Optimizing TSCA's Potential to Reduce Plastic Waste

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A critical element of the U.S. Environmental Protection Agency's (EPA) *Draft National Strategy to Prevent Plastic Pollution* (Strategy) is to "improve post-use materials management." The Strategy identifies potential voluntary actions EPA believes can be implemented to prevent plastic waste. Plastics recycling, both mechanical and "advanced," is core to achieving improved post-use plastics materials management. Post-use plastics management, in turn, is core to achieving circularity. Logic would have it then that the Biden administration would be enthusiastically promoting policies that advance responsible plastics recycling. The reality is something else. This article explains how the Biden administration's implementation of the Toxic Substances Control Act (TSCA) is missing opportunities to grow advanced recycling and diminishing its potential to enable a circular economy.

The Promise of Advanced Recycling

Pyrolysis and gasification are the Benjamin Button technologies of the plastic circular economy. These technologies use heat and catalysts to jump-start chemical reactions that return post-use plastic to or near its original monomer state, identical in chemical structure to the original monomer, or as petrochemical feedstocks, such as naphtha. Advanced recycling technologies have been used for decades to produce hydrocarbons (to replace petroleum) and synthesis gas, or syngas, to replace coal or natural gas.

Advanced recycling can take one of three general forms: depolymerization, pyrolysis, or carbon recycling. In depolymerization, the polymer is converted back into monomers—the original building blocks for the polymer—such as the depolymerization of nylon-6 to its monomer, caprolactam. If a polymer can be converted by depolymerization to its ultimate monomer, the polymer can be remanufactured with high quality at maximum efficiency. Not many polymers are amenable to depolymerization to the original monomer.

Pyrolysis involves heating the plastic to high temperature in the absence of air and in the presence of a catalyst to break the high molecular weight polymer chains into small molecules. Pyrolysis oils have compositions similar to petroleum fractions and are processed in the same refineries as oil. Pyrolysis facilities typically are required to follow exacting specifications for what plastics can be used as feedstocks, including limits on halogens and metals. Once the plastic is broken down, the resultant pyrolysis oils can be further converted to the common molecules used to make plastic, such as ethylene and propylene; into other petrochemicals; into fuel. Pyrolysis oils can also be blended directly into fuels.

Carbon recycling is a third technology that converts waste plastic into a mixture of carbon monoxide and hydrogen, also called syngas. The goal is to sever all bonds to carbon, so the result is a one-carbon substance (carbon monoxide) and hydrogen. The carbon monoxide and hydrogen are then used to make products including hydrogen fuel, methanol, fertilizers, and other chemical building blocks. Traditionally, syngas has been made from fossil resources like coal, oil, and natural gas.

Circularity goals have renewed interest and investment in these technologies because they are designed to process solid and semisolid feedstocks, including biomass, post-use plastics, tires, and other post-use materials, to reduce or replace the use of fossil resources to make useful products, including building-block chemicals, fuels, and energy. They offer an elegant and efficient means of solving one of our most vexing pollution problems—what to do with the seemingly intractable problem of plastic waste. These processes form the backbone of a new and promising generation of technologies essential to achieving plastics circularity and promoting sustainability.

Advanced recycling could grow from 20 to 40 million metric tons and meet up to 8% of polymer demand by the end of the decade. This growth reflects investment opportunities of approximately $40 billion and could effectively divert plastic from landfills and diminish the use of fossil resources, goals that align perfectly with the Biden administration's goal of achieving circularity, preventing pollution, and advancing sustainability.

Plastics Recycling and TSCA

TSCA is probably not the federal statute that first leaps to mind in assessing commercial opportunities to repurpose plastic waste. Since everything we need, and the products we cannot live without, are rooted in chemicals, our collective indifference to TSCA's powerful role in ensuring sustainability and advancing circularity is curious. So is EPA's underperformance in optimizing TSCA's utility as a change agent to achieving these goals.

Pyrolysis oils themselves, or hydrocarbon fractions made from a combination of petroleum and waste plastic pyrolysis, are often considered "new" chemicals under TSCA.

Congress overhauled TSCA in 2016 with enactment of the Frank R. Lautenberg Chemical Safety for the 21st Century Act (Lautenberg). Lautenberg provides yet untapped opportunities for EPA to promote TSCA as a true game changer in commercializing new sustainable chemicals and fostering opportunities to support chemical recycling technologies like pyrolysis and gasification. EPA's implementation of TSCA has instead confounded new chemical innovation, diminished R&D investment in new chemicals and chemical technologies, and chilled the once-hot domestic advanced recycling market. To understand exactly what these EPA policies are and how they are undermining domestic investment in circularity, some background is necessary.

TSCA Chemical Inventory

Almost a half century ago, Congress tasked EPA with creating a catalog of chemicals believed to be in commerce and used for commercial purposes. Chemicals added to this chemical "Inventory" were deemed "existing" chemicals needing no EPA risk review as a condition of continued commercialization. Chemicals not listed on the Inventory were (and are) considered "new" and require EPA pre-market review as a predicate to commercial manufacture or import. Under new and old TSCA, new chemicals have been reviewed by EPA scientists to assess risk. Lautenberg now requires EPA to document its evaluation. This has caused EPA to take a precautionary approach in its chemical review, and most new chemicals are subject to restriction.

TSCA Nomenclature Anomalies

Chemicals fall into two classes under TSCA. Class 1 substances are single, defined substances and can be made by any means without changing the chemical identity of the substance. Class 2 substances reflect some degree of variability, including alkyl ranges, isomeric variability, and so-called UVCBs (Unknown or Variable composition, Complex reaction products, and Biological materials). UVCB substances are named with the source of the chemical and/or process in the name or as part of the definition, which is part of the identity.

New chemicals, including those that use plastic waste as a feedstock, compete for market share with older, petroleum-based existing chemicals that rely on "source-based" naming conventions. As discussed below, EPA's hazard-based approach to new chemicals review causes most new chemicals to be regulated. This places newer chemicals and the technologies that produce them at a significant competitive disadvantage vis-à-vis older, generally riskier chemicals that will not undergo risk review for decades.

How is this relevant to advanced recycling? Pyrolysis oils themselves, or hydrocarbon fractions made from a combination of petroleum and waste plastic pyrolysis, are often considered "new" chemicals under TSCA. This is because under TSCA, given the naming conventions noted above, chemicals produced from "novel" feedstocks like waste plastic would not fit with the name of any existing chemical. Consider, for example, this UVCB hydrocarbon product with Chemical Abstracts Service Registry Number® (CAS RN®) 64742-48-9:

> Naphtha (petroleum), hydrotreated heavy: A complex combination of hydrocarbons obtained by treating a petroleum fraction with hydrogen in the presence of a catalyst. It consists of hydrocarbons having carbon numbers predominantly in the range of C6 through C13 and boiling in the range of approximately 65°C to 230°C (149°F to 446°F).

According to EPA nomenclature rules, this substance must meet the carbon and boiling point range, it must be made by hydrogenation, and it must be made from petroleum. Because the TSCA Inventory was created decades ago, most distillate fractions include petroleum as the source. Making a hydrocarbon distillate from another source, such as biomass or waste plastic, means that the manufacturer of these distillates cannot identify the product using the petroleum-based identity. As such, manufacturers of those distillates are not able to rely upon the TSCA Inventory listing of the petroleum-source chemical and must instead submit a premanufacture notification (PMN) for the circular-source distillate even if the two chemicals are chemically indistinguishable.

A few pyrolysis oils are listed on the TSCA Inventory, sourced from both waste tires and waste plastic. There are also petroleum-equivalent hydrocarbons made from biomass

listed on the Inventory. But the petroleum-equivalent distillate fractions are not listed on the public portion of the Inventory, meaning that refineries may not produce substances like the hydrotreated heavy naphtha from pyrolysis oils or combinations of pyrolysis oils and petroleum without pre-market approval. Novel distillates are expected to evolve significantly, and current TSCA policies will greatly frustrate the evolution of this industry.

Consequently, refineries wishing to repurpose plastic waste or biomass as a feedstock may not do so in most cases without preparing a PMN. Much has been written about the challenges PMN submitters experience today and the dysfunction of the new chemicals review process. Delays beyond the statutory 90-day PMN review period are significant, often exceeding a year. More troubling is outcome uncertainty. Despite the explicit language in TSCA section 5 that EPA evaluate substances against a risk-based standard, EPA instead is regulating every substance that it concludes is not "low hazard" for both health and ecological toxicity, regardless of the substance's relative hazard or sustainability benefits. This hazard-based approach is inconsistent with the plain language of TSCA. The implementation delays and inconsistent and resulting overly conservative risk reviews stifle innovation in provable ways.

For hydrotreated heavy naphtha, EPA would identify hazards for worker inhalation (from the anesthetic effect of the hydrocarbon), aspiration hazard, skin irritation, and aquatic toxicity. Critically important to this discussion is the fact that the hazards identified in "new" chemical reviews exist regardless of the source, as they are intrinsic to hydrocarbons. This is why there are workplace protection standards, Clean Air Act (CAA) standards, and a prohibition from releasing the product to water under the Clean Water Act (CWA). If a refiner were to submit a PMN for a plastic- or biobased naphtha, EPA would duplicate preexisting Occupational Safety and Health Administration (OSHA), CAA, and CWA protections in a TSCA section 5(e) consent order.

This redundancy matters for many reasons. As noted, new chemicals compete with existing chemicals. All things being equal in terms of chemical profile and functionality, regulated entities will elect commercial pathways subject to the least amount of regulation. EPA dismisses the commercial effect of new chemicals regulation, but the paperwork burdens, reporting obligations, and unfavorable optics that significant new use rules (SNUR) invite are hard to sell to employees, downstream customers, and commercial partners. Customers may reasonably ask, if the hazard is the same, why is EPA regulating the new one? If using circular-based feedstocks creates extraordinary market entry delays, significant paperwork burden, and enhanced enforcement scrutiny, as is now the case, refiners will simply forgo greening their feedstocks.

Troubling Policy Initiatives

The foregoing provides context on how TSCA nomenclature rules pose challenging regulatory impediments for chemical manufacturers wishing to optimize waste plastic feedstocks. These rules have been on the books for decades. It is easy to forgive a collective lack of appreciation for the insidious effect nomenclature rules have on innovation of new chemicals. More recent EPA initiatives, however, are harder to explain and align with the Biden administration's commitment to prevent plastic pollution.

To those of us in the TSCA community, the hyper specificity of EPA's language seemed unusually scripted, and the Strategy seemed an odd context to roll out a new policy.

The administration's strong support for preventing plastic pollution was articulated in response to the December 2020 passage of the Save Our Seas 2.0 Act. The Act tasks EPA with developing a strategy to improve post-consumer materials management and infrastructure to reduce plastic waste. In April 2023, EPA released its draft Strategy. In it, EPA identifies how it will prevent plastic waste and reduce, reuse, recycle, and capture plastic from land-based sources. Curiously, EPA announced in the Strategy its intention to require companies submitting new pyrolysis oil chemicals under TSCA to conduct testing for impurities that could be present in the new chemical substance testing both before and after submission to ensure there is no variability in the plastic waste stream that is used to generate the pyrolysis oil. To those of us in the TSCA community, the hyper specificity of EPA's language seemed unusually scripted, and the Strategy seemed an odd context to roll out a new policy. As discussed below, other events may have influenced the inclusion of this focused language in the Strategy and EPA's surprising simultaneous decision to reevaluate approval of certain distillates derived from plastic waste.

To understand the relevance of EPA's new policy, some background is needed. On April 5, 2023, just before the Strategy was released, Senator Jeff Merkley (D-OR) wrote EPA Administrator Michael S. Regan to express his concerns with substances derived from plastic waste and potential exposures to communities living near a refinery. Two days later, on April 7, 2023, Earthjustice filed suit on behalf of Cherokee Concerned Citizens, a community group in Pascagoula, Mississippi, in the U.S. Court of Appeals for the District of Columbia Circuit seeking review of a TSCA Consent Order for new petrochemicals under TSCA section 5 issued by EPA on August 11, 2022. The Order authorizes the manufacture of certain new chemical substances made from waste plastic. Earthjustice's press release states that EPA approved the new chemicals to make fuels "despite finding that the resulting air pollution would pose a cancer risk 250,000 times greater than what the agency typically

considers unreasonable." Zahra Ahmad, *Community Sues EPA for Allowing Production of Petrochemical Fuel Despite Extreme Cancer Risk*, Earthjustice (Apr. 7, 2023). According to the press release, EPA determined that the use of the new chemicals will pose up to a one in four cancer risk, meaning 25% of residents living nearby could develop cancer over their lifetime.

With remarkable and unprecedented speed, on June 20, 2023, just 81 days after the suit was filed, EPA proposed SNURs for the 18 chemicals that were the subject of the Order at issue in the lawsuit. The 18 chemicals at issue are made from plastic waste–derived feedstocks, and the proposed SNURs would, according to EPA, ensure they are free from unsafe contaminants before they can be used to make transportation fuels. EPA acknowledged that at the time it approved them, "the companies provided some data on impurities and these data showed there were no impurities of concern. . . ." EPA noted, however, in the proposed SNUR that it "knew less about impurities that may be included in plastic-based feedstocks in 2015 and 2019 than it does today." Press Release, EPA, EPA Proposes New Protections for Communities from Fuels Made Using Plastic Waste Based Feedstocks (June 15, 2023).

The clear message in EPA's Strategy and subsequent proposed SNURs is soul crushing for entities wishing to optimize plastic waste in beneficial and safe manufacturing operations.

The proposed SNURs would require notification to and review by EPA before the manufacturing or processing of the chemicals using waste-derived feedstocks that contain *any amount* of the following: heavy metals (e.g., arsenic, cadmium, chromium VI, lead, and mercury), dioxins, phthalates, per- and polyfluoroalkyl substances (PFAS), polybrominated diphenyl ethers (PBDE), alkylphenols, perchlorates, benzophenone, bisphenol A (BPA), organochlorine pesticides (OCP), ethylene glycol, methylene glycol, or N-methylpyrrolidone (NMP). The proposed SNURs would designate as a significant new use the absence of certain protective measures identified in the order. Additionally, the proposed SNURs would designate as a significant new use manufacture of the PMN substances using feedstocks containing *any amount* of the identified contaminants. EPA did not specify whether the prohibition was for the immediate precursor (likely a pyrolysis oil) or the ultimate feedstock (waste plastic).

The flood of adverse comments on the proposal cautioned that if issued, the rule would effectively prohibit entirely the manufacture of the substances that include some variations of products derived from pyrolysis oils. EPA provided no de minimis level below which the SNUR does not apply. This is especially problematic for manufacturers of any of the PMN substances because a manufacturer would be required to document the absence of all the specified substances in all of its feedstocks or risk being in violation of TSCA. Even if a company could test the feedstock it uses, itself an impracticable commercial expectation, detection can only be made to an analytic level of detection. The complete absence of a contaminant cannot be measured.

Legitimate questions have been raised about whether the products of advanced recycling, including pyrolysis oils, present an unreasonable risk. These questions relate to whether contaminants in plastic feedstocks lead to the presence of hazardous byproducts that are not present in similar fossil-based products. These questions, however, are properly answered in EPA's new chemicals review process, where EPA specifically examines the composition of the advanced recycling products and compares them to hydrocarbons made from petroleum products. Like plastics, fossil resources, especially petroleum and coal, are highly heterogeneous; converting them to other hydrocarbons requires separation of heteroatoms (nitrogen, oxygen, sulfur, halogens) and metals from the raw material.

EPA's proposed SNURs are extraordinary and disappointing for several reasons. First, the proposal lacks scientific justification. Presuming EPA proposed the SNUR in response to the petition filed by Cherokee Concerned Citizens, the exposure "concern" widely reported in the media appears to be premised on an erroneous reading of EPA's risk assessment for one of the 18 substances included in the SNUR. Apparently, and as explained in EPA's response to Senator Merkley's letter to EPA, the Agency predicted a high level of cancer risk in response to a speculative condition of use that even EPA concedes will never happen. Specifically, the hypothetical condition of use involves hypothetical emissions from the simultaneous use nationwide at airports of the biojet fuel in the Order. Even if this absurd scenario were anything other than purely hypothetical, the potential risk is entirely unrelated to the feedstock or to the production facility at issue.

Second, if issued in final, the rule would prohibit what is contained in the feedstock plastic without regard to the chemical composition of the products. This is an unprecedented application of TSCA section 5 and entirely inconsistent with TSCA.

Finally, the clear message in EPA's Strategy and subsequent proposed SNURs is soul crushing for entities wishing to optimize plastic waste in beneficial and safe manufacturing operations. Whether it was intentional or not, the SNURs would effectively ban the production of the notified substances from waste plastic because no converter can prove the total absence of the specified contaminants. Whether EPA's indifference to the fact that further processing in a refinery (via distillation, isomerization, hydrotreating, cracking, or other processes) poses no difference between the petroleum- and plastic-based feedstocks is intentional or willful indifference, the result is the same, and the policy and proposal reflect bad science, bad law, and really bad policy.

Needed Policy Changes

To achieve circularity to address the plastics crisis, EPA needs to interpret TSCA to align better with the Biden administration's commitment to sustainability and circularity. Three TSCA policy changes should be made.

First, EPA should consider broadening the TSCA exemption from section 5 reporting for imported nonhazardous solid waste, including plastics, that is being used as a recycling or chemical feedstock as opposed to being disposed of as a waste. Currently, such waste may be imported if it is sent for disposal. EPA should instead focus its effort on the products of advanced recycling (e.g., pyrolysis oils) and ensuring that such products themselves are not an unreasonable risk. The potential risk does not arise from the components of the waste plastic feedstocks, but from the composition of the advanced recycling products.

Second, EPA should develop a standardized approach to the PMN review process for crude pyrolysis oils and subsequent distillate fractions. The concerns for hazardous pyrolysis byproducts should be consistent, so EPA's approach also should be consistent. A standardized approach would also pose fewer burdens on EPA staff and expedite the review process.

Third, EPA should suspend the source-based naming conventions for TSCA chemical identity purposes for refinery products made from pyrolysis oils (or biomass) rather than petroleum. While the pyrolysis oils are similar, but not equivalent, to petroleum converted in petrochemical facilities to other hydrocarbon streams, the waste-based substances become indistinguishable from the equivalent petroleum-based streams. EPA's policy now requires that manufacturers distinguish between petroleum-based, biobased, and waste-based hydrocarbon fractions at each refinery step, even when all are co-manufactured in a single process. If EPA finds risk from the production of such streams, regardless of the source, that risk should be managed through other authorities, such as the CAA. To manage risks for only the new fractions using TSCA places a barrier to reducing reliance on petroleum and to finding a productive use for waste plastic without achieving EPA's protective goal because refineries will instead rely on petroleum.

Finally, if EPA is unwilling to suspend its source-based nomenclature for distillate fractions, stakeholders could pursue equivalency determinations under new authority given EPA under Lautenberg in TSCA section 8(b)(3)(B). Despite the passage of seven years, EPA has yet to establish the criteria it will use to evaluate equivalency. This could be done for distillates made from pyrolysis oils and biobased fractions.

The Future of Advanced Recycling

EPA can and should evaluate pyrolysis oils and similar hydrocarbons from biomass as new chemicals under TSCA. EPA should look for problematic components, but once the pyrolysis oils are found to have hazards equivalent to fossil oils, TSCA should step out of the way and allow the pyrolysis oils and hydrocarbon fractions made from them to be incorporated into the petrochemical supply chain without further regulatory friction. Disallowing waste-based products from petrochemical manufacturing will not address pollution from refineries; it will only extend our dependence on fossil sources and limit our end-of-life options for plastics. We need advanced recycling to manage plastic waste responsibly and to achieve circularity.

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If EPA continues to use TSCA to prohibit, rather than manage, advanced recycling, the United States will not address its plastic waste problem and will not reduce its reliance on fossil resources, all without any protective benefit.

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