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RECOMMENDATIONS FOR THE NEW ADMINISTRATION

The Future of Plastics Sustainability: Advanced Recycling

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This brief is part of a series of policy recommendations for the administration of President Joe Biden. Focusing on a range of important issues facing the country, the briefs are intended to provide decision-makers with relevant and effective ideas for addressing domestic and foreign policy priorities. View the entire series at www.bakerinstitute.org/recommendations-2021.

THE PLASTIC WASTE CRISIS CONTINUES TO EVOLVE

Plastic waste not only affects environmental quality and ecosystem health, but it also has consequences for our communities in both developed and developing economies.[1,2,3,4,5] Recent data challenges the once-held assumption that the United States is adequately managing its plastic waste through proper collection, recycling, and permitted landfilling.[6] In fact, the United States could be as high as third among countries contributing to coastal plastic pollution, according to new figures that account for U.S. plastic exports and illegal dumping and littering domestically.[7] More than half of all plastics collected for recycling in the United States were exported, and, of this, 88% of exports were routed to countries with insufficient solid waste infrastructure, unable to effectively manage, recycle, or dispose of plastics.[8] Accounting for these updated contributions, the amount of plastic waste generated in the United States and estimated to enter the coastal environment is five times larger than previously estimated, rendering the U.S. contribution among the highest in the world.[9]

This underscores a glaring need within our own U.S. borders to improve the quality of plastics and the economics around collection, sorting, and waste management and to advance recycling technologies, infrastructure, and consumer education. Without a transformational shift in our approach, the mismanagement of plastics waste will continue, resulting in the loss of valuable materials and squandered opportunities to recover and harvest the value of these resources. If sustainability is a global and national priority, it is imperative to understand that the vision of a circular economy can only be realized by deeming used plastic a resource and not a waste, and through employing advanced recycling technologies that "keep the molecule in play" and maintain materials at an economic value.

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ADVANCED RECYCLING: AN UNTAPPED OPPORTUNITY TO PROGRESS TOWARD A CIRCULAR ECONOMY

Plastic recycling in the United States has remained steady at 9% since 2012;[10] globally, current recycling rates are thought to be between 14% and 18%.[11] Low recycling rates can be attributed to technical challenges

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such as the contamination of recyclable polymers; the customization for particular applications that inhibit collection, separation, and reuse; and the quality and complexity of plastics that are made of multiple polymers and additives. With global demand for plastics projected to triple by 2050,[12] the overall contribution of plastic waste to the supply chain must change dramatically. The recycling and petrochemical industries can play an important role in the transition to a circular economy by converting polymeric waste into virgin-grade feedstock, which can then be used to produce new materials and chemicals of virgin-grade quality. However, the current conventional recycling technology the nation is reliant on is strained by the steadily increasing volume of plastics, which cannot be managed using only traditional mechanical recycling.

To efficiently recycle large amounts of plastic waste, a circular economy requires innovative technologies such as advanced recycling, commonly known as chemical recycling. Chemical recycling, such as pyrolysis or depolymerization, occurs at the molecular level, where plastic polymers are broken down into their constituent monomers that can then be used as feedstock or raw materials for manufacturing new products of equal or greater quality. Studies illustrate that as much as half of all global plastics packaging could be recycled by 2040 if chemical recycling technologies were widely adopted.[13] However, in order to achieve a recycling rate of 25% of plastics packaging, $50 billion in investment would be required by 2040 to deliver enough chemical recycling capacities.[14] Advanced recycling technologies have been used to turn plastics into fuels for decades, but the growing market demand for high-quality plastic recyclate—due to significantly higher recycled content targets in packaging products, a heightened sense of corporate and social responsibility, and China's waste import ban—have revealed a need to improve domestic and global capabilities of waste management and recycling systems.

While mechanical recycling is the primary mechanism to manage PET, HDPE, and PE plastic (some of the most common types of plastic in use today), the reality is that a high percentage of mixed chemistry, low-quality, and low-density plastic material may never be eligible for recycling or reuse without an integrated waste management approach. Even with investments in advanced robotics, enhanced optic recognition technologies, and artificial intelligence to improve mechanical recycling processes, there are fundamental limitations that inhibit traditional methodologies from recovering all polymer families on the market and entering the end-of-life waste stream. Understanding the risks across the entire life cycle is critically important for establishing regulatory certainty, sustainability, and commercial viability for various recycling strategies.

RECOMMENDATIONS TO ENABLE ADVANCED RECYCLING TECHNOLOGIES

Improve the economics around collection.

Even if advanced recycling technologies were commercially deployed, many of the same challenges inherent in the current recycling system remain, such as collection, sorting, and processing. Insufficient investment in collection infrastructure and low municipal solid waste management budgets fail to cover operating costs. Increasing the value of after-use plastic packaging in the form of packaging fees or recycled-content legislation could help to incentivize the collection of waste plastics and reduce the likelihood of leakage from the collection system.

Ensure modernized regulatory and permitting frameworks.

Outdated regulations and permitting frameworks that fail to keep pace with technologies create a barrier for innovation and can impede the uptake of advanced recycling efforts. Advanced recycling technologies that are classified as waste disposal instead of manufacturing processes impede the expansion of chemical recycling and decrease economic opportunities to repurpose plastics for feedstocks that can produce higher-value products. Policies should appropriately classify and delineate commodities versus waste by ensuring that post-consumer plastic feedstock intended for advanced recycling is not classified as "solid waste" and the facilities that produce them are permitted accordingly.

Support an integrated waste management framework.

An integrated waste management framework aims to accelerate transformational change to meet ambitious recycling targets and is foundational to sustainable materials management. The Biden administration should encourage circularity measures that go beyond the traditional mindset of reduce, reuse, and recycle to include a progressive approach that promotes recovery, redesign, and remanufacture. Chemical recycling increases our capacity to process and recover unrecyclable plastics waste, ensures that more polymers are reprocessed into higher-value products, recaptures the value of plastics by "keeping the molecule in play," and reduces the need for primary extraction and production.

Commission a sustainability study on the social, environmental, and economic impacts of chemical recycling technologies to understand the costs, benefits, and trade-offs and to identify where federal investment in research and development (R&D) is needed.

There is a dearth of information on the overall environmental performance of advanced recycling technologies from cradle to grave and across the value chain, particularly regarding energy consumption and safety of the process output. A lack of insight around sustainability metrics encumbers public acceptance, delays commercial uptake, and ultimately prevents innovations from advancing U.S. leadership in science and technology to help solve the growing plastic waste crisis. The study should also develop a waste management priority and timetable for different polymers that focuses on cost and recyclability of plastics and the need for R&D to advance the options for those currently hard-to-recycle plastics.

Integrate life-cycle dimensions into waste management strategies for an understanding of sustainability metrics.

Although current methodologies and tools for assessing and comparing the environmental and social impacts of a product or process are not well adapted to chemical recycling, integrating a life-cycle dimension into all waste management strategies in the waste hierarchy can objectively inform decisions and accelerate the transition of innovations to higher technology readiness levels.

Commission a national study of projected plastic waste quantities and types.

The Biden administration should commission a national study that quantifies and analyzes projected polymer waste streams and their compositions at the national level to strategize and support the establishment of suitable regulatory and investment conditions for conventional and advanced recycling technologies. The study should provide recommendations for improving national data collection, quality, and reporting and for ensuring the compatibility of definitions, terms, and language around recycling and waste management systems.

CONCLUSION

Increasing plastics sustainability can generate new opportunities for modernization, competitiveness, and job creation, consistent with global and national economic, energy, and environmental objectives. The United States cannot progress to circularity without an advanced recycling agenda that recognizes the value in plastic waste. Chemical recycling is only one key component in an overall integrated waste management system that will complement existing mechanical methods that are successfully and profitably managing a subset of polymers. Advanced recycling has the potential to help the nation achieve global sustainability goals and a climate-neutral, circular economy. However, if circularity is the preferred way forward, it is imperative to consider and assess innovative recycling technologies that could have enormous economic value in transforming plastic waste into building blocks that can be reintegrated to material supply chains as feedstock for new, higher-value products.

Technology alone will not solve the plastic waste issue. Transforming the system and evolving to a circular economy will only be successful if the economics around collection and sorting are improved. Additionally, it is essential to invest in emerging technologies, shift consumer behavior, design for circularity, and utilize fiscal instruments, government standards, and voluntary measures across the entire value chain. Regardless of the configuration, a circular economy will require the underpinning of informed and balanced policies that keep pace with technologies across their whole life cycle and account for impacts along the global supply chain.

ENDNOTES

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Cite as:
Meidl, Rachel. 2021. *The Future of Plastics Sustainability: Advanced Recycling.* Policy brief: Recommendations for the New Administration. 02.15.21. Rice University's Baker Institute for Public Policy, Houston, Texas.

https://doi.org/10.25613/DBW9-DN79