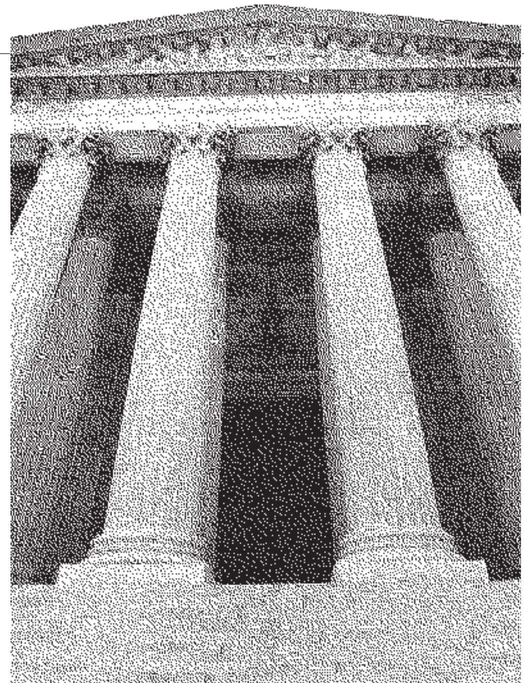

THE DEBATE

Chemical Recycling: More Pollution? Or a Sustainability Solution for Plastic?

A global crisis of plastic waste is well understood to be threatening ecosystems around the world, with roughly 400 million metric tons generated annually, much of which ends up in the biosphere. But far less understood are a suite of technologies and processes called "chemical recycling" or "advanced recycling" that break down plastics into molecules that can be remade into new plastics or other products.

Proponents tout these techniques as a sustainable solution for managing hard-to-recycle plastic wastes. Critics, however, argue that facilities engaging in chemical recycling are not in fact recycling—and through their processes are generating hazardous waste and air pollution.

Twenty-five states have adopted laws to promote chemical recycling, with both Republican and Democratic support. But controversy has accompanied the promotion of facilities—with public protests, for example, shutting down a proposed recycling plant in Georgia in 2022.

While plastic waste must be better managed, what if any should be the role for these various chemical recycling and reuse technologies? What are the arguments for and against this kind of management as the waste crisis continues here and abroad? How much good or harm can these technologies do? Can chemical recycling finally make plastic a true part of the circular economy?

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Recycling Facade Cracks Upon Closer Inspection

By Davis Allen

It's little wonder that there is so much confusion about chemical, or "advanced," recycling—most of the available information about the technologies is created by parties with an economic incentive to make them seem viable. Whether coming from plastic-producing petrochemical companies, their trade organizations, or researchers funded by the industry, most public messaging emphasizes every imagined benefit of chemical recycling while shifting attention away from its many downsides. It is sold as a technological solution that demands no changes in the way we use plastics, and indeed justifies ever-increasing production of new plastics on the grounds that waste produced today will simply be fed back into a "circular" system.

This facade cracks upon closer examination of the significant disparities between how the plastics industry publicly markets chemical recycling and how industry insiders internally acknowledge its shortfalls.

The industry has repeatedly claimed that chemical recycling is a solution for plastic waste going back to the 1970s, but has yet to overcome key technical and economic constraints that have prevented it from operating at scale. Today, plastics producers tout their investments in chemical recycling—and claim that it will soon be ready to address the plastic waste crisis—even though industry-wide spending on chemical recycling since 2017, as advertised by the American Chemistry Council, is less than the amount ExxonMobil is preparing to spend on a single new plastic production facility.

The obstacles that industry consultants and trade groups have been identifying for years have not been resolved, and Shell has already backed away from its previously stated chemical recycling goal. As the Association of Plastic Recyclers explained last year, "To date, much of the information promoting chemical recycling technologies overlooks the necessary design, collection, sortation, and end markets that need to be in place for any type of recycling to scale." Repeated failures have left the industry with an "urgent need for success stories," as one consultant put it at a 2024 chemical recycling conference.

The plastics industry claims chemical recycling can address hard-to-recycle mixed plastic waste, including the more than 90 percent of that isn't recycled today. But no single chemical recycling process can handle all plastics. That means that post-consumer waste streams pose many of the same challenges for chemical recycling that they do for existing plastic recycling operations. As a report conducted on behalf of the Alliance to End Plastic Waste —an organization created by the American Chemistry Council—explained in 2022, "pyrolysis operators require well-sorted, clean, and largely homogenous feedstock . . . and suffer from contamination similarly to mechanical recyclers."

Chemical recycling is also frequently portrayed as environmentally friendly by the plastics industry, even though these processes produce significant localized pollution and are extremely energy-intensive in practice. Plastics producers rely upon misleading evaluations, like comparing the impact of chemical recycling to incineration rather than to the production of new plastics or other end-of-life outcomes for plastic waste, while ignoring the concerns of experts and impacted members of frontline communities.

The Plastic Pollution Working Group at Duke University warned in 2023 that chemical recycling "poses significant threats of harm to already overburdened communities" and called for "caution in evaluating the industry's claims." But, as a consultant explained at a conference the same year, "concerns about potential externalities remain largely unaddressed" by the industry.

Perhaps most misleading of all, plastics producers have tried to co-opt the language of circularity while promoting a technological solution and a business model that are inherently at odds with a circular economy. Chemical recycling does not keep plastic in the production cycle—the processes available today produce fuels at a much higher rate than feedstocks for new plastics. As a 2022 report from consulting firm Roland Berger explained, "advanced recycling output is also frequently used in fuel applications, instead of in the reproduction of plastics," which, the report concluded, "does not help close the plastics loop."

"Advanced recycling" is a marketing ploy. There is no technology capable of doing what the plastics industry promises, and there is nothing to be gained by pretending one exists—unless, that is, you're an industry trying to produce and sell more plastic. When the state of California filed suit against ExxonMobil for deceiving the public about the recyclability of plastics, it revealed the firm's logic for promoting chemical recycling, according to internal documents: "the public perception benefits received will be invaluable . . . even if it proves to not be financially sustainable."

As was the case when the plastics industry for decades deceptively promoted mechanical recycling as a solution to the plastic waste crisis, plastic producers don't need chemical recycling to work. Rather, they need it to seem like a plausible solution for long enough to escape accountability for the staggering amounts of plastic waste they create.

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A Sustainable Solution We Certainly Need

By Sandeep Bangaru

It's no secret that plastic waste is an issue. Each year, 920 billion pounds of plastics are produced globally. Yet, only 15 percent of that is collected for recycling. Even less is actually recycled.

This has led some to question plastic's use altogether, but the available alternative materials offer mostly impractical solutions. Glass bottles require four times as much energy to produce as plastic, and aluminum cans require twice as much energy. Paper cartons often must be combined with other materials to be usable as food containers, making them hard to recycle.

If we care about the impact of climate change and ensuring continued access to important products such as food, cars, and medicines, we must acknowledge that plastics will play an important role—whether it be for packaging material, durable plastic applications, or reusable items that provide better performance when made from plastic.

Plastic keeps our food fresher, helps our infrastructure be more efficient, and makes our lives safer. However, we must curb single-use virgin plastic production, by reducing when possible, reusing what's practical, and driving recycling innovation to get more into the circular economy.

Traditional mechanical recycling works well for clear, single-use plastic such as water and soda bottles, which are typically made from a polyester-based plastic called PET. But clear bottles make up only a tiny fraction of our waste. PET and polyester constitute 30 percent of all plastic packaging and textiles, with demand quickly outpacing other materials. Still, almost no polyester textiles can be recycled, and only 23 percent of PET is recycled by traditional methods, making it impossible for mechanical recycling alone to solve the plastic waste crisis.

Innovation is needed. While this problem is generally thought of as an overreliance on single-use plastic, the crisis is much broader. One-fifth of all electronic waste is comprised of plastic, and new cars today are made of about 50 percent plastic by volume. When it comes to textiles, 60 percent of material made into clothing worldwide is plastic. All of this makes scaling new, innovative recycling technologies that can process these products an absolute imperative.

More voices rightly demand a new approach to processing plastic waste, with many questioning the potential impacts of new recycling innovations. At Eastman, we believe that to effectively address the waste problem, any new recycling technology must follow a set of principles: it must turn waste plastic into new plastic products to help reduce the production of virgin plastics; it must complement mechanical recycling to expand what gets recycled today; it must be better for the environment than producing new plastic from fossil fuels; and it must be transparent and open to scrutiny by independent auditors.

Eastman's molecular recycling technology is one such example of a technology that embodies these principles. It safely and efficiently processes hard-to-recycle PET, including colored bottles and polyester textiles.

This innovative technology helps enable the development of a closed-loop PET economy by making common plastics endlessly recyclable and reducing the need for new plastic production. Roughly 90 percent of the plastic waste entering our system is turned into high-quality recycled plastic materials that are safe for food packaging, better for consumers, and cleaner for the environment.

This process is already making a meaningful impact. Eastman's facility in Kingsport, Tennessee, is the largest of its kind in the world. It can process 250 million pounds of plastic waste per year—equivalent to 11 billion plastic bottles—while cutting greenhouse gas emissions by up to 30 percent. A second facility planned in Longview, Texas, will more than double Eastman's recycling capacity while cutting emissions by 70 percent compared to virgin PET production.

To scale this technology, Eastman is joining forces with recyclers nationwide, accepting plastic waste that would otherwise be destined for incinerators or landfills. In Ohio, for example, a major partnership with Rumpke Waste & Recycling paved the way for a new material recovery facility that can handle up to half a billion pounds of recycling materials annually from more than 50 counties across the state. Technology innovation in recycling has allowed this facility to expand curbside collection to include trays and colored/opaque polyester as examples.

A wave of innovation in recycling is essential for ushering in a new era of circularity—moving beyond recycling what's easy and beginning to tackle what isn't. Innovative recycling technologies like Eastman's play a crucial role in rethinking our relationship with this useful material, realizing a future where plastic is safer for our communities, better for the environment, and beneficial for the circular economy.

Sandeep Bangaru is vice president of circular economy platforms at Eastman.

Chemical Recycling Is a Deception

By Lee Bell

In a debate, it's important for readers to know the biases of the participants. IPEN aims to eliminate hazardous chemicals that pollute our air and water, that threaten the healthy environments we need to survive. These chemicals are linked to serious health concerns like cancer, infertility, heart disease, and many others. Our bias is that public health—your health—is more important than chemical industry profits.

The chemical industry's bias appears to be the opposite—to them, making money is more important than their consequences to people and our planet. When asbestos was linked to cancer, the industry spent millions in lobbying to maintain their sales (with ongoing lobbying to this day). When DDT was shown to be a hazardous pesticide that was poisoning the food chain, industry responded by attacking Rachel Carson, the scientist who identified the problem, and by manipulating science and using tobacco industry tactics to fend off regulations.

More recently, a peer-reviewed publication noted that the industry knew of the health and environmental threats from PFAS "forever chemicals" for decades but covered them up, using "strategies that have been shown common to tobacco, pharmaceutical. and other industries to influence science and regulation—most notably, suppressing unfavorable research and distorting public discourse."

These are just a few of dozens of examples of industry's use of disinformation, greenwashing, and other deceptive tactics to maintain sales of dangerous products. Their current promotion of chemical recycling as a way to resolve the plastics crisis is equally disingenuous. As a recent report noted, chemical recycling at best generates plastic with 10 percent recycled content—and typically as low as 2-5 percent. Most of the rest of the waste plastic going into the process remains waste, or is converted to emissions and even more hazardous waste that needs to be landfilled or burned, with just a small amount of dirty fuel produced as the desired end product. Most chemical recycling is energy intensive and generates a high carbon footprint to produce a small amount of contaminated output. The report investigated several industry projects that claimed chemical recycling was already creating useful recycled plastic products and found none of them stood up to scrutiny.

As the recent report on chemical recycling by IPEN and Beyond Plastics noted, wide adoption of chemical recycling would do nothing to resolve the plastics crisis. Indeed, it would actually support expansion of plastic production, while causing unacceptable levels of environmental and social harm, as well as impacts on human health, through emissions, waste generation, energy consumption, and contaminated outputs.

Chemical recycling is neither a new nor advanced technology. It is based primarily on old processes that have struggled for decades technically and commercially to manage plastic waste. The majority of the output is not new "circular" or "green" plastic but dirty petrochemical fuels that will be burned, creating toxic emissions and emitting greenhouse gases. Every step of these technologies is expensive, polluting, and energy-intensive. In fact, an independent study found that the economic and environmental impacts of common chemical recycling technologies were up to 100 times higher than for virgin plastic production.

Chemical recycling facilities emit cancer-causing chemicals and substances that have been banned globally because they are among the most toxic chemicals known. Yet in the United States, many states eliminate or relax environmental and health rules to incentivize new plants, and the industry often evades federal clean air rules and pollution controls. Environmental justice communities who already experience unequal health risks from toxic pollution will face the highest health risks from the expansion of chemical recycling. Especially as chemical recyclers seek to co-locate with petrochemical refineries that are already impacting communities.

Even if these were not inherent problems with chemical recycling, the technology is simply not efficient enough to make a dent in the plastic pollution problem. In the United States, our report found that as of September 2023, 11 chemical recycling facilities were operating in the United States. Several of these facilities have since closed and most were not working at anywhere close to full capacity, but even if they were, these facilities would process less than 1.3 percent of the 35.7 million tons of discarded plastic generated in the country each year. Similarly, an independent researcher told ProPublica that the world could, at best, replace 0.2 percent of new plastic with recycled plastic from chemical recycling.

In short, the only benefit from chemical recycling is to chemical and plastic industry profits. Instead of promoting and subsidizing the industry's dirty and dangerous technology, we should demand governments address the plastics crisis by limiting plastic production, restricting the use of toxic chemicals, and pursuing innovative, safer materials made without climate-destroying fossil fuels or harmful chemicals.

Lee Bell is a technical and policy advisor for the International Pollutants Elimination Network.

Let's Get the Most Out of Plastic Waste

By Marco J. Castaldi

Since the advent of large-scale, plastic production, there have been numerous advances enabled by novel products. These benefits span categories, from energy efficiency to medical technology to lower spoilage of meats and produce. Plastics also often deliver many positive attributes when compared with alternative materials for the same products or packaging. Plastics are an enabling material that has demonstrated advantages when substituted for other substances, such as metal, glass, and paper.

The plastic waste that results is primarily due to consumer behavior. That behavior ranges from frugal purchasing habits to post-use product disposal. Yet, the attention that has been given to the waste issue is sometimes misguided. The plastic producers are making products that are in demand by consumers; packagers are using plastics to satisfy performance requirements that reflect consumer preferences; and waste management entities work to safely handle the material that the consumer discards.

It appears that consumers will not compromise or relax their demands regarding the properties and performance they want in the products they purchase. Therefore, efforts to ban plastics (or possible technologies) are often counterproductive to reducing environmental impacts.

Furthermore, consumer behavior, at least in the United States, has not evolved sufficiently to separate the appropriate resins post-use. Evaluation of recycling growth options is an important part of a comprehensive approach to keeping post-use plastics in the economy. Yet, mechanical recycling rates for plastics in the United States have plateaued and many non-bottle plastics go unrecycled. This is not due to lack of source separation or collection efforts. For example, a recent analysis our research team completed showed that in New York City only 49 percent of the plastics that go into the recycle bin actually get recycled. Consequently, the actual recycling rate is due to several factors ranging from economic to final product performance requirements.

To align with the sustainable waste management hierarchy supported by the the United States and several other developed nations, all possible solutions must be deployed. Those solutions include reducing consumption to improvements in extraction of energy and materials. The overarching goal is to avoid plastics from going to landfills.

Specific to recycling, EPA defines it "as the recovery of useful materials, such as paper, glass, plastic, and metals, from the [municipal solid waste] stream, along with the transformation of the materials, to make new products to reduce the amount of virgin raw materials needed to meet consumer demands." Fortunately, plastics can be a feedstock for chemical synthesis—a process that can be achieved without combustion by several existing "advanced recycling" technologies, which are being developed and commercialized as a complement to mechanical recycling by a number of companies. Advanced recycling processes break down the plastic polymers to their chemical constituents to enable downstream processes to remanufacture new plastic products or plastic-derived chemicals.

Two examples are pyrolysis (heating without oxygen) that yields an oil, and gasification (heating with air but not enough to completely burn) that produces a gas that is further processed into chemicals. In studies we have done with established commercial-scale processes it has been demonstrated that plastic molecules cannot be 100 percent directed to only one final product using advanced thermal (not combustion) techniques. This is also true for mechanical, conventional, plastic recycling.

In the purest of waste plastic streams, the maximum that will actually be recycled is up to 80 percent. However, in real life impurities will reduce that closer to 50 percent. We have shown that by using advanced thermal fluid catalytic cracking processes, 50 percent of plastics can be recycled back into starting chemicals for plastics. The rest is made into lubricating oils or fuel. That remainder is a direct offset of virgin raw material that would normally be extracted for oils and fuels.

It must be recognized that all processes related to waste plastic management, except for consumer waste reduction efforts, produce emissions. Even reuse of plastic products requires cleaning and the use of water that gets discharged into the environment. The emissions that would be generated from advanced recycling come from performance additives and contamination from the waste stream. The typical operating temperature of pyrolysis destroys many problematic chemicals, including BPA and PDBEs nearly completely and PFAS to a lesser extent. Gasification temperatures almost entirely destroy those problematic chemicals. Although protocols exist to have those materials separately collected, there is inevitable contamination that exists in a real-world mixed plastic waste stream. The important aspect is that the emissions are properly treated or managed consistent with best practices and regulations.

Not using all solutions available to manage the plastic waste that you and I generate will only result in more going into landfills. After the products have outlived their intended use it would be better to extract some value.

Marco J. Castaldi is chair of the Chemical Engineering Department at City College of New York.

A Step Toward a Circular Economy

By Ross Eisenberg

The U.S. recycling system was built in the 1970s to handle a limited set of materials—primarily bottles, cans, and newspapers. But as consumer products and packaging have evolved, so too must our recycling infrastructure. A refresh is underway, integrating new technologies like AI, robotics, and chemical recycling to modernize the system and process a wider variety of plastic materials.

Chemical recycling refers to a suite of technologies that break down used plastic into molecular building blocks, allowing it to be remanufactured into new plastic and other products. This process expands the types of plastics that can be recycled, strengthens domestic supply chains, and supports sustainability goals. Chemical recycling enables the remanufacturing of high-quality, food- and medical-grade plastic from used plastic, giving these materials new life in a wide range of applications.

Some critics mistakenly conflate chemical recycling technologies with incineration or waste-to-energy processes, but the differences are significant. Incineration involves burning waste materials in the presence of oxygen, producing energy but destroying the material in the process.

In contrast, chemical recycling technologies such as pyrolysis and gasification use thermal energy in the absence of oxygen, meaning there is no combustion. Instead of being burned, plastics are broken down into their building blocks, which can then be used to produce new plastic, chemicals, waxes, and other valuable products. This distinction is critical: combustion oxidizes organic molecules, leaving no viable product, whereas chemical recycling preserves these molecules for reuse.

EPA determined in 1997 that it would not be appropriate to regulate the use of pyrolysis on medical waste or hospital waste as incineration because it recognized pyrolysis is different. The goal is to recover and repurpose plastic material, not destroy it. This reduces the need for fossil resources in making new plastics. Research shows these technologies can cut fossil energy use by 97 percent compared to landfilling.

While these technologies can be used to convert plastics into fuel, the primary focus today is on remanufacturing used plastic to create new materials, supporting a circular economy. When the outputs are used to produce new plastic and other materials, it is recycling. Converting plastics into fuel is not considered recycling, ensuring the technologies align with long-term sustainability goals.

Traditional mechanical recycling is effective but limited. Many plastics, particularly multi-layered and contaminated materials, cannot be mechanically recycled and instead end up in landfills. Chemical recycling addresses this gap by being able to process a broader range of plastic materials, converting them into feedstocks for new plastic production. This reduces reliance on virgin resources and enhances sustainability efforts.

Chemical recycling can help divert millions of tons of plastic from landfills each year by converting used materials into high-quality raw feedstock suitable for use in new plastic products, including food packaging and medical supplies. This is a crucial step toward achieving a circular economy, where plastic materials are continuously repurposed rather than discarded.

Environmental professionals rightly scrutinize any new technology for its ecological footprint. While chemical recycling does require energy inputs, its overall environmental impact can be significantly lower than conventional plastic production. By using used plastic as a feedstock, chemical recycling reduces demand for virgin plastic, mitigating the extraction and processing of fossil resources. Additionally, chemical recycling facilities are increasingly integrating renewable energy sources and process efficiencies to further minimize their environmental footprint.

These facilities are strictly regulated at federal, state, and local levels, and subject to the Clean Air Act, Clean Water Act, and state permitting requirements. Their emissions are comparable to other businesses in the community, like hospitals and universities.

From an economic standpoint, chemical recycling fosters domestic supply chain resilience. The United States has already seen billions of dollars invested in chemical recycling infrastructure, generating high-quality manufacturing jobs and positioning the country as a global leader in sustainable materials management. Major brands and manufacturers are increasingly turning to chemical recycling to meet their sustainability commitments, underscoring its role in future-proofing the industry.

Just as smartphones, solar panels, and electric vehicles continue to evolve, these recycling technologies are scaling up, becoming more efficient, and making an impact. Today, more than a dozen commercial facilities in the United States have a combined capacity to process nearly a billion pounds of plastic each year.

No single solution will modernize recycling in the U.S., but dismissing chemical recycling ignores a vital opportunity to make the system more efficient and effective. By leveraging these new technologies, we can transform used plastic into valuable resources—strengthening our circular economy and fostering economic growth.

For environmental professionals dedicated to pragmatic, science-based solutions, the path forward is clear: chemical recycling must be part of our sustainable future.

Ross Eisenberg is president of America's Plastic Makers.

Recycling Can Mean a Future for All Plastics

By Rachel Meidl

Plastics play a critical role in shaping the future of energy, healthcare, aerospace, construction, electronics, transportation, agriculture, telecommunications, advanced manufacturing, and the digital economy. Plastics enable high performance, efficiency, and durability across nearly every product sector, driving economic growth and technological progress. Plastics enhance competitiveness, supply chain resilience, and sustainability.

Most multi-material and complex plastics, including many types of packaging, cannot be recycled in current systems. Traditional mechanical recycling, designed primarily for simple packaging like PET bottles, has inherent limitations in processing the diversity of plastics used across modern industries. As a result, even if collected, many are ultimately destined for landfills or incinerators, resulting in lost economic and material value.

Even with maximum reuse, repurposing, and reduction, substantial volumes of complex and difficult-to-recycle plastics will inevitably require disposal. Thus, resource recovery solutions will remain necessary, making chemical recycling a complementary pathway to a circular economy for otherwise non-recyclable plastics.

Chemical recycling describes dozens of technologies that break down plastic waste into its building blocks for reuse in new chemicals, virgin-grade plastics, and other products. Each chemical recycling technology exhibits distinct environmental, social, and economic performance characteristics, as well as an ability to process specific plastic types. Unlike mechanical recycling, chemical recycling minimizes polymer degradation, allowing plastics to be converted into high-value feedstocks.

Within a circular framework, products and materials are maintained at their highest economic value through strategies such as reuse, repurposing, and recycling. Chemical recycling advances this objective by redirecting plastic waste streams from landfills or incinerators, instead converting them into virgin-quality plastics and other materials that can be continuously recirculated.

Given the substantial energy and resource inputs required for plastic production, disposal represents a significant loss of embodied energy. Chemical recycling mitigates these losses by breaking down plastics into their constituent molecular components, enabling reintegration into manufacturing and reducing reliance on fossil resources for new plastic production. This process preserves both material and economic value, extends the useful life of plastics, and lessens dependence on fossil-based resources.

From a lifecycle sustainability perspective, chemical recycling can demonstrate avoided impacts across environmental, economic, and social dimensions—such as reducing plastic leakage, avoided emissions, creating new markets for recycled plastics, and driving regional economic development. The objective is to balance benefits and risks for long-term viability, not to eliminate impacts or prematurely exclude technologies that could expand and redefine plastic lifecycle solutions.

While chemical recycling offers potential benefits, many techniques are in various stages of development and require careful evaluation of key challenges, including energy and resource demands, material recovery efficiency, emissions, cost-effectiveness, product quality and safety, affordability, and community impacts. Circularity does not necessarily equate to sustainability. Due diligence is essential to ensure that high-performing, and safe technologies and materials are scaled—and that circular activities do not offset sustainability gains. Addressing data gaps—particularly regarding environmental and public health impacts—is essential for building transparency, fostering public trust, and advancing responsible innovation in chemical recycling.

As do all technologies aimed at transforming material flows, innovations follow a trajectory of development, refinement, and optimization. They evolve through continuous research, real-world deployment, and iterative improvements, requiring time and investment to address operational efficiencies, system-wide impacts, and health considerations. These obstacles should not be viewed as failures but as integral steps in the innovation process—critical to ensuring that new technologies are safe, efficient, and effective. Rather than rejecting these innovations out-right, a measured approach is needed—one that supports investment, research, and responsible deployment to close knowledge gaps.

Plastic management strategies should promote a holistic systems framework that drives innovation and continuous improvement throughout the lifecycle. Rather than limiting efforts to easily recyclable plastics, solutions must account for the full range of materials reaching end-of-life—now and in the future. Achieving this requires a long-term, science-driven strategy that balances technological advancement with safety, performance, and market viability. This means encouraging innovative technologies, such as chemical recycling, while ensuring rigorous oversight of the potential environmental and safety impacts.

Real progress in a circular economy requires a comprehensive approach that supports consumer education, supply chain coordination, improved collection and sorting infrastructure, robust secondary markets for recycled plastics, and product design that reduces material complexity to enhance recyclability—all supported by practical, lifecycle-based policies that drive long-term sustainability.

Rachel Meidl is a fellow of energy & sustainability at Rice University's Baker Institute for Public Policy.

A Classic Case of Industry Greenwashing

By Renée Sharp

For decades, the plastic industry has promised that recycling would solve the problem of its waste, yet the crisis continues to grow. The dismal U.S. plastic recycling rate continues to hover around just 5 percent. Globally, plastic use is projected to almost triple by 2060, relative to a 2019 baseline.

Now the industry is doubling down on its deceptive recycling claims—promoting incineration and other toxic methods for end-of-life plastic management under the misleading term "chemical recycling"—also greenwashed as "advanced recycling" and "molecular recycling."

The truth is: these approaches largely fail to recycle plastic. Their expanded use will only lead to more toxic pollution of our air and water and more waste in landfills and incinerators. Meanwhile, the industry hopes that production of new plastic will continue to grow, unrestricted because the public's concerns will be eased by this new promise of "recycling."

The term chemical recycling is used by plastic companies to refer to a number of different technologies that include pyrolysis, gasification, solvolysis, and solvent-based purification. The 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. Pyrolysis is a form of incineration (as is gasification) with serious toxic impacts and is regulated as such under the Clean Air Act.

Yet pyrolysis actually can't recycle much, if any, plastic. A 2023 study by scientists from the National Renewable Energy Lab at the Energy Department found that when pyrolysis is used to process plastic waste, only 0.1 to 6 percent can become new plastic. NREL scientists also concluded that "the economic and environmental metrics of pyrolysis and gasification are currently 10–100 times higher than virgin polymers." In other words, it would be cheaper and environmentally preferable to make plastic from virgin fossil fuels than to try to use pyrolysis or gasification to turn plastic waste into new plastic products.

What pyrolysis mostly produces is fuels, yet fuel production and use do not constitute recycling. What's more, these fuels can be highly toxic. In 2023, EPA approved 18 new chemical mixtures derived from plastic waste for use as fuels, even though agency scientists had also determined that some of these chemicals posed astoundingly high cancer risks. One of the 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). EPA later rescinded the approvals and is reassessing the chemicals.

At the same time, the pyrolysis process creates large amounts of hazardous waste. EPA reporting data show that between 2021-24, just three pyrolysis facilities that were processing plastic waste generated more than 2 million pounds of hazardous waste and shipped it off site for disposal. If all 26 of the pyrolysis facilities that are currently proposed or under construction are actually built and put into operation, this could mean between 624,000 and 10.8 million additional pounds of hazardous waste generated in, transported through, and disposed of in neighborhoods across the country.

Even communities and states without chemical recycling facilities could still be impacted due to the transportation of hazardous waste. Hazardous waste generated by just three existing pyrolysis facilities already travels through 13 states on the way to disposal facilities, putting even more communities at risk. The dangers of transportation-related releases of hazardous materials should be clear to the public given the 2023 train derailment in East Palestine, Ohio.

While chemical- and solvent-based methods 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. Solvent-based purification and solvolysis, for example, use chemicals linked to neurotoxicity, respiratory toxicity, cancer, developmental harm, and other health problems. Not only do these technologies often use toxic solvents and chemical agents, in other words, but in some cases they can also generate significant quantities of hazardous waste.

Chemical recycling is a false solution to our plastic problem. It doesn't halt the deluge of plastic waste, and it creates new harms. Policymakers, companies, and the public should not fall for the industry greenwashing and should instead focus on real solutions to the plastics crisis: reducing production and use, switching to more environmentally sound materials, eliminating the most toxic plastics and chemical additives, and building a robust infrastructure for nontoxic plastic reuse/return systems.

For more information, please see NRDC's reports "Recycling Lies: 'Chemical Recycling' of Plastic Is Just Greenwashing Incineration," and "More Recycling Lies: What the Plastics Industry Isn't Telling You About 'Chemical Recycling.'"

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