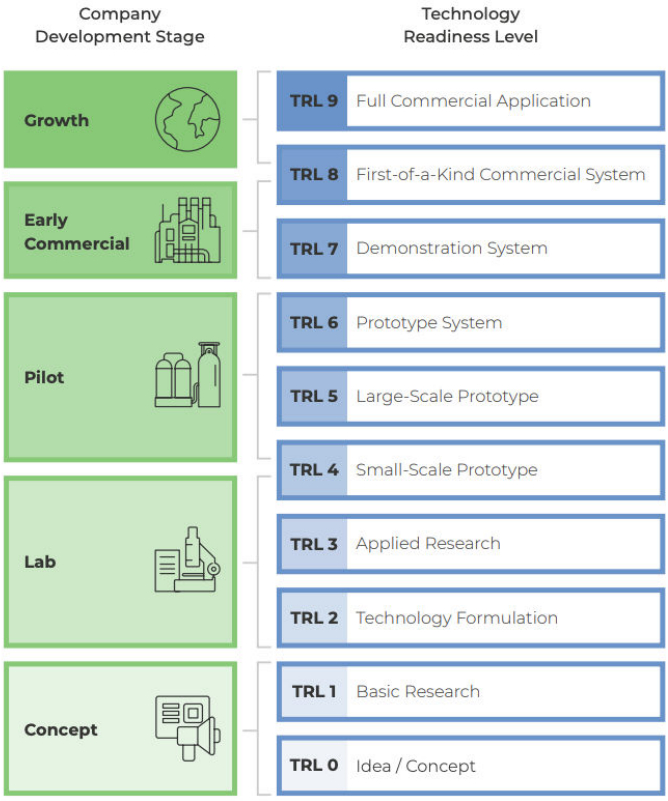

Figure 1: Technology Readiness Levels. Figure from Closed Loop Partners, Global Directory of Molecular Recycling Technologies – Supplemental Resource from Transitioning to a Circular System for Plastics: Assessing Molecular Recycling Technologies in the United States and Canada (2021).

[23] Closed Loop Partners, *Accelerating Circular Supply Chains for Plastics* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/01/CLP_Circular_Supply_Chains_for_Plastics_Updated.pdf

[24] Closed Loop Partners, *Transitioning to a Circular System for Plastics* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/AR-report-V23_final7.pdf

[25] The National Academies of Sciences, Engineering, and Medicine, "Reckoning with the U.S. Role in Global Ocean Plastic Waste" *The National Academies Press* 2022. https://doi.org/10.17226/26132

[26] Joe Brock, Valerie Volcovici and John Geddie, "The Recycling Myth: Big Oil's Solution for Plastic Waste Littered with Failure" *Reuters* 2021. https://www.reuters.com/investigates/special-report/environment-plastic-oil-recycling

[27] Ivy Schlegel, "Deception by the Numbers" *Greenpeace* September 9, 2020. https://www.greenpeace.org/usa/wp-content/uploads/2020/09/GP_Deception-by-the-Numbers-3.pdf

Evaluation Criteria

Since the term chemical recycling is used to refer to such a wide variety of existing and emerging technologies, assessing which, if any, can support a more sustainable economy with reduced environmental impacts is challenging. To better define their goals, PSI's local and state government Members identified seven attributes of a sustainable circular economy with a minimal environmental footprint:

- Reduce, and ultimately eliminate, fossil fuel extraction.
- Reduce greenhouse gas (GHG) emissions.
- Reduce biodiversity loss and the loss of ecosystem services.
- Reduce emissions of toxic chemicals.
- Reduce the financial burden on taxpayers for materials management.
- Prevent disproportionate harm to overburdened communities domestically and globally.
- Prevent production of unnecessary and problematic materials.

The criteria are intended to serve as a starting point for further stakeholder dialogue, not as static guidelines.

The following criteria are proposed to assess which, if any, emerging technologies can help achieve these seven goals. The criteria are intended to serve as a starting point for further stakeholder dialogue, *not* as static guidelines. The objective of this report, as previously stated, is to elicit further discussion among stakeholders in the hope of reaching consensus on the best policy approach to chemical recycling.

- **Criteria #1: Proper Inputs.** The process should only source inputs that need to be disposed of, do not have reusable or mechanically recyclable alternatives, and have no less impactful end-of-life management options (e.g., plastics from medical waste, e-waste, textiles, and construction waste). By utilizing only non-mechanically recyclable inputs, the process should avoid competition for feedstocks with mechanical recycling operations. The technology should not be used to perpetuate unsustainable production of problematic or unnecessary materials, such as single-use cutlery and straws.

- **Criteria #2: Transparent Outputs.** The process should be publicly transparent about its outputs, including waste, emissions, and final products (except for proprietary information that would prevent fair competition among companies, which must still be disclosed as part

Natural Resources Defense Council, *Recycling Lies: "Chemical Recycling" of Plastic is just Greenwashing Incineration* February 2022. https://www.nrdc.org/sites/default/files/chemical-recycling-greenwashing-incineration-ib.pdf.

of the permitting process). Only processes that produce plastics as their final output should be referred to and treated as recycling. Plastics-to-fuel technologies — whether the fuel is used for on-site or off-site combustion — should be referred to and treated as energy recovery, not recycling, as these technologies do not fit the U.S. Environmental Protection Agency (EPA) definition for recycling, which is "collecting and reprocessing a resource so it can be used again."[28] If a chemical recycling process produces some plastics and some fuels, these outputs should be transparently reported and only the portion of outputs that are plastics should be considered recycled. Third-party certification or other independent verification should be provided to support any claims regarding a technology's efficiency, outputs, environmental impacts, and other factors.

- **Criteria #3: Reduced Climate Impacts and Fossil Fuel Extraction.** The outputs of chemical recycling technologies must have lower life-cycle impacts, including GHG emissions, than the same outputs produced through traditional means. For example, polypropylene (PP) resins produced through purification must have a lower life-cycle impact than PP resins produced using virgin feedstocks derived from fossil fuels – accounting for the energy sources used to process the resins. In other words, the process of converting waste plastics into feedstocks must not use more non-renewable energy or resources than traditional plastic production processes and should support efforts to mitigate climate change.[29] Additionally, it is important to incorporate the full scope of each technology into assessments of impact, from collection and pre-processing through to end market.

- **Criteria #4: Minimal Harm.** The process should minimize emissions of harmful pollutants into the land, air, and water. Emissions must not exceed, at a minimum, federal Clean Air Act or Clean Water Act standards, or state standards if they are more stringent, and facilities should not add to any cumulative pollution impacts in overburdened communities.[30] The siting process for any facilities should include robust community engagement and transparency. Additionally, the process should prioritize the management of outputs and wastes within the United States over exporting them abroad. For any

[28] EPA, *Recycling, Glossary of Climate Change Terms* September 9, 2013. https://sor.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do;jsessionid=Z2Wb-1xpDbgotz2v_jX3Ai4v_oT4YUUAkt6hQXAQEhkmhAix0bor!-1829608955?details=&vocabName=Glossary%20Climate%20Change%20Terms&filterTerm=recycling&checkedAcronym=false&checkedTerm=false&hasDefinitions=false&filterTerm=recycling&filterMatchCriteria=Contains.

[29] Lifecycle Assessment (LCA), the most common methodology for assessing the GHG and lifecycle impacts of a given product or material, is subject to significant variability depending upon the assumptions and parameters used. For example, Closed Loop Partners' own LCAs on chemical recycling technologies include a caveat that varying electrical grids across regions of the United States, among other factors, could significantly alter the results. Closed Loop Partners *Transitioning to a Circular System for Plastics: Assessing Molecular Recycling Technologies in the United States and Canada* https://www.closedlooppartners.com/appendix-molecular-recycling-technologies/#appendix40.

[30] Based on New Jersey's Environmental Justice Law, enacted September 2020. https://www.nj.gov/dep/ej/policy.html#ejlaw.

materials exported or proposed to be exported, the process should guarantee that all materials will be managed responsibly and without harm to receiving communities.[31]

- **Criteria #5: Widespread, Convenient Collection.** The process should have a convenient, equitable, and accessible means for waste generators to provide materials that do not increase contamination in mechanical recycling streams. For example, collection of flexible plastics for processing at chemical recycling facilities should not occur in such a way that mechanical recycling streams see increased contamination from flexibles due to consumer confusion.

- **Criteria #6: Operates at Scale Without Public Subsidy.** The process should be commercially viable within a realistic time frame. Technologies should ultimately result in a reduced financial burden on taxpayers for waste management and should not be dependent on public subsidies. Significant federal, state, and local government attention and funding have already been invested into chemical recycling technologies[32] and the petroleum industry has been heavily subsidized by taxpayers for decades.[33] PSI's government Members have emphasized that public subsidies should not be used to address a waste crisis that was caused by private industry. Public recycling programs may wish to consider whether selling materials from collection programs or MRFs to processors using plastics-to-fuel technologies also constitutes taxpayer support.

Considerations for Public Entities

Permitting

In 2021, the U.S. EPA opened a formal rulemaking process to consider whether any additional regulation of gasification, pyrolysis, and related technologies is needed at a national level. Currently, chemical recycling technologies and their associated facilities are regulated by existing federal and state permitting requirements. A full analysis of state laws and regulations regarding

[31] Based on Oregon's EPR law for packaging and paper products, enacted August 2021. https://olis.oregonlegislature.gov/liz/2021R1/Downloads/MeasureDocument/SB582/Enrolled

[32] U.S. Department of Energy, *Department of Energy Launches Plastics Innovation Challenge* November 21, 2019. https://www.energy.gov/articles/department-energy-launches-plastics-innovation-challenge
U.S. Department of Energy, "Department of Energy Announces $25 Million for Plastics Recycling R&D, Launches Upcycling Consortium" March 16, 2020. https://www.energy.gov/articles/department-energy-announces-25-million-plastics-recycling-rd-launches-upcycling-consortium
Colin Staub, "Federal lawmakers launch plastics recycling task force," *Plastics Recycling Update* December 11, 2019. https://resource-recycling.com/plastics/2019/12/11/federal-lawmakers-launch-plastics-recycling-task-force
Colin Staub, "Plastics recovery efforts receive millions in state funding" *Resource Recycling* May 21, 2019. https://resource-recycling.com/recycling/2019/05/21/plastics-recovery-efforts-receive-millions-in-state-funding

[33] Yale School of the Environment, "Fossil Fuels Received $5.9 Trillion in Subsidies in 2020, Report Finds" *E360 Digest* October 6, 2021. https://e360.yale.edu/digest/fossil-fuels-received-5-9-trillion-in-subsidies-in-2020-report-finds

purification, depolymerization, and conversion technologies is beyond the scope of this report; however, an example can be found in the Oregon Administrative Rules Database (OARD).[34]

There is ongoing debate over whether to classify these technologies as forms of manufacturing or forms of waste management. The American Chemistry Council (ACC) and other industry groups seek to have all purification, depolymerization, and conversion technologies regulated as manufacturing processes because they consider waste plastics as feedstocks for manufacturing processes that produce either fuels or the building blocks for new plastics.[35]

In contrast, environmental groups and other advocates strongly support regulating these technologies as waste management processes,[36] because this would require more stringent restrictions on emissions and strong oversight over the handling of the primary inputs for each of the three technology types that use post-consumer or post-industrial wastes. Many of the existing facilities in the U.S. have been permitted as hazardous waste facilities due to the storage and release of chemicals and toxics.[37] Permitting for purification, depolymerization, or conversion facilities should address the following issues:

- Potential impacts on state and/or local GHG emissions reduction targets.
- Transparent and thorough environmental justice and environmental impact reviews, alongside robust community engagement and transparency.
- Financial assurance in the event of site failure(s), especially in the event that cleanups will be needed.

Extended Producer Responsibility (EPR) Legislation

EPR is a policy tool that requires producers of consumer goods to take responsibility for their products and packaging both upstream in the design phase and downstream in the post-consumer management phase. With government oversight, EPR policy shifts financial and sometimes management responsibility away from the public sector to producers and provides financial incentives for producers to incorporate environmental considerations into the design of their products and packaging. EPR intends to increase capacity for, and investments into, waste reduction and recycling infrastructure using producer – rather than taxpayer – funds.

There is growing consensus among governments, recyclers, and producers that EPR legislation should define "recycling" to include plastics-to-plastics technologies and never include energy recovery or plastics-to-fuel, but no national consensus on the terms has been established.

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[34] Oregon Administrative Rules Database *Solid Waste: Special Rules For Selected Solid Waste Disposal Sites* accessed September 2022. https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=1492

[35] Steve Toloken, "ACC pushes chemical recycling legislation" *Plastics News* April 22, 2019. https://www.plasticsnews.com/article/20190422/NEWS/190429997/acc-pushes-chemical-recycling-legislation

[36] GAIA, "All Talk and No Recycling: An Investigation of the U.S. 'Chemical Recycling' Industry" July 28, 2020. https://www.no-burn.org/wp-content/uploads/All-Talk-and-No-Recycling_July-28.pdf

[37] Ohio Environmental Protection Agency, "PureCycle RCRA Subtitle C Site Identification Form" March 15, 2019. http://edocpub.epa.ohio.gov/publicportal/ViewDocument.aspx?docid=1046080

Another critical topic is the need for transparency: EPR programs may require disclosure of inputs for each processing facility – including whether these are post-consumer, post-industrial, post-commercial, or a combination of these, and whether they are mixed with wastes not covered by the EPR program, such as automotive parts or medical waste – as well as outputs, such as whether or not a portion of the inputs is converted to fuel and how much is sold as plastic feedstock. They also may require reporting on the final destination of and/or the emissions from processing covered materials.

For now, the issue of whether and how to allow for purification, depolymerization, and conversion technologies in EPR programs tends to arise when defining "recycling," as well as in parameters defining PRO investments. Many producers view EPR systems – especially for packaging – as a means to invest in purification, depolymerization, and conversion technologies, among other upgrades to recycling infrastructure and waste reduction. But as states across the country introduce and pass EPR legislation covering packaging, electronics, carpet, textiles, and other products made from plastics, questions about how to treat plastics-to-plastics and plastics-to-fuel technologies in these systems continue to emerge. Some state EPR bills have sought to exclude certain chemical recycling technologies from the definition of "recycling," which has drawn opposition from consumer goods companies that would otherwise be supportive of EPR legislation.

For example, NY S1185-C (2021) included the following definition: "'Recycling' means reprocessing, by means of a manufacturing process, of a used material into a product, a component incorporated into a product, or a secondary (recycled) raw material. 'Recycling,' for purposes of this title, does not include energy recovery or energy generation by means of combustion, use as a fuel, or landfill disposal of discarded covered materials or products or discarded product component materials or chemical conversion processes, as determined by the department to not qualify in the state as recycling."[38]

The Sustainable Food Policy Alliance (SFPA) – a consortium of four major global consumer brands – wrote in testimony to State Senator Todd Kaminsky: "Our companies recognize the need for a suite of strategies, including innovative recycling technologies, to enable the recycling of both the rigid and flexible plastics that we use. We disagree that advanced recycling technologies that deliver feedstock to make new packaging are considered recovery, not recycling, under this bill. We agree that energy and fuel are considered recovery but advanced recycling technologies are a necessary part of the solution to not only recycle flexible plastic packaging but to also deliver food-safe recycled content."

The first two EPR laws for packaging in the U.S., both enacted in 2021, take distinct approaches to the management of packaging waste. While neither explicitly uses the terms "chemical" or "advanced" recycling, Oregon's new law prescribes an overall preference for EPR programs to

[38] *New York Extended Producer Responsibility Act of 2021* S1185-C 2021. https://www.nysenate.gov/legislation/bills/2021/s1185/amendment/c

result in "reduction of net negative impacts on human well-being and environmental health" and requires program plans, submitted by producers to the state for approval, to include lifecycle assessments and additional information for any materials not managed through mechanical recycling.[39] Maine's new law requires the state's contracted stewardship organization to submit all proposals for infrastructure investments to the Department of Environmental Protection for approval and establishes criteria by which the state will assess such proposals on a case-by-case basis.[40]

In 2022, Colorado passed the nation's third packaging EPR law, which emulates Oregon on the issue of recycling technologies – requiring producers to submit information on whether processing technologies will affect the ability for plastics-to-plastics recycling; details on the potential supply-chain impacts for food and pharmaceutical-grade plastic packaging; compliance with federal air, water and waste permitting requirements; and analysis of the environmental impacts of each technology as compared to incineration.[41] In both Oregon and Colorado, "mechanical recycling" is defined as "a form of recycling that does not change the basic molecular structure of the material being recycled," which means purification technologies might fall under this umbrella. It remains to be seen whether this will be further clarified in regulations or how this definition could be applied to existing and emerging technologies.

On June 30, 2022, California became the fourth state in the nation to enact a packaging EPR law. California's law leaves open the possibility for advanced plastics-to-plastics technologies but does not allow combustion, incineration, waste-to-energy, waste-to-fuel production (except for anaerobic digestion), or "other forms of disposal" to count as "recycling."[42] The inclusion of chemical recycling technologies hinges on the word "disposal." Existing California statute defines "disposal" to include pyrolysis, distillation, and "biological conversion other than composting,"[43] which calls into question whether certain chemical recycling technologies might be permissible under the new EPR program while others (like pyrolysis) are not. The new packaging EPR law also prohibits a producer responsibility organization (PRO) from investing program funds "to subsidize, incentivize, or otherwise support" any non-recycling operations, including any forms of "disposal."[44] Under the law, CalRecycle will enact regulations that encourage less impactful recycling processes and will prohibit recycling technologies that produce "significant amounts of hazardous waste."[45]

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[39] Oregon SB 582, Chapter 681, 2021 Laws" effective January 1, 2022. https://olis.oregonlegislature.gov/liz/2021R1/Downloads/MeasureDocument/SB582/Enrolled

[40] ME LD 1541, Chapter 455 approved July 12, 2021. https://legislature.maine.gov/legis/bills/getPDF.asp?paper=HP1146&item=11&snum=130

[41] CO HB 1355, as signed, Section 25-17-709. https://leg.colorado.gov/bills/hb22-1355

[42] CA SB 54 Chaptered, Section 42051.1(aa)(1). https://legiscan.com/CA/text/SB54/2021

[43] CA PRC Sec. 40192 defines "disposal" to include "transformation," which is defined in Sec. 40201 June 6, 2016. https://california.public.law/codes/ca_pub_res_code_section_40201

[44] CA SB 54, Chaptered, Section 42051.1(j)(2)(D) June 30, 2022. https://legiscan.com/CA/text/SB54/2021

[45] CA SB 54, Chaptered, Section 42042 Z(aa)(5) June 30, 2022. https://legiscan.com/CA/text/SB54/2021

All four new packaging EPR laws will incentivize increased use of post-consumer recycled (PCR) content in covered materials, which is likely to increase the drive, at least among some industry stakeholders, to achieve these targets through emerging chemical recycling technologies:

- Oregon's new law includes a requirement for producers to include consideration of PCR content use within the program's fee structure.
- Maine's requires the Department of Environmental Protection to specify program performance requirements through rulemaking that include increased use of PCR content.
- Colorado's law requires the PRO to set targets for PCR content for certain material types within its program plan that must increase over time, which the state will need to approve.
- California's law requires the PRO to describe in its program plan how PCR content will be incorporated into covered materials, and to include PCR content as a factor in the program's fee structure.

As demonstrated, the inclusion of plastics-to-plastics and plastics-to-fuel technologies in EPR systems is currently being addressed state-by-state. A more consistent evaluative approach should be developed, which could be applied not just to packaging but to all products containing plastics, including construction waste, electronic waste, textiles, and medical waste. Such an approach could be developed through a consensus-based process to harmonize criteria across states, or through the publication of a national standard. The draft criteria presented in this report are intended to support the development of a harmonized approach.

Chemical Recycling Technology Types

Technology Type #1: Purification

This technology uses solvents to dissolve plastics, removing additives, dyes, and other contaminants to obtain virgin-grade material. There is no change to the plastics at a molecular level. Purification includes processes such as dissolution and de-inking, which produce virgin-like resin pellets that can then be used to create new plastic items (see Fig. 2).[46] Because chemical solvents can reduce contamination (including resins that are not desired outputs), purification can accommodate slightly more contamination – including colorants, stabilizers, organic residues, and others – in post-consumer plastics than mechanical recycling.[47] However, purification technologies still require pre-processing as they are optimized for single-stream plastics and perform best when the inputs are clean.[48] Purification is the least energy-intensive of the three chemical recycling technology types and shows the highest plastic-to-plastic processing efficiency rate – i.e., the rate

[46] James Sherwood, "Closed Loop Recycling of Polymers Using Solvents" *Johnson Matthey* 2020. https://www.ingentaconnect.com/content/matthey/jmtr/2020/00000064/00000001/art00002;jsessionid=37mf8bcoou8jb.x-ic-live-03

[47] Eunomia, *Chemical Recycling: State of Play* December 8, 2020. https://www.eunomia.co.uk/reports-tools/final-report-chemical-recycling-state-of-play/

[48] Closed Loop Partners, *Transitioning to a Circular System for Plastics* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/AR-report-V23_final7.pdf

of plastics outputs vs. plastics inputs – 91% on average[49] - slightly higher than mechanical recycling (see Fig. 3 and Appendix A).

- **Inputs:** Purification is used for single-material plastics (also referred to as mono-material plastics), such as PE, PET, PS and PP. In theory, it could be used on any single resin type, provided a suitable solvent could be identified. But because purification relies on tailoring the specific solvent to the desired polymer, these processes perform best with source-separated, relatively clean inputs.[50]
- **Outputs:** The primary outputs of purification are virgin-like plastics of the same polymer type as the inputs. For example, when post-consumer PE is purified, virgin-like PE polymers are produced. Purification technologies are not always able to remove all contaminants from input materials, which means there can be residual toxics in the resulting resins.[51] Wastes from the process include spent solvents and other chemicals, which must be safely managed to avoid releasing environmental contaminants. **Level of commercialization**: Purification is a relatively new technology. Globally, there are approximately 11 pilot or early commercial-stage companies using purification – three with headquarters in the U.S. (one of which is a university conducting research).[52]

Plastic Polymers

This report refers to various plastic polymers as follows:

- PP = polypropylene
- PET = polyethylene terephthalate
- PE = polyethylene
- HDPE = high density polyethylene
- LDPE = low density polyethylene
- PS = polystyrene
- EPS = expanded polystyrene
- PLA = polylactic acid
- PVC = polyvinyl chloride
- PU = polyurethane

When preceded by "r," as in "rPP," the polymer are recycled (i.e., made from recycled resin).

EXAMPLE: PureCycle Tech, a U.S. company with headquarters in Orlando, Florida, uses a plastics-to-plastics purification technique patented by Procter & Gamble that separates color, odor, and other additives and contaminants from PP to "transform it into virgin-like resin." In 2019, PureCycle announced plans to open its first plant in Lawrence County, Ohio, in partnership with Milliken & Company and Nestlé[53] and the plant is expected to be completed by the end of 2022.[54] The company has since broken ground on another plant in Augusta,

[49] Ibid.

[50] Eunomia, *Chemical Recycling: State of Play* December 8, 2020. https://www.eunomia.co.uk/reports-tools/final-report-chemical-recycling-state-of-play/

[51] Ibid.

[52] Closed Loop Partners, *Global Directory of Molecular Recycling Technologies* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/CLP_Molecular-Recycling-Directory-2021.pdf

[53] "PureCycle Technologies partners with Milliken, Nestlé to accelerate revolutionary plastics recycling" March 13, 2019. https://purecycle.com/2019/03/purecycle-technologies-partners-with-milliken-nestle-to-accelerate-revolutionary-plastics-recycling

[54] "PureCycle Technologies Provides Second Quarter 2022 Update" August 12, 2022. https://purecycle.com/2022/08/purecycle-technologies-provides-second-quarter-2022-update/.

Georgia.[55] In November of 2021, PureCycle announced the first consumer product manufactured using its recycled PP: A personal-care product dispenser made with post-consumer PP collected at stadiums.[56] PureCycle's Ohio-based plant will focus primarily on five inputs of PP: plastic tubs and lids, metallized films, supersacks (bulk bags made of woven PP), and waste carpet.[57] For its Georgia plant, the company aims to source residuals from materials recovery facilities (MRFs) and other materials bound for landfill, such as plastic billboards, fishing nets, PET films, and medical waste.[58] PureCycle states that it has tested a wide array of post-consumer products, including diapers and e-cigarettes,[59] and that its recycled PP (rPP) can be "infinitely" recycled.[60]

Technology Type #2: Depolymerization

Depolymerization, also referred to as decomposition, involves breaking the molecular bonds of plastics to recover simple molecules (monomers or oligomers), which can then be reconstructed ("repolymerized") into plastics. The molecular bonds can be broken through biological, chemical, or thermal means, or a combination of these (see Fig. 2). Depolymerization is one of the most rapidly evolving of the three technology types; most processes use chemical depolymerization, though thermal and biological methods are emerging as well. In some instances, depolymerization is more energy intensive than purification, but less energy intensive than conversion (see Technology Type #3). On average, it has a lower plastic-to-plastic processing efficiency than purification or mechanical recycling (75% - see Fig. 3)[61] but can process a wider variety of materials, including those with higher levels of additives and contaminants, because it includes more capabilities for removing them. Like purification, depolymerization also requires a degree of pre-processing as most technologies are optimized for clean, mono-material inputs.[62]

Chemical depolymerization: Chemical depolymerization uses chemical reagents to break down plastics into their building blocks (monomers or oligomers). The names of various chemical depolymerization technologies are derived from the chemical solution in which the plastics are deconstructed— e.g., hydrolysis (depolymerizing plastics in a water-based solution), methanolysis (depolymerizing plastics in methanol), glycolysis (depolymerizing plastics in glycol), etc.[63]

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[55] "PureCycle Breaks Ground on New Recycling Facility in Augusta, Georgia" March 23, 2022. https://purecycle.com/2022/03/purecycle-breaks-ground-on-new-recycling-facility-in-augusta-georgia/.
[56] "The Sustainable Plastic Revolution is Here" November 5, 2021. https://purecycle.com/2021/11/the-sustainable-plastic-revolution-is-here.
[57] Tamsin Ettefagh, CSO and VP of Industry, PureCycle Technologies, video call with author, February 2021.
[58] Ibid.
[59] Ibid.
[60] "The Sustainable Plastic Revolution is Here" November 2021. https://purecycle.com/2021/11/the-sustainable-plastic-revolution-is-here
[61] Closed Loop Partners, *Transitioning to a Circular System for Plastics* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/AR-report-V23_final7.pdf
[62] Ibid.
[63] Closed Loop Partners, *Accelerating Circular Supply Chains for Plastics* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/01/CLP_Circular_Supply_Chains_for_Plastics_Updated.pdf

- **Inputs:** Chemical depolymerization is used for certain mono-material polymers – specifically, a subset of plastics known as *condensation polymers,* which describes the molecular process through which they are formed – including PET, PU, polycarbonate, PLA, and some types of nylon.[64] Although chemical depolymerization can accommodate some contamination (additives, pigments/colorants, non-target polymers, etc.), these technologies perform best when the inputs are from source-separated, homogenous waste streams, necessitating sorting and pre-treatment.[65]

Plastic Building Blocks

The basic building blocks of plastics referred to in this report are as follows:

- **Monomers**: Molecules that can be bonded with other molecules to form polymers.
- **Oligomers**: Simple units consisting of few repeating monomers bonded together.
- **Polymers**: Substances (resins and plastics) consisting of many bonded monomers or oligomers.

- **Outputs:** The outputs of chemical depolymerization are the monomers or oligomers of the inputs. For instance, if post-consumer polyester is depolymerized, the monomers or oligomers of polyester will be the outputs. Monomers and oligomers are used to produce polymers, which are manufactured into new plastic items. Waste from the process includes spent reagents and other chemicals, which must be safely managed to avoid releasing environmental contaminants.
- **Level of commercialization:** Chemical depolymerization is one of the most rapidly evolving technology types. Globally, approximately 19 companies use chemical depolymerization techniques, with most still in research or pilot stages. Six of these are headquartered in the U.S.[66]

EXAMPLE: Eastman, a U.S. company with headquarters in Kingsport, Tennessee, has developed polyester renewal technologies that use chemical depolymerization by glycolysis and methanolysis to produce monomers of polyester, with a primary focus on methanolysis.[67] The monomers from this process can be used to create co-polyesters, specialty plastics, and other chemicals with 30% to 100% recycled content[68] for commercial products that are already being sold.[69] According to available LCA summaries commissioned

Closed Loop Partners, *Transitioning to a Circular System for Plastics* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/AR-report-V23_final7.pdf

[64] Eunomia, *Chemical Recycling: State of Play* 2020. https://www.eunomia.co.uk/reports-tools/final-report-chemical-recycling-state-of-play/

[65] Ibid.

[66] Closed Loop Partners, *Global Directory of Molecular Recycling Technologies* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/CLP_Molecular-Recycling-Directory-2021.pdf

[67] Eastman, *Polyester Renewal Technology* accessed January 4, 2022. https://www.eastman.com/Company/Circular-Economy/Solutions/Pages/Polyester-Renewal.aspx

[68] Eastman, "Polyester Renewal: A Big Step Toward a Small Footprint" 2021. https://www.eastman.com/Company/Circular-Economy/Resources/Documents/Polyester-Renewal-LCA-Infographic.pdf

[69] Eastman, "Success stories" March 17, 2022. https://www.eastman.com/Company/Circular-Economy/Success-Stories/Pages/Success-Stories.aspx

by Eastman, the company's polyester renewal technology will reduce greenhouse gas (GHG) emissions by 20-30% as compared to fossil-fuel based production of the same monomers.[70] Eastman is building a 100,000 metric ton methanolysis facility in Kingsport, which will process a variety of difficult-to-recycle polyester wastes including polyester textiles, carpet fiber, and byproducts from mechanical recycling processes.[71]

Thermal depolymerization: This technique breaks down plastics into their monomers or oligomers by heating the plastics along with catalysts. Thermal depolymerization is frequently used in combination with chemical processes.

- **Inputs:** Thermal depolymerization is used for polymers such as PP, PS, and acrylics.
- **Outputs:** The outputs of thermal depolymerization are the monomers or oligomers of the inputs. For instance, if post-consumer PS is an input, then the monomers or oligomers of PS (e.g., styrene) will be the output. Monomers and oligomers are used to produce polymers, which are manufactured into new plastic items.
- **Level of commercialization:** Thermal depolymerization is less developed than chemical depolymerization. Just two companies (Agilyx and Aquafil) currently use thermal depolymerization; both are headquartered in the U.S.[72]

EXAMPLE: Agilyx, a U.S. company with headquarters in Tigard, Oregon, processes post-consumer and post-industrial mixed plastics using several technology types. While the majority of Agilyx's outputs thus far have been a synthetic crude oil, its "single polymer pathway" includes a patented Polystyrene-to-Styrene Monomer (PSM) System, which uses post-consumer and post-industrial PS to produce styrene oil. Agilyx has operated a pilot facility, Regenyx, at its headquarters in Tigard in partnership with AmSty to recycle polystyrene since 2018.[73]

Biological depolymerization: This technique uses enzymes instead of chemical solvents or heat to break down plastics into their monomers or oligomers.

- **Inputs:** There are very limited biological (enzymatic) depolymerization technologies available today and those that are being researched or piloted are primarily focused on processing PET, mostly from textiles and beverage bottles.
- **Outputs:** The outputs of biological depolymerization are the monomers or oligomers of the inputs. For instance, if post-consumer PET is an input, then the monomers or oligomers of PET, such as PTA (terephthalic acid), will be the outputs. Monomers are used to produce polymers, which are manufactured into new plastic items.

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[70] Eastman, "Building a better circle with less impact" March 2022. https://info.eastman.com/LCA

[71] Eastman, "Eastman and Governor Lee Announce World-Scale Plastic-to-Plastic Molecular Recycling Facility to be Built in Kingsport, Tenn." January 29, 2021. https://www.eastman.com/Company/News_Center/2021/Pages/Eastman-and-Governor-Lee-Announce-Plastic-to-Plastic-Recycling-Facility.aspx

[72] Closed Loop Partners, *Global Directory of Molecular Recycling Technologies* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/CLP_Molecular-Recycling-Directory-2021.pdf

[73] Tim Stedman, CEO, Agilyx, presentation at Paper and Plastics Recycling Conference, November 5, 2021.

- **Level of commercialization:** Like thermal depolymerization, biological depolymerization is not yet widely adopted. Globally, two entities (Carbios and the University of Portsmouth, UK, in partnership with the U.S. National Renewable Energy Laboratory, NREL) are currently exploring biological depolymerization.[74]

EXAMPLE: Carbios, a European company with headquarters in France, claims to have developed the world's first enzymatic recycling technology for PET. The process, currently in the pilot stage, uses enzymatic hydrolysis to break down PET from rigid plastics of any color, along with textiles, into the monomers PTA and EG (ethylene glycol).[75]

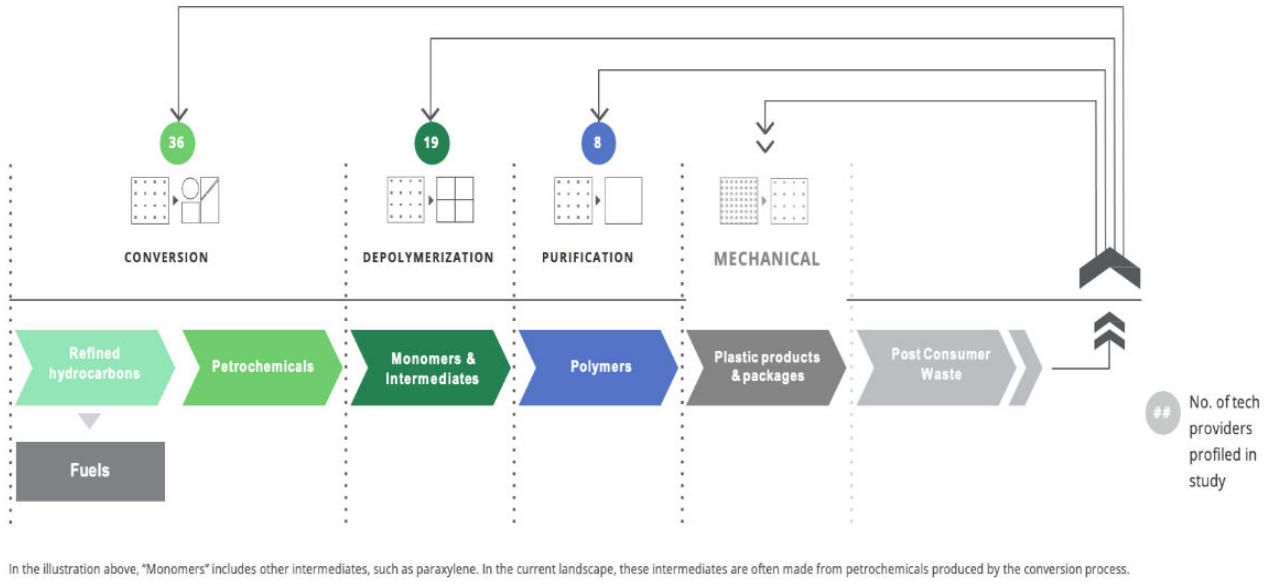

Figure 2: Schematic of Purification, Depolymerization and Conversion. Figure from Closed Loop Partners, Accelerating Circular Supply Chains for Plastics: A Landscape of Transformational Technologies That Stop Plastic Waste, Keep Materials in Play and Grow Markets (2019).

Technology Type #3: Conversion

The final technology type, conversion, includes — and is most widely known as — gasification and pyrolysis, which is sometimes classified as thermal depolymerization, rather than conversion. There are subtleties in the distinctions between different patented pyrolysis technologies and the distinct outputs from different companies' processes that lead to these different classifications, but pyrolysis is generally recognized by local and state government agencies as a form of conversion technology and has therefore been included in this section.

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[74] Closed Loop Partners, *Global Directory of Molecular Recycling Technologies* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/CLP_Molecular-Recycling-Directory-2021.pdf

[75] Carbios, "Enzymatic recycling: Removing the constraints of current processes" March 17, 2022. https://www.carbios.com/en/enzymatic-recycling

V. Tournier et al., "An engineered PET depolymerase to break down and recycle plastic bottles" *Nature No. 580* pages 216-219 April 2020. https://doi.org/10.1038/s41586-020-2149-4

Gasification and pyrolysis convert mixed and multilayer plastics into refined hydrocarbons and petrochemicals. The hydrocarbon outputs can either be used as fuels or reprocessed into feedstocks, from which monomers, then polymers, and, finally, plastic items can be produced (see Fig. 2). Like depolymerization technologies, conversion technologies break the molecular bonds of plastics — but the outputs distinguish conversion from depolymerization: Conversion produces liquid or gaseous hydrocarbons, whereas depolymerization produces plastic monomers. Today, conversion is the most widely adopted of the chemical recycling technologies, largely due to support and adoption by the petrochemicals sector. Conversion also requires less pre-processing than purification[76] Relative to the other technology types, conversion is the most energy intensive, and has the lowest average material processing efficiency (42% – see Fig. 3)[77]

- **Inputs:** Proponents of conversion technologies note that they accommodate the widest array of plastics, including highly contaminated mixed materials and durable, bulky plastics that would otherwise be landfilled. Some technologies specialize in processing items considered to be undesirable contaminants in other systems such as purification and depolymerization. While conversion technologies do perform best with heterogenous waste streams of simple polymers, they can accommodate more contamination than purification or depolymerization technologies.[78]
- **Outputs:** Conversion technologies are commonly criticized because they are often used to produce fuels (plastics-to-fuel) rather than recycled plastics (plastics-to-plastics). Outputs differ between pyrolysis and gasification technologies (see below). There is limited publicly available information documenting the percentage of outputs as fuels versus those used to produce recycled plastics. Because the end product depends on market demand, feedstock composition, local markets, and other factors, there is no guarantee that these technologies will produce only recycled plastics.
- **Level of commercialization:** Over 40 pilot or commercial-stage companies operating globally use conversion technologies that include pyrolysis and gasification; at least 25 are headquartered, operate, or have partnerships in the U.S.[79] Conversion facilities are the most developed of the three technology types.

Below is a brief comparison of pyrolysis and gasification, with emphasis on their distinct outputs.

[76] Closed Loop Partners, "Transitioning to a Circular System for Plastics" 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/AR-report-V23_final7.pdf.
[77] Ibid.
[78] Eunomia, *Chemical Recycling: State of Play* December 9, 2020. https://www.eunomia.co.uk/reports-tools/final-report-chemical-recycling-state-of-play/. Note that this report characterizes conversion technologies as thermal depolymerization.
[79] Closed Loop Partners, *Global Directory of Molecular Recycling Technologies* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/CLP_Molecular-Recycling-Directory-2021.pdf

Pyrolysis: Pyrolysis converts plastics into oils and waxes by heating them in an oxygen-free environment so that they do not burn.[80] Pyrolysis is a lower-temperature process than gasification (see below), which is why it primarily results in longer-chain hydrocarbons (oils).

- **Outputs:** The outputs of pyrolysis include oils and waxes, gases, and char (a waste product). The oils and waxes can either e burned (on-site or off-site) as fuels, or post-processed into plastic monomers through a separate process. Monomers can be repolymerized to produce polymers, which can be manufactured into new plastic items. The gases created through pyrolysis are often used to generate electricity, sometimes directly powering the pyrolysis facility as a replacement for other energy sources. Char is an ash-like waste product that is typically landfilled but can be burned to capture energy. It often contains the contaminants (additives, pigments, etc.) that were removed from the plastics during the pyrolysis process.

Incineration vs. Pyrolysis and Gasification
Heat-based conversion processes such as pyrolysis and gasification are sometimes equivocated with incineration. Technically, incineration is a distinct process that uses different temperature ranges than either pyrolysis or gasification to heat plastics and other waste materials in a high-oxygen environment so that they combust. Temperatures for incineration range from 590°C to 1200°C, whereas temperatures for pyrolysis and gasification range from approximately 500°C to 850°C.

The outputs of each process are also distinct: incineration produces waste gases and ash that cannot be converted back into plastics of any form and is disposed of in landfills.

EXAMPLE: Nexus Circular, a U.S. company with headquarters in Atlanta, Georgia, uses pyrolysis to process primarily post-industrial and post-commercial plastics, with an emphasis on plastic film.[81] Of the plastic inputs that Nexus processes, as much as 85% result in saleable oils and waxes. Nexus claims that 100% of these oils and waxes are used by its partners to produce like-new polyethylene resin with minimal post-processing, which can then be converted into new plastic items.[82] The pyrolysis process used by Nexus also produces char as a waste product, and non-condensable gas, which Nexus uses to power its plant.[83]

[80] Pooja Ghosh et al., "Life cycle assessment of waste-to-bioenergy processes: a review" pages 105-122 *Bioreactors* 2020.
Muhammad Saad Qureshi et al., "Pyrolysis of plastic waste: Opportunities and challenges" *Journal of Analytical and Applied Pyrolysis,* vol. 152 November 2020. https://doi.org/10.1016/j.jaap.2020.104804
Prabir Basu, "Pyrolysis" *Biomass Gasification, Pyrolysis and Torrefaction (Third Edition): Practical Design and Theory* 2018 pages 155-187. https://doi.org/10.1016/B978-0-12-812992-0.00005-4
[81] Jeffrey Gold, Founder & CEO, Nexus, presentation at Paper and Plastics Recycling Conference, November 5, 2021.
[82] Ibid.
[83] Ibid.

Technology Type	Average Processing Efficiency (Plastics to Plastics)	Average Non-Pellet Outputs
Purification	91%	N/A
Mechanical Recycling	83%	N/A
Depolymerization	75%	18%
Conversion	42%	17%

Figure 3: Average processing efficiency of each technology type, based on Closed Loop Partners independent research, using a small sample size for each technology: purification (2), depolymerization (4), conversion (3).[84]

Gasification: Gasification heats plastics in a low-oxygen environment to produce gaseous hydrocarbons, which can be separately processed into oils and waxes.[85] Gasification uses higher temperatures than pyrolysis, which results in shorter-chain hydrocarbons (primarily gases).

- **Outputs:** Gasification outputs include syngas (a gaseous mixture of carbon monoxide and hydrogen known as synthetic gas, or syngas), as well as char and slag by-products that become waste. The syngas can be used to produce methanol, which is a building block of plastics.

  EXAMPLE: Eastman has developed a "carbon renewal technology" that is capable of using most types of plastic waste as feedstock.[86] This technology produces syngas, which Eastman

[84] Closed Loop Partners, *Transitioning to a Circular System for Plastics*, 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/AR-report-V23_final7.pdf "We calculated how much plastic resin would be produced by each technology category if we were to put 1,000 kilograms of plastic feedstock into the technology reactor. Each technology category's feedstock corresponds to their specifications and is therefore different from one another" (p. 83). Calculations are from Figure 24 (p. 84). Processing efficiency is calculated by dividing pellet product outputs by material sorting & rejection inputs to account for the pre-processing stage of each technology type.

[85] Yaning Zhang et al., "Gasification Technologies and Their Energy Potentials" pages 193-206 *Sustainable Resource Recovery and Zero Waste Approaches* 2019. https://doi.org/10.1016/B978-0-444-64200-4.00014-1
Andrew N. Rollinson "Fire, explosion and chemical toxicity hazards of gasification energy from waste" pages 273-280 *Journal of Loss Prevention in the Process Industries*, vol. 54 July 2018. https://doi.org/10.1016/j.jlp.2018.04.010
Paola Lettieri and Sultan M. Al-Salem, "Thermochemical Treatment of Plastic Solid Waste" pages 233-242 *Waste: A Handbook for Management* 2011. https://doi.org/10.1016/B978-0-12-381475-3.10017-8

[86] Eastman, *Carbon Renewal Technology* accessed January 4, 2022. https://www.eastman.com/Company/Circular-Economy/Solutions/Pages/Carbon-Renewal.aspx

uses exclusively to replace coal-based syngas feedstocks for plastics, paint additives, and textile fibers.[87] According to available LCA summaries commissioned by the company, Eastman's carbon renewal technology reduces the GHG emissions for production of syngas by 20% to 50%, depending on the composition of the plastic waste feedstock.[88]

[87] Eastman, *Project Data on Eastman Chemical Company's Chemicals-from-Coal Complex in Kingsport, TN* March 2003. https://netl.doe.gov/sites/default/files/netl-file/Eastman-Chemicals-from-Coal-Complex_0.pdf

[88] Eastman, *LCA Carbon Footprint Summary Report for Eastman Carbon Renewal Technology* June 10, 2020. https://www.eastman.com/Company/Circular-Economy/Resources/Documents/CRT-Technical-LCA-report.pdf.

Next Steps

This report is the first step in a larger discussion. It is intended to clarify some of the basic facts and initial questions on purification, depolymerization, and conversion technologies. A shared understanding among stakeholders will be critical to inform future dialogue with those working across the plastics lifecycle on whether and how these technologies can be addressed through EPR and other legislation, regulations, and permitting procedures. Below is a brief outline of some topics that warrant further discussion. It is our hope to address these items through structured dialogue with key stakeholders including environmental organizations, consumer goods companies, and plastics reclaimers, and incorporate them into a complementary report.

Refinement of the proposed criteria:

- What is the threshold of "over-production" of unnecessary and problematic plastics?
- How should "unnecessary and problematic plastics" [89] be defined so as to assess whether a given technology type is perpetuating their production?
- What is a realistic timeframe for commercial viability of a given facility or company?
- What existing or new standards should be used to measure cumulative pollution impacts and responsible materials management?
- What is an effective model for "robust community engagement and transparency" during permitting and siting processes?
- What are potential economic impacts and benefits to state and local governments from new recycling technologies, including chemical recycling?

Application of the proposed criteria to emerging technologies:

- To what extent do specific emerging technologies meet the proposed criteria?
- Are there existing, credible, third-party certification or other independent verification processes to support claims regarding a technology's efficiency, outputs, environmental impacts, and other factors?
- Who should develop LCAs or other assessments to determine the climate impacts and fossil fuel usage for various technology types, and how can the assumptions and parameters be standardized across assessments?
- Should the characterization of plastics-to-plastics technologies be revised to capture plastics-to-*products* processes (for example, the use of post-consumer plastics as feedstock to create composite lumber)?

Further detail on EPR recommendations:

- What has each state proposed in EPR legislation for packaging and other plastics-containing products regarding plastics-to-plastics or plastics-to-fuel technologies? When should

[89] U.S. Plastics Pact, "Problematic and Unnecessary Materials List" January 25, 2022. https://usplasticspact.org/problematic-materials/. This list, which is exclusive to non-reusable plastics, includes cutlery, PFAS, non-detectable pigments such as carbon black, opaque or pigmented PET bottles, oxo-degradable additives, PETG in rigid packaging, problematic label constructions, PS, PVC, stirrers, and straws.

purification, depolymerization, or conversion technologies be considered across EPR systems for different types of consumer goods?
- How should EPR legislation and other policies address bio-based plastic, and how does this compare with recycled plastics when chemical recycling technologies are used?

The following technical details were beyond the scope of this initial report:

- Impacts of various technologies on plastics recycling rates, and percentages of plastics currently on the market that can be managed through mechanical recycling, purification, depolymerization, and conversion technologies.
- How mechanical recycling, purification, depolymerization, and conversion can contribute to emerging post-consumer recycled content requirements and mandates, and how post-consumer recycled content resulting from each technology type can be independently verified.
- An overview of *mass balance* – a set of techniques for assessing the quantity of inputs vs. outputs for a given process – and how mass balance might be used to verify the outputs of each technology type and further inform compliance with post-consumer recycled content mandates.
- Details on the pre-processing steps needed for post-consumer plastics by each technology type.
- Details on the post-processing steps needed for each technology type – especially depolymerization and conversion – to obtain plastics from the outputs.
- Specifics on the chemical solvents and reagents used for various technologies and their known or potential human and environmental health impacts.
- Environmental and human health impacts for each type of technology, including wastes produced, water usage, energy usage, toxic emissions, and other factors, and how these compare with existing mechanical recycling technologies and potential upgrades to mechanical recycling facilities.
- Cost considerations for each technology type.

Further details on enzymatic depolymerization and waste-to-energy technologies.

For more information on these and other technical topics, we encourage readers to review the many comprehensive technical resources referenced throughout this report.

Key Terms

- **Advanced Recycling:** This term is often used interchangeably with “chemical recycling.”
- **Chemical Recycling:** This term refers to a wide range of technologies including but not limited to pyrolysis, gasification, depolymerization, solvolysis, catalysis, reforming,

purification, hydrogenation, dissolution, and dehydrochlorination that convert waste plastic into various forms of feedstocks or intermediaries for plastics or fuels. These technologies fall into three major categories: purification, depolymerization, and conversion, each of which is defined herein.

- **Conversion:** Technologies (most commonly pyrolysis and gasification) that convert plastics into refined hydrocarbons and petrochemicals using heat and pressure, which can be used as fuel or reprocessed into plastics.
- **Depolymerization:** A technique that breaks the molecular bonds of plastics to recover building blocks (monomers or oligomers) that can be reconstructed into "like-new" resins. Also referred to as decomposition. The process is most commonly chemical but can be thermal or biological as well.
- **Energy Recovery**: According to the U.S. EPA, "Energy recovery from waste is the conversion of non-recyclable waste materials into useable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion, and landfill gas (LFG) recovery. This process is often called waste-to-energy (WTE)."[90]
- **Mechanical Recycling:** Traditional recycling, also known as mechanical recycling, involves sorting, crushing, washing, shredding, and pelletizing post-consumer or post-industrial plastics. This process does not change the polymer structure of the plastics. Some consider all mechanical recycling of plastics to be downcycling, because there is a loss of quality each time an item is recycled, which limits the overall number of times that plastics can be mechanically recycled before they degrade too far to be reused.
- **Molecular Recycling:** Another term used interchangeably with "advanced" and sometimes "chemical" recycling. Some who use this term indicate that it refers to a wider array of technologies than chemical recycling because it includes nonchemical means of transforming plastic waste at the molecular level (e.g., technologies that use enzymes to break down polymers into monomers). In that case, chemical recycling could be considered a subset of molecular recycling. However, most continue to use these terms interchangeably as there are no universally accepted definitions of these technologies. This report uses "chemical recycling" for simplicity — see definition above.
- **Plastics-to-Fuel:** Technologies that convert waste plastics to fuels (rather than plastic feedstocks). This includes any processes that create poor-quality or contaminated feedstocks, which are ultimately incinerated. This is technically distinct from "waste-to-energy" (see below) because it does not directly produce energy but merely the fuel with which energy is then generated through combustion. However, both waste-to-energy and plastics-to-fuel technologies involve the destruction of plastics. Plastics-to-fuel technologies are considered energy recovery and not recycling by PSI and our state and local government Members.
- **Plastics-to-Plastics (or Material-to-Material):** Technologies that convert waste plastics into plastic pellets or new plastic items. These technologies may still have some residual (waste) outputs. Mechanical recycling is one form of plastics-to-plastics recycling.

[90] U.S. *EPA Sustainable Materials Management: Non-Hazardous Materials and Waste Management Hierarchy* July 5, 2022. https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy

- **Processing Efficiency:** As used in this report, the "processing efficiency" of a certain technology refers to the proportion of plastic inputs that are successfully converted into plastic resin pellets. An analogy to mechanical recycling would be the proportion of municipal solid waste (MSW) successfully sorted, cleaned, and baled for resale at a Materials Recovery Facility (MRF).[91] Another way to think about processing efficiency is that it reflects the inverse of yield loss (i.e., processing efficiency = 1 – yield loss).
- **Purification:** A technique that uses chemical solvents to dissolve plastics in a pressurized environment, separating and removing additives, dyes, and contaminants to produce "pure" resins. There is no change to the plastics at a molecular level.
- **Recycling:** The U.S. EPA defines "recycling" as "collecting and reprocessing a resource so it can be used again." An example is collecting aluminum cans, melting them down, and using the aluminum to make new cans or other aluminum products."[92] Many U.S. states have introduced their own definitions of recycling, which can address considerations such as whether waste-to-fuel technologies are considered recycling, and where recycling fits within the state's waste management hierarchy and priorities. It is generally (though not always) agreed that recycling does *not* include conversion of waste plastics into fuels (plastics-to-fuel technologies) or waste-to-energy processes.
- **Waste-to-Energy:** The process of burning municipal solid waste (MSW) to produce steam that generates electricity or heat. Some landfills also generate electricity by capturing methane gas from decomposing biomass.[93] Waste-to-energy technologies are considered energy recovery and not recycling by PSI and our state and local government Members.

Plastics-to-fuel technologies are considered energy recovery and not recycling by PSI and our state and local government Members; similarly, waste-to-energy technologies are considered energy recovery and not recycling.

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[91] Closed Loop Partners, *Transitioning to a Circular System for Plastics* 2021. https://www.closedlooppartners.com/wp-content/uploads/2021/11/AR-report-V23_final7.pdf.
[92] U.S. EPA *Glossary of Climate Change Terms* 2017. https://19january2017snapshot.epa.gov/climatechange/glossary-climate-change-terms_.html
[93] U.S. Energy Information Administration *Biomass explained: Waste-to-energy (Municipal Solid Waste)* November 26, 2021. https://www.eia.gov/energyexplained/biomass/waste-to-energy.php

LEGISLATION & REGULATIONS | ADVANCED RECYCLING | NEWS

Trump's DOE Nixes $375M Eastman Grant

The grant would have helped to fund construction of an advanced recycling facility in Longview, TX.

Norbert Sparrow
June 2, 2025

2 Min Read

US Secretary of Energy Chris Wright announced a $3 billion cutback on previously approved federal funding of projects that the Trump administration considers "green" initiatives. ALEX WONG/GETTY IMAGES NEWS

Local media outlets are reporting that the US Department of Energy (DOE) has canceled a $375 million grant to Eastman for its chemical recycling facility in Longview, TX. The move is part of a $3 billion cutback on previously approved federal funding of projects that the Trump administration considers "green" initiatives.

24 grants terminated

The cutback in funding for Eastman is part of a larger "termination of 24 awards issued by the Office of Clean Energy Demonstrations (OCED)" under the Biden administration, US Secretary of Energy Chris Wright announced on May 30. The statement on the energy.gov website said that "that these projects failed to advance the energy needs of the American people, were not economically viable, and would not generate a positive return on investment of taxpayer dollars." The DOE estimates that rescinding funding for these projects will generate "$3.6 billion in savings for the American people."

The press release did not name Eastman as being affected by the cutback but reporting from media outlets confirmed that the Tennessee-based company is included.

Total cost estimated at $1.2 billion

The total cost of the Longview project is estimated to be $1.2 billion and the grant would have accounted for about one-third of the required funding, according to media reports. At the time of writing, Eastman has not issued a response to the government's action.

Related: Shell Walks Back Chemical Recycling Project

As reported in *PlasticsToday* last year, Eastman said the Texas facility will have the capacity to recycle approximately 110,000 metric tonnes of hard-to-recycle plastic waste, and is expected to generate more than 200 full-time jobs in addition to approximately 1,000 temporary construction jobs. Eastman said it has operated in the Longview community for more than 70 years and currently has over 1,500 employees at the location.

World's largest advanced recycling plant planned for France

Eastman's first molecular recycling facility was recently completed at its Kingsport, TN, headquarters. It is also in the process of building a facility in France, first announced by Eastman CEO Mark Costa and French President Emmanuel Macron in January 2022. Once completed, Eastman claims it will be the largest advanced recycling facility in the world,

Eastman's molecular recycling technology breaks down hard-to-recycle plastic waste into its molecular building blocks, which are reassembled into virgin-quality material without compromising performance. The technique has the potential to enable infinite reuse by keeping these molecules in production in a material-to-material high-yield loop, according to Eastman.

Related: Chemical Recycling Just Isn't Feasible

About the Author

Norbert Sparrow

Editor-in-chief of *PlasticsToday* since 2015, Norbert Sparrow has been an editor working within business-to-business media since 1996. Prior to taking the helm of *PlasticsToday*, Sparrow oversaw the editorial content of several media outlets devoted to the medical device manufacturing sector, including *European Medical*...

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