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The Changing Plastics Landscape:
Is the chemical industry prepared?

Contents

Introduction

Single-use plastics (SUPs)—disposable plastics that are used only once before they are thrown away or recycled—have become a focus of increased policy and regulatory attention and are the subject of a great deal of consumer activism on social media. Packaging accounts for 36 percent of all global plastics production[1] and includes many SUPs, such as straws, bags, and bottles that pollute the environment when they're not properly disposed of or recycled. Since plastic is not biodegradable, it does not break down easily and can harm the environment. Even when it does break down into smaller pieces, called microplastics, the tiny (five millimeters or less) fragments can still contaminate soil and waterways. Consumer concerns about their impact have led over 127 countries to enact legislation targeting plastic bags, one of the most common forms of SUPs.[2]

Permanent bans on the production and use of SUPs, as well as increasing demand for more sustainable alternatives, has implications for the chemical industry. How can the chemical industry respond to address the disruption, find new opportunities for growth, and contribute to increased sustainability? The solutions lie in reducing nonrecyclable materials and looking for alternative sourcing opportunities such as bioplastics; investing in improved recycling technologies; and working toward the development of a circular economy. Through a coordinated and cooperative effort across the value chain, the chemical industry can address the challenges surrounding SUPs.

Consumer activism is driving regulatory action

Globally, less than 9 percent of plastics waste is recycled, with the rest ending up in landfills that are usually not properly managed, thereby polluting the environment[10]

Plastics have become a part of everyday life—they are used in food packaging, cars, and innumerable household items we rely on for a better quality of life. The production of plastic has increased substantially, growing from 1.5 million tons in 1950 to over 320 million tons in 2015.[3] And the single largest category of plastics is SUPs, one that is largely used for packaging and generates the most waste.[4] However, in recent years, three major issues seem to be driving consumer perception and prompting increased regulatory pressure—usage of fossil fuels in manufacturing plastics and the resultant greenhouse gas (GHG) emissions, inadequate sustainable disposal and recycling solutions, and the potential risks to public health.

Use of fossil fuels in manufacturing plastics and GHG emissions: One of the primary concerns, centered around sourcing, is the use of fossil fuels or non-renewable energy in the manufacturing of SUPs. Producing SUPs using fossil fuels increases the amount of GHG emissions significantly—about 1.8 billion tons of CO2 are released annually.[5] Replacing fossil-based energy with renewable sources would reduce GHG emissions from plastics by up to 51 percent.[6] Furthermore, recycling plastics reduces total energy consumption by 79 percent for polyethylene terephthalate (PET), 88 percent for high-density polyethylene (HDPE), and 88 percent for polypropylene (PP)[7].

Inadequate sustainable disposal and recycling solutions: Decreasing capacity for sustainable disposing of plastics waste is another cause for concern. Many landfills in developed nations are reaching their maximum capacity, driving them to export their plastic waste to emerging countries for processing. For instance, by 2021, only 15 years of landfill capacity is expected to remain in the US.[8] In recent years, over 50 percent of the waste from plastic was being exported to China, and the US alone sent 1.4 million tons of scrap plastics annually to China for recycling.[9] But since China's ban on waste plastic import in 2017, many developed nations are struggling to cope. Moreover, deficiencies in current recycling programs cause substantial amounts of SUPs to end up in landfills than get recycled. Globally, less than 9 percent of plastics waste is recycled, with the rest ending up in landfills that are usually not properly managed, thereby polluting the environment.[10]

Potential risks to public health: SUPs may have serious consequences on public health as human beings are consuming plastics that contain carcinogens and other toxic substances that can cause cancer. According to a new study in the *Environmental Science and Technology journal*, human beings are consuming as much as 52,000 microplastic particles a year.[11] Plastics and the associated chemicals typically end up in human bodies from eating seafood—mostly sea organisms that have ingested microplastics because of the degradation of products containing SUPs.[12]

The chemical industry is at a crossroads

What will be the magnitude of impact of the SUPs ban on chemical industry growth?

Regulations limiting the use of SUPs have ramifications for chemical companies, especially those players that produce polyethylene (PE) and polypropylene (PP) for the consumer packaging sector. Given that SUPs represented a third of all plastics produced in 2017,[13] a ban on SUPs may result in slower revenue growth for petrochemical companies. Products associated with the highest number of regulatory limits include plastics bags, food containers, bottle caps, and straws.[14] Consumer product companies are likely to switch to other relatively less energy-intensive materials like paper or biopolymers, altering the supply chains. As a result, there will likely be reduced capital investments in ethylene plants, as ethylene remains the backbone of all major polymers used in products containing SUPs.[15]

What will be the magnitude of impact of the SUPs ban on chemical industry growth? Demand for petrochemicals will likely grow more than the demand for fuels through 2040 and emerge as one of the major drivers for global oil sales.[16] There are a significant number of polyethylene plants that are currently being constructed worldwide—about seven million metric tonnes of polyethylene capacity is expected to come online between 2019 and 2022 in the US.[17] The underlying assumption is that demand for plastics will grow at an average annual rate of 3 percent. But given the changing consumer preferences and regulatory risks, the growth rate in demand for plastics could potentially halve in the long run, and a decrease in SUP consumption could lead to overcapacity and a decrease in prices.[18]

The way forward: Chemical companies have long-term sustainable options

To prepare for and thrive in this shifting landscape, chemical companies appear to have three options: (1) consider alternative sourcing opportunities such as bioplastics to reduce nonrecyclable materials; (2) evaluate investing in improved recycling technologies and sustainable disposal of plastic waste; and (3) work with the value chain toward achieving a circular economy.

1. Consider alternative sourcing opportunities: Much of the demand for SUPs could be met using materials other than traditional virgin plastics. Alternatives at chemical companies' disposal include materials that are more easily recyclable or bio-based. Glass can be reused and recycled many times over without structural degradation. In terms of bio-based options, chemical players have access to bioplastics like liquid wood and polymer substitutes produced from fermented plant starch, such as corn. For instance, liquid wood derived from wood pulp-based lignin can be mixed with other materials to create a reliable, nontoxic alternative to petroleum-based plastics.

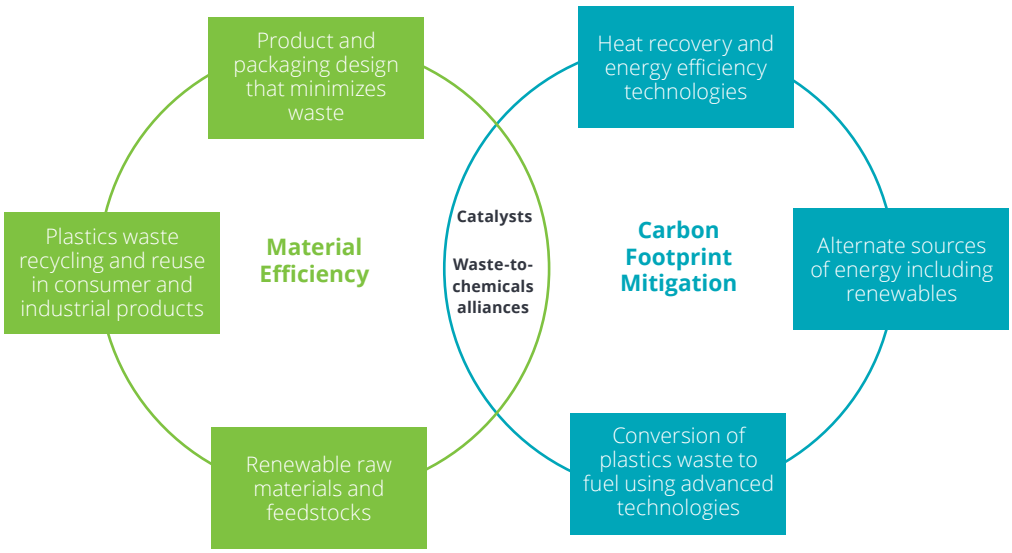
However, as it's not easy to substitute materials because companies invest heavily in manufacturing capabilities, switching to alternatives should be carried out in a way that adds value in forward progression.

2. Evaluate investing in improved recycling technologies and sustainably disposing plastic waste: There is an existing $120 billion market opportunity in the US and Canada for plastics and petrochemicals that could be developed by recovering waste plastics.[19] Using closed-loop recycling, a polymer could be chemically reduced to its original monomer form so that it could be then processed or re-polymerized and remade into new plastic materials. This could help overcome the limits of traditional or mechanical recycling, which takes the plastic and reforms it into a usable pellet. Even as some chemical companies are adopting practices that enable nearly closed-loop systems with minimum waste and constant material recycling and reuse, there is a potential opportunity for the entire industry to make it economically viable.

Moreover, companies can address the plastics waste challenge by using sustainable disposal mechanisms. One such process is pyrolysis, which helps turn non-recycled plastics from municipal solid waste into synthetic crude oil that could be in turn refined into gasoline, diesel, or heating oil. Besides, using pyrolysis to convert non-recycled plastics into ultra-low sulfur diesel fuel (ULSD) can reduce GHG emissions by 14 percent and save up to 96 percent in traditional energy use, compared to ULSD from conventional crude oil.[20]

3. Work with the value chain toward achieving a circular economy: From a long-term standpoint, the chemical industry could consider working toward achieving a circular economy (figure 1) where almost everything gets used and nothing goes to waste. The chemical industry's role involves bringing new materials that can be part of a circular economy and demand, pay for, and incorporate recycled content into their products to preserve raw materials and reduce emissions. Through a coordinated effort across the value chain, the chemical industry can make great strides in the development of a circular economy—one, chemical players could develop polymers that allows processors to consume less material while maintaining the quality of their products, whether it is strength or durability. Two, they could work with consumer goods companies and other end-use industries to design more sustainable products, such as recyclable packaging.

Figure 1: Aspiring towards a circular economy where everything is utilized, and nothing goes to waste



* Minimum waste needs to be considered throughout the full life-cycle. Advantages like increased product lifespans and recycling potential are key factors to consider.

Source: Deloitte analysis based on various sources including Raffaele Cucciniello, Daniele Cespi, Recycling within the Chemical Industry: The Circular Economy Era, MDPI, May 2018, https://www.mdpi.com/2313-4321/3/2/22; The National Academies Press, Sustainability in the Chemical Industry: Grand Challenges and Research Needs, 2006, https://www.nap.edu/read/11437/chapter/3; Cefic, Teaming Up for a Sustainable Europe, 2014, http://www.cefic.org/Documents/RESOURCES/Reports-and-Brochure/Cefic-Sustainability-Report-2013-2014.pdf.

Realizing this vision of a truly circular economy can lead to substantial economic benefits, including significant net material savings.[21] The full value of the circular opportunities globally in the packaging industry is estimated at about US $270 billion per year in materials savings, all net of materials used in the reverse-cycle processes.[22]

And many chemical manufacturers have already begun taking steps to move toward circular economy. For example, SABIC has already tied up with recycling technology and consumer product companies to launch circular polymers generated from plastics waste.[23] LyondellBasell, through its joint venture with SUEZ, is not only recycling used polypropylene but also playing a more significant role in applying process technologies in segregating and processing difficult-to-recycle, multi-layered plastics waste.[24]

Final thoughts

Addressing the SUPs challenge sustainably includes chemical manufacturing companies adopting practices that enable nearly closed-loop systems with minimum waste and constant material recycling and reuse. Developing innovative solutions for tackling plastics purification, decomposition, and conversion can be possible if the industry advances recycling technologies and brings new solutions to scale through continued collaboration across stakeholders. Many chemical companies have begun taking action—they are taking a single-use item and making it usable multiple times. And this could be a game-changer for the industry in the long run.

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Acknowledgments

The authors would like to thank Sophia Paul, Susannah Harris, Jennifer McHugh, Jake Shirmer, Josh Mellinger, Mayank Agarwal, Andrew Slaughter, Heather Ashton, and Sandeepan Mondal for their help with the development of this article.

Endnotes

1. United Nations Environment Program, Single-Use Plastics - A Roadmap for Sustainability.
2. UNDP, Legal limits on single-use plastics and microplastics.
3. E. Beckman, "The world's plastic problem in numbers," August 13, 2018.
4. R. Geyer, J. R. Jambeck, and K. L. Law, "Production, use, and fate of all plastics ever made," *Science Advances*, 2017.
5. University of California - Santa Barbara, "Plastic's carbon footprint: Researchers conduct first global assessment of the life cycle greenhouse gas emissions from plastics," *ScienceDaily*, April 15, 2019.
6. Science News, Plastic's carbon footprint, April 15, 2019.
7. The Association of Plastic Recyclers, Life Cycle Impacts for Postconsumer Recycled Resins, December, 2018.
8. James Thompson, Waste Business Journal, SWEEP Steering Committee & Rob Watson, Chief Science Officer, Eco-Hub LLC. Founder & Co-chair SWEEP Standard.
9. J. Dell, "157,000 Shipping Containers of U.S. Plastic Waste Exported to Countries with Poor Waste Management in 2018," March 6, 2019.
10. R. Geyer, J. R. Jambeck, and K. L. Law, "Production, use, and fate of all plastics ever made," *Science Advances*, 2017.
11. National Geographic, You eat thousands of bits of plastic every year, June 5, 2019.
12. B. Bienkowski, "Two-thirds of all plastic ever produced remains in the environment," February 19, 2019.
13. BP, "BP Energy Outlook 2019: News and insights: Home," February 14, 2019.
14. UNEP, "SINGLE-USE PLASTICS: A Roadmap for Sustainability."
15. Main polymers used for producing single-use plastics are HDPE, LDPE, PET, PP, PS, and EPS.
16. The International Energy Agency, The Future of Petrochemicals.
17. Petrochemical Update, US polyethylene flood in 2H 2019 to squeeze supply chain, February 26, 2019.
18. Christof Ruhl, "The war on plastic will dent oil demand more than anticipated," Financial Times, February 2019.
19. Closed Loop Partners, Accelerating circular supply chains for plastics.
20. Plastics Industry Association, Advanced Recycling.
21. World Economic Forum, "An economic opportunity worth billions—Charting the new territory," January 2014.
22. Ibid.
23. Eco-Business, "Sabic and customers launch certified circular polymers from mixed plastic waste."
24. Lyondell Basell, "LyondellBasell and SUEZ Collaborate with Samsonite to Create Recycled Plastic Suitcase Collection," April 19, 2019.

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