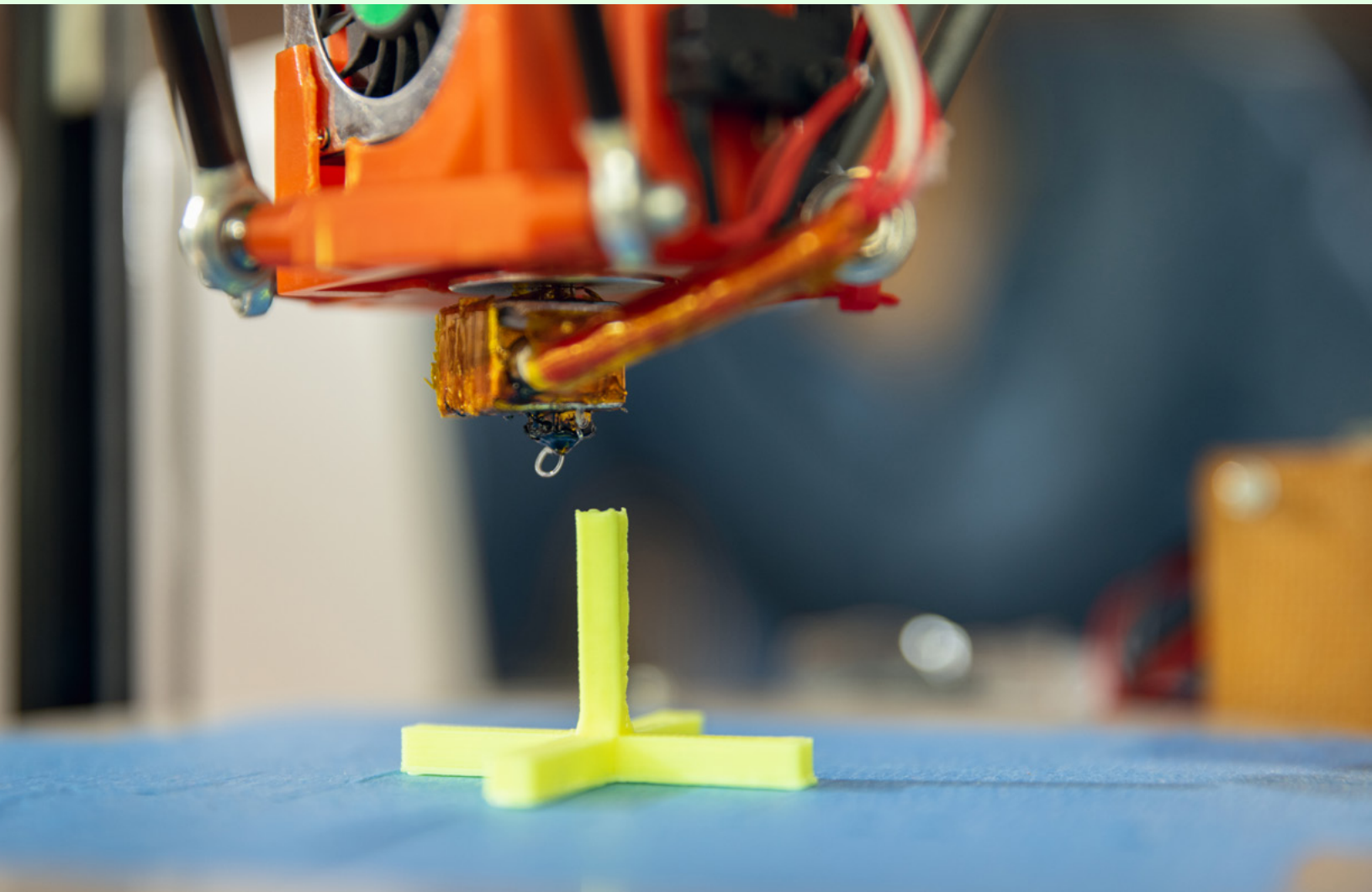
U.S. Chamber of Commerce Foundation

The State of Innovation and Investment into Sustainable Plastics within the U.S.



Key Takeaways

The private sector plays an important role in investing and driving innovations to solve the issues of plastic waste.

Opportunities for greater private sector involvement in those innovations exist throughout the plastic value chain.

It is necessary to facilitate greater interactivity and rationalization among plastic and circular economy innovators and investors. This could be addressed with a curated marketplace that facilitates the growth and evolution of plastic innovations across the value chain.

SHETH SANGREAL FOUNDATION

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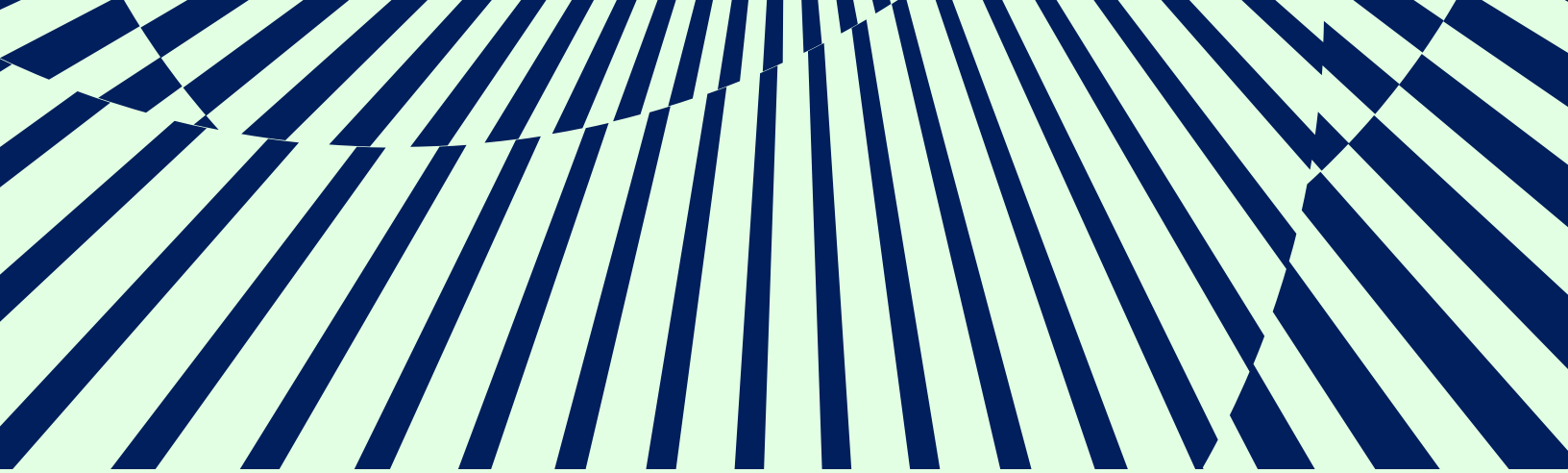
The Paradox of Plastics

Plastics are a ubiquitous material. Their durability, versatility, and light-weight nature have transformed industries and created significant advantages. Since the evolution of plastic's mass production over 70 years ago, production has increased over 200-fold, reaching 400 million tonnes per year.[1] Yet over this time, as plastic production has increased, solutions for keeping plastic waste out of the environment have failed to match the speed of its manufacture. Only 9% of plastics that have been produced since 1950 have been recycled; the remainder has been lost to incineration, landfill, or littering the environment.

Plastics will be needed to play a role in a low carbon economy through their ability to reduce the weight ("light-weight") of automobiles, material demand, and reduce food waste, but their reliance on petroleum for production and lack of end-of-life recovery options also pose a significant risk to environmental and human health. Finding ways to leverage the value of plastics while addressing leakage into the environment will be essential to realizing their value.

Although the U.S. trails Asia in terms of cumulative plastic production, the U.S. is one of the largest per capita users of plastics in the world.[2] It is also home to some of the largest plastics manufacturing companies and has one of the more robust waste management systems. If designed right, the U.S. could leverage its reputation to create an ecosystem of innovation that advances the promises of plastics while mitigating their shortfalls. If it prioritizes reducing or eliminating plastic waste, the U.S. is positioned to leverage its competitive advantage toward advancing a sustainable plastics system.

This report is the result of three roundtables with a total of nearly 60 stakeholders from all aspects of the plastics value chain.[3] By sharing their perspectives of what the sustainable plastics landscape looks like in the U.S., we can develop further insights on how to develop the ecosystem for innovation and investment to help the U.S. retain competitiveness in this important space.



We begin by outlining the plastic waste ecosystem and then discuss how innovations are driving solutions. Throughout, we argue that the private sector plays a major role in investing in and driving innovations for plastic waste, recycling technologies, and the circular economy. From small innovators focusing on developing specific technologies to large corporations looking to solve systemic plastic waste challenges, a multitude of ongoing efforts exist.

We provide data and learnings from those roundtables, as well as case studies from roundtable participants and plastics innovators who have found creative ways to overcome the challenges of plastic sustainability. In addition to the case studies included in this paper, we have provided a list of companies working to advance innovations to create a sustainable plastics economy.

These findings illustrate the potential value we found in what a private sector-led plastics innovation marketplace can bring. A marketplace can serve as an information hub by curating a list of plastic waste solution efforts that are past the development stage across industries, processes, and types. Potential funders can learn more about what innovations are available and investigate potential impacts of an investment across the plastics waste industry. In return, those innovators have an opportunity to be seen by a wider set of potential investors, can scale their work by identifying gaps in the market, and learn about best practices.

Understanding Plastics

Plastics are a wide range of synthetic or semi-synthetic materials that use long-chain compounds (polymers) as a main ingredient. Their flexibility makes it possible for them to be shaped as needed, providing for their wide use in multiple applications. Plastics are typically broken out into three uses:[4]

- **Commodity thermoplastics** are polymers that are softened by heat and hardened by cooling in their final state as a finished product. They can be resoftened to their original condition by heat, allowing them to be recycled. Polyethylene (PE), Polypropylene (PP), Polystyrene (PS), and Polyvinyl Chloride (PVC) are the most common.

- **Thermoset plastics** are polymers that in their final state as a finished product cannot be resoftened or recycled by heat. Thermosets are primarily used in building and construction, transportation, appliances, adhesives, and inks/coating. The most popular resins for thermosets are polyurethane (PUT), melamine (MF), and epoxy, among others.

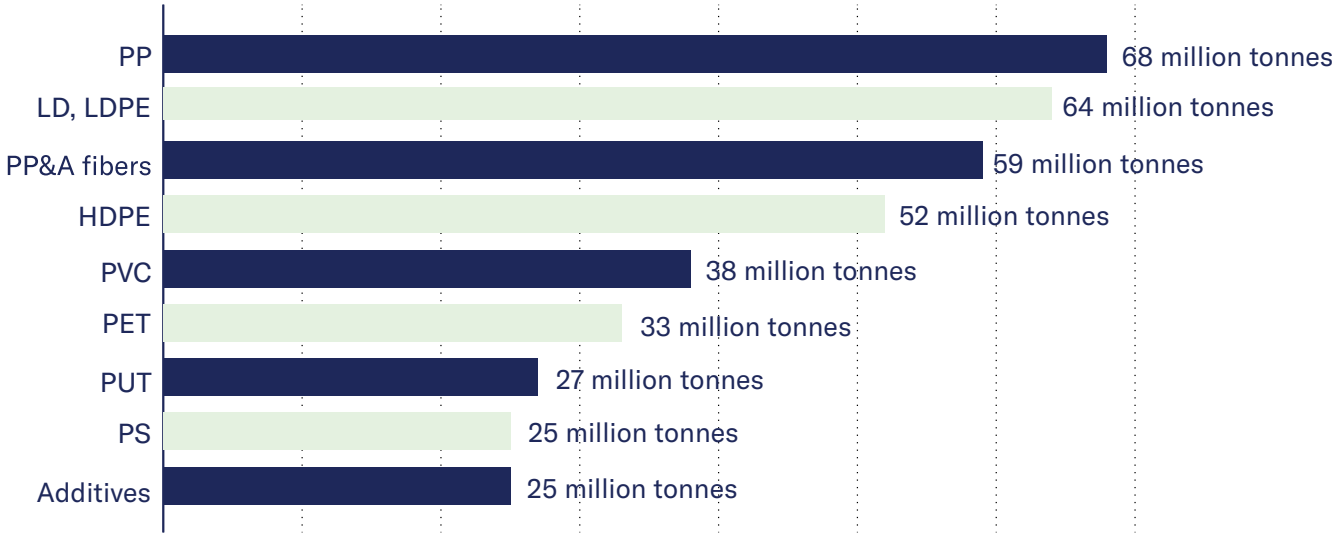
- **Engineering plastics** have high-performance mechanical, thermal, electrical, and chemical properties and are often used in applications to replace metals. These are typically found in automotive, electrical/electronic, and consumer markets and include polycarbonates (PC), fluoropolymers, acetal, and other resins.

Because plastics have become so ubiquitous, it is important that society treats them not simply as a type of material to manage but as a complex ecosystem of polymers that interact across a wide life cycle of supply chain partners, industries, and chemical properties that will demand multiple solutions and strategies to tackle.

To reflect the diversity of plastics and to understand how we should engage in dialogues with plastics stakeholders, we began by analyzing plastics by resin type, industry demand, and waste generation. This data can educate us on where the most effective intervention points are, what the future might hold, and who can be most effective in interceding to advance solutions. We believe these data points offer more insights than simply tackling the plastics problem writ large.

Figure 1: Primary Plastic Production by Polymer Type, 2015[5]

Global primary plastic production by polymer type, measured in tonnes per year. Polymer types are as follows: LDPE (Low-density polyethylene); HDPE (High-density polyethylene); PP (Polypropylene); PS (Polystyrene); PVC (Polyvinyl chloride); PET (Polyethylene terephthalate); PUT (Polyurethanes); and PP&A fibres (Polyester, polyamide, and acrylic fibres).

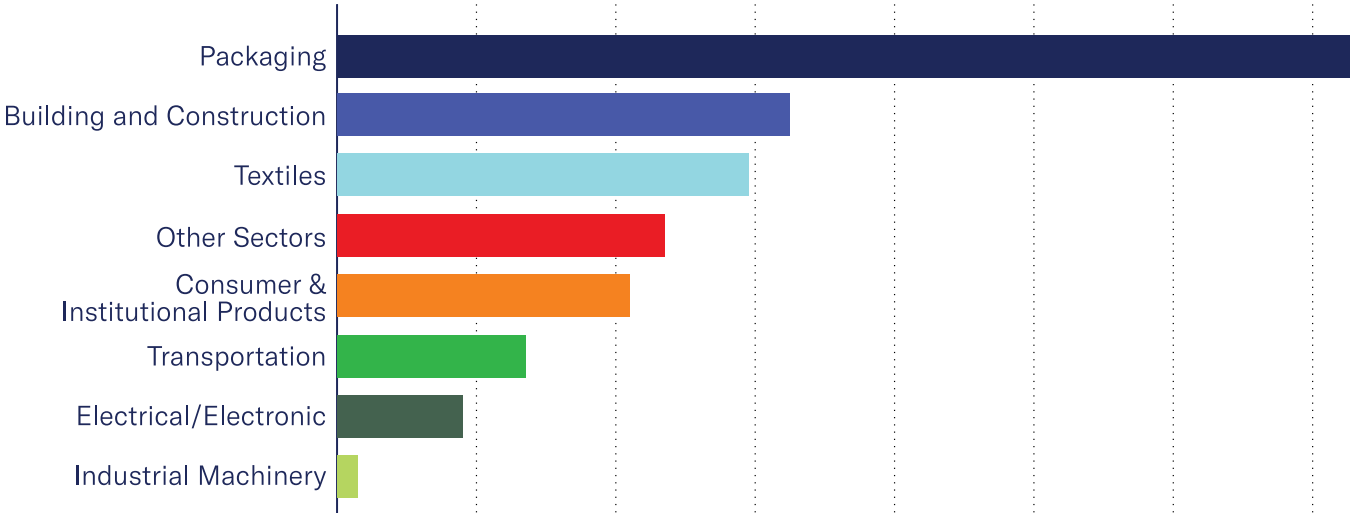


Although Figure 1: Primary Plastic Production by Polymer Type is based on global and not U.S. production, the trends are still indicative of where the U.S. can focus. This data indicates that commodity thermoplastics, particularly PP and PE, make up a majority of produced polymers.

Recognizing what goods use these resins can identify the sectors and products that would benefit from a deeper focus. Figure 2: Primary Plastic Production by Industrial Sector, 2015 shows the amount of plastics production that goes towards each industry. Packaging uses the greatest amount of singular plastic, followed by building and construction and textiles—namely clothing, carpets, and fabric.

Figure 2: Primary Plastic Production by Industrial Sector, 2015[6]

Primary global plastic production by industrial sector allocation, measured in tonnes per year.



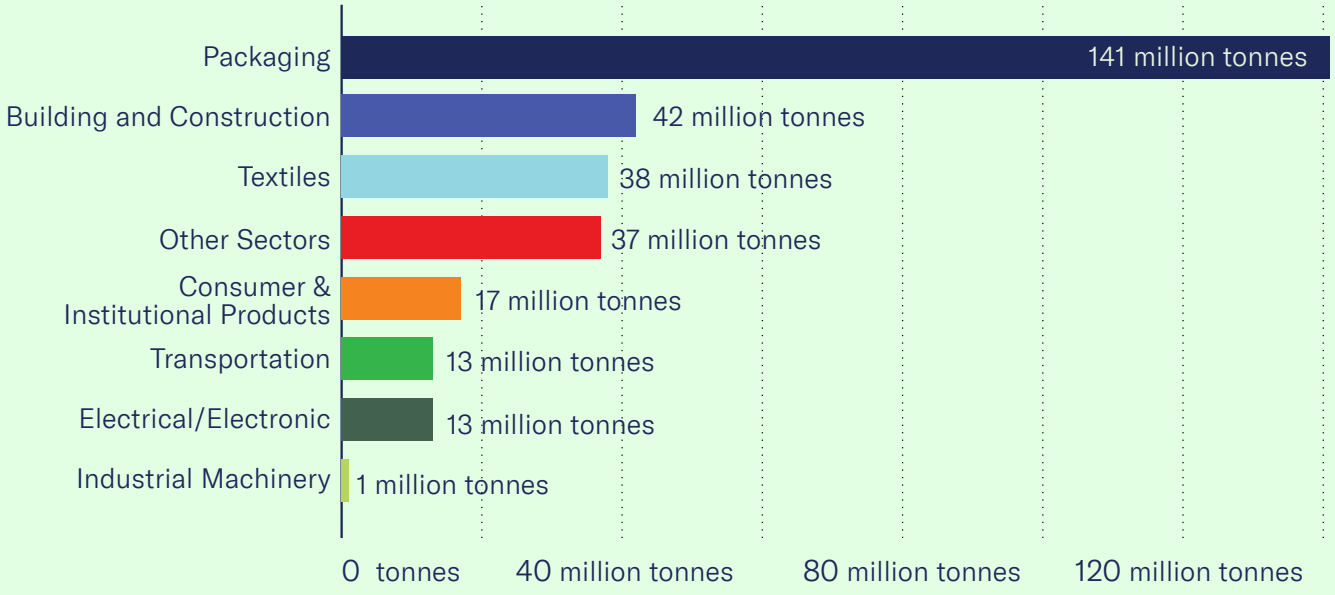
To date, much of the global attention on plastics has emphasized the impact of single-use plastics; much less attention has been given to plastics used in building and construction or textiles.

The last aspect of the sustainable plastics ecosystem to address is to determine the industrial sectors that contribute the most to plastic waste.

Figure 3: Plastic Waste Generation by Industrial Sector, 2015 presents distinctions between plastic usage and plastic waste. Although building and construction was the second-largest user of plastics, that sector's impact significantly drops when measuring waste generation, indicating that the durability and use of these products result in less waste than those of packaging, textiles, and other consumer products. We conclude that plastic products that rank high in waste generation are predominately fast-moving consumer goods.

Figure 3: Plastic Waste Generation by industrial sector, 2015[7]

Global plastic waste generation by industrial sector, measured in tonnes per year.



In a 2021 report, Closed Loop Partners states that:

The plastic waste crisis has been defined in the public and policy discourse as created by single-use plastics. Yet two-thirds of plastics put into use in the U.S. today are used for purposes other than single-use packaging.[8]

Despite plastics' significant prevalence in industry, data on its impact in many sectors is hard to find. However, based on available data, a focus on thermoplastics and consumer goods would have the greatest cumulative impact on advancing sustainable plastics.

Packaging Trends

Plastic packaging represents an estimated 26% of all plastics use—making it the largest user of plastics of all sectors.[9]

Packaging (not just plastics) is currently the largest material collected in U.S. waste streams. Plastics alone represent 12.2% of landfilled waste, making it the third greatest material in U.S. landfills behind paper and food waste, respectively.[10]

An estimated 32% of plastics packaging escapes collection and is littered into our environment.[11] This makes plastic packaging items 7 of the top 10 items most frequently found in beach clean-ups.[12]

Textiles Trends

In the first two decades of the 21st century, the volume of textiles sent to landfill has doubled.[13] This aligns with a doubling in global clothing production since 2000 due to the rise of fast fashion.[14]

The World Resources Institute points out that the average consumer bought 60% more clothing in 2014 than in 2000 but kept these articles for only half as long.[15] Additionally, textiles have been identified as a major contributor to ocean plastics as a result of fiber shedding during standard washing processes.[16]

Evaluating Intervention Points

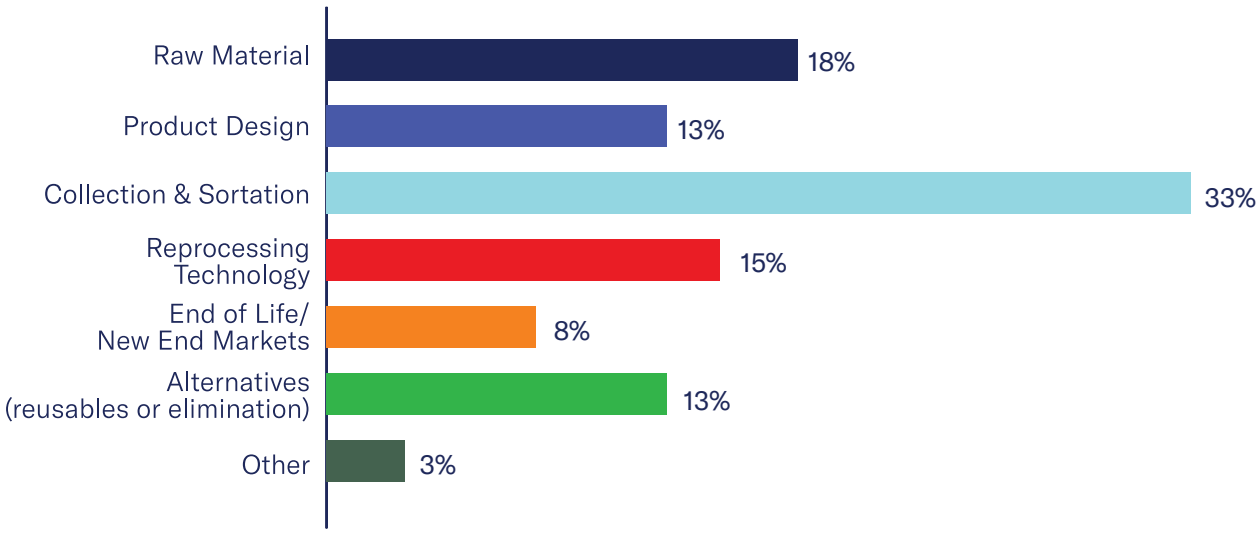
Throughout fall 2021, the Chamber Foundation hosted a series of virtual roundtables with stakeholders across the plastics value chain. Representatives from the plastics packaging, textiles, automotive, and durable goods industries were invited. A total of 54 stakeholders met across three roundtables to share their experiences and opinions on the state of investment and innovation for advancing sustainable plastics in the U.S.[17]

In addition to sharing their knowledge, participants engaged in a polling exercise to provide some sense of the trends on where interventions to advance sustainable plastics could be most effective.

Many participants noted that given the wide breadth of plastics already in our environment, it is necessary to focus on recycling and reuse of these materials, both to capture material in our environment and to recognize the challenges inherent in transitioning existing manufacturing systems toward new and emerging materials.

Many of the end market innovators at the roundtables said that they secured used plastics not from consumer collection systems but, instead, from collaborative relationships with companies that were supplying post-industrial plastics—further indicating that there is a gap between the plastics the industry is collecting curbside and what is being used in innovation.

Figure 5: Roundtable Poll: Where in the Value Chain is Innovation Most Needed to Advance Sustainable/Circular Plastics?



It was widely noted that once a more efficient and complete sorting mechanism for used plastics could be operational, then more reuse solutions would follow. Currently, though, challenges with contamination remain a huge barrier for effective recycling and reuse.

All these challenges support why many of our participants indicated the value in investing in collection and sortation technologies as key to advancing a sustainable plastic system.

We asked the roundtable participants the source they thought most responsible for current investment in advancing sustainable plastics.

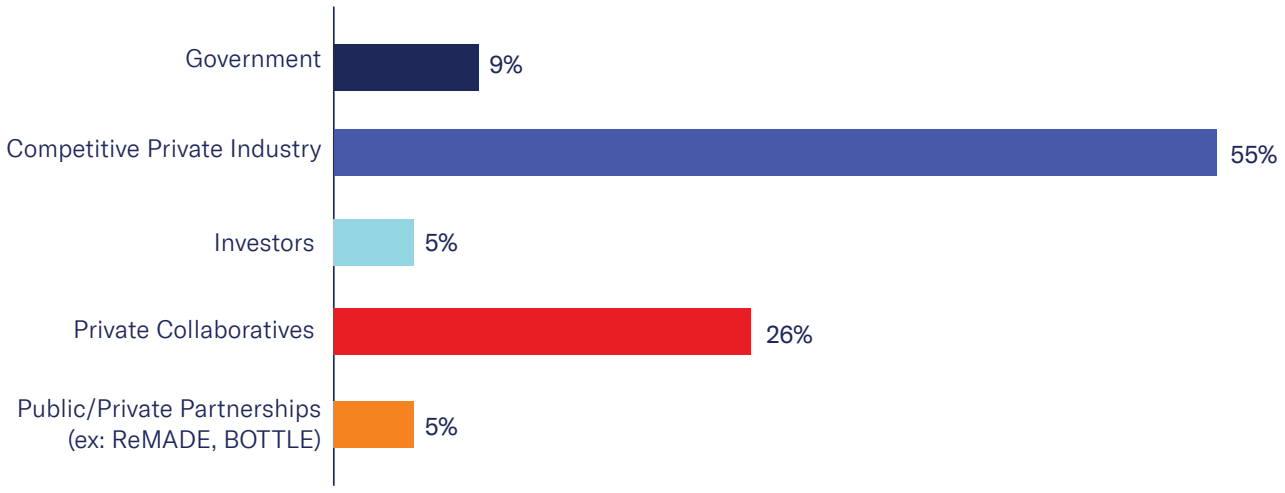
Overwhelmingly, the participants indicated that investment in sustainable plastics came predominately from companies already involved in the plastics value chain that saw these investments as providing a competitive advantage and risk mitigation strategy. These companies were seen as the primary drivers of investment into plastics R&D; followed by collaborative efforts to fund third parties to address broad plastic waste issues.[18]

While government investment in sustainable plastics has significantly increased over the past decade, neither the entrepreneurs or corporate innovators in our roundtables felt that government efforts were a key driver, or at least played a significant role, in their efforts to accelerate plastics development.

We theorize this reflects the nature of traditional government investment—one that focused more on early-stage research through agreements with research universities and institutions. As research at these organizations advances, we anticipate that the impact of these government-led early-stage programs may increase.

While traditional investment and capital funders have shown a greater interest in a company's environmental impact in the last few years, the roundtable participants agreed that this type of investment funding was not common among sustainable plastic innovations. We will discuss some potential reasons for this further in the following section.

Figure 6: Roundtable Poll: In Your Opinion, Where is the Greatest Source of Funding for Sustainable/Circular Plastics coming from?



Defining Sustainable Plastics: Transitional and Disruptive Opportunities Needed

During our roundtables, we intentionally avoided defining the terms "sustainability" and "circularity" because we wanted to understand the participants' perspectives on how they viewed these terms applied in the context of the plastics value chain. While our goal was not to settle on a definition *per se*, we discovered some insights that were valuable in helping define how society should approach a strategy to advance sustainable plastics.

Sustainable Systems Are Complex

Most participants agreed that a sustainable plastics system requires redirecting polymers toward their highest and best use. This did not necessarily mean repetitive reuse from one product back into the same product but, ensuring that when polymers are used that they offer significant value and decreased environmental and social impact across their entire life cycle.

Participants shared examples of how plastics could reduce food waste, lower product damage, and provide lifesaving benefits over and above what some alternatives could offer despite plastics' limited end-of-life benefits. Participants said that they needed improved analytical tools to evaluate highest and best use.[19]

Another point roundtable participants made was that the innovations in existence today may not be the solutions the industry needs in the future. As innovations advance, stakeholders must also adapt. A recent study by Google states that based on today's existing solutions, five strategic interventions will have the greatest impact on reducing plastics.[20] Two of them—chemical and mechanical recycling—focus on recovery, while the other interventions focus on reduction. Despite these available solutions, Google says that 42% of plastics will still be wasted.[21] An on-going viable marketplace can help highlight, accelerate, and fund some of those not-yet available solutions.

At the same time, society must start now to explore the next iteration of innovations to help reduce plastics in the environment.

Case Study

HydroBlox—Evaluating Impact When You Offer Multiple Benefits

Using mechanical recycling technologies, Hydroblox utilizes waste mixed plastics and other hard to recycle plastic products to create stormwater drainage, filtering, and green roof systems.

Stormwater management is an environmental approach to ensure that runoff from rains, snow, and flooding can be redirected back into soil for reuse. Failure to adequately capture water can create the accumulation of particles, chemicals, and other debris present in our communities, which eventually enter our waterways and streams increasing environmental impact. Many countries regulate strategies for stormwater management.

By developing a technology that permits water to flow freely through its system without the use of aggregates, geotextiles, or down sloping, Hydroblox reduces cumulative material demand and simplifies the installation process. Hyrdroblox has been proven stronger and more durable than traditional plastic piping, and recent innovation with biochar is helping their technology turn collected water into cleaner water than when it first entered the system.

The multiple benefits from Hydroblox illustrate the challenge many of the respondents noted in defining circularity or sustainability. From a traditional waste management perspective, Hydroblox is seen as downcycling since it takes plastic waste and turns it into a product that can be reused once.

However, when we look at the additional value it offers in terms of water management and creating a solution for plastics that do not already have one, the product's value far exceeds that of using raw inputs. As HydroBlox founder Ed Grieser says, "Trying to explain the value of my product to investors and partners has always been a challenge because there are no easy ways to quantify the value of these dual solutions. I am not really a plastics solution in so much as I'm primarily a product for stormwater management."

Multiple Strategies Are Needed

There was overwhelming agreement among the participants that there was no single solution that would resolve concerns around plastics. Rather, they said that with multiple different resins, sectoral uses, and supply chain players involved, a toolbox of approaches would be required. It was noted, for example, that compostable plastics are effective when paired with food waste serving as a vessel to transport nutrient rich food waste toward reuse as compost, or that reusables could offer value in some cases but may not be a solution for all plastics. These examples indicate the complexities behind plastic use and how the actors must understand the full scope of the impacts across a value chain rather than simply emphasize one or two attributes.

Some of the participants also said that solutions to reuse or recycle plastics could vary depending on the desired end product or process. Most participants felt that at this stage in sustainability efforts, it was more important to increase the demand for recycled content rather than focusing solely on true circularity by returning a used product to its original form.

For instance, plastic PET bottles can be recycled back into textiles, a bottle, piping, or plastic lumber. The recycled content quality requirements for these end markets would differ based on the various product needs. In some cases, having different end markets would not only increase the value of these materials overall but would provide different streams through which materials could be best directed based on available quality. This approach could reduce the overall environmental impact by demanding less processing and increased reuse opportunities.

No matter where these either incremental or disruptive technologies came from, participants added that there needed to be a market ecosystem in place to facilitate industry's quest for circularity, that there is value in both incremental and disruptive technologies, and both would be necessary to find plastic waste solutions

Sustainable Plastics Requires All of Us

The roundtable participants noted that while the terms sustainability and circularity are widely understood, there is a lack of understanding among consumers, on how they can contribute to advancing solutions towards either.

Participants said that finding ways to communicate to consumers the value of recycling and recycling correctly to reduce contamination would have a significant impact on improving the quality of feedstock for recycled content. In addition, as consumers' awareness of the value of recycling expanded, their engagement in advocating for recycled content could have a significant effect in driving increased demand. It is also important to highlight that US EPA received funding in the new bipartisan infrastructure law that will help address public awareness.

A few participants said that caution is needed so that consumers do not see recycling as the only path toward circularity and their engagement to advocate for reuse systems, decrease their consumption, and evaluate their own choices could play a significant role in reducing plastics and overall environmental impacts like climate emissions.

Communicating opportunities for investors was another area where the participants felt intervention could be warranted. Instead of focusing on eliminating or eradicating plastics any and everywhere, having a private-sector led comprehensive market for innovations that reduced or reused plastics more efficiently could drive increased interest in investment and focus resources on promising technologies. Creating a standardized market that potential investors and other stakeholders could compare and evaluate plastics innovations would be a good start to broadening the scope of what type of "good" plastic innovations can make that are not solely working on eliminating plastic as a commodity. Metrics that make those comparisons and evaluations easier is also an emerging area that the Platform for Accelerating the Circular Economy is seeking to identify. Among molecular/chemical recycling systems particularly, Closed Loop Partners has a model in place to help investigate and evaluate these types of innovations.[23]

Promoting educational efforts that define a circular system, and how consumers and investors can be active participants, was an initiative that many at the roundtables felt could have significant impact but was frequently overlooked and undervalued.

Case Study

AMP Robotics—Collaborative Partnerships to Improve Design and Recyling Quality

AMP Robotics offers advanced AI and robotics technologies for recycling facilities. By applying automation over hard-to-secure manual labor, the company can increase productivity, efficiency, and quality—improving both costs and revenues for those leveraging its technology.

A case study for a recycler customer demonstrated that AMP's technology doubled the amount of PET bottles recovered and removed up to 90% of contamination across the reclaimer's different lines. This type of technology could have a significant impact on increasing volumes of recycled feedstock and improving its value. Additionally, it creates the opportunity for curated bales of recyclables that could help direct materials for specific reuse opportunities.

The company's artificial intelligence (AI) platform powers its automation solutions for recycling, providing greater visibility into the material stream. The AI platform that guides AMP's systems can differentiate objects found in the waste stream by color, size, shape, opacity, brand, and more; contextualizing and storing information about each item it perceives.

AMP's AI unlocks opportunities beyond sortation. The company has leveraged this technology to help brands and packaging producers analyze how their packaging moves through the recycling system. Better data supports producer initiatives to increase recycling rates and create new value streams for recyclables, ultimately aiding their pursuit of recycled content goals. Data collection, measurement, and material characterization for recycling also create a mechanism to support federal, state, and local government programs focused on landfill diversion goals and recycled content standards to advance a more circular economy.

The Value in Complex Collaboration

The roundtable participants mentioned that while there are efforts between market competitors to collaborate on plastic waste through groups like the Alliance to End Plastic Waste, there is a need to break down silos and collaborate among different industries and between public and private enterprises. Particularly for those participants working in chemical recycling, collaboration would be necessary to create the scale and quantities needed to operate the facilities efficiently would likely require more inputs than what one sector alone could provide.

Participants recommended that the industry needs to create a way for lessons to be drawn from failures as well as successes and that insights drawn from one industry could support insights from others. For example, both packaging and textiles are leveraging digital watermarking and advanced intelligence technologies to improve sortation and supply chain efforts. Cross-sectoral lessons could help reduce the learning curve of these efforts, as well as accelerate their adoption.

For example, both packaging and textiles are leveraging digital watermarking and advanced intelligence technologies to improve sortation and supply chain efforts. Cross-sectoral lessons that are shared collaboratively or leveraged through a marketplace could help reduce the learning curve of these efforts, as well as accelerate their adoption and investment in them.

Bridges Are Needed to Avoid the "Valley of Death"

Several innovators said that while there has been an influx of support from incubators in the last decade, retaining their support as they moved beyond a successful pilot toward commercial scale was the hardest phase in their journey. Moreover, those who required capital-intensive infrastructure to scale faced additional challenges as the high risk, long return on investment was a deterrent to many traditional investors.

For some solutions, such as reusables or chemical recycling, their environmental value will only come from obtaining sufficient scale. There is a need to collaborate with multiple industries and competitors. In addition, those solutions would require funding to support this important period of growth just beyond their startup phase.

For example, the market for reusable coffee cups would depend on the consumer being able to take a coffee to-go and return it to a different location. Collaboration between restaurants and delivery services, for example, might be needed to help leverage reusable food containers.

Collaborations like those are easier to form in a marketplace where innovations can be funded in tandem by private sectors partners who can also exchange extensive market knowledge and relationships between industries they are operating in. The valley of death that occurs between piloting and scaling can be avoided by making it easier for investors to learn more feasible and fundable solutions.

Equally important, however, is consumer adoption to these types of changes. In addition to building the network to support reusables, any solution would need to include educational collateral to effectively inform consumers. Completing a successful educational campaign can easily push an initiative past the traditional 5–10 year investment we see in most venture capital deals.

Case Study

Novoloop—Creative Financing

The Chamber Foundation found that plastics innovators are commercializing new materials by developing partnerships with existing supply chain players to secure buyers of their material in advance of scaling. These partnerships help brands secure sustainable sources and accelerate the development of upcycled materials. Whereas for the technology developers, advance funding and having customer commitment up front helps them plan to scale and make necessary investments for success.

Novoloop Inc. and Bemis Associates Inc. are examples of these types of advance sourcing agreements that we discovered were essential to new materials adoption and perhaps which point out why customer investment is seen as the key driver for innovation.

Novoloop is a venture-backed company in California that is commercializing a novel process technology to turn polyethylene plastics from municipal waste into high-performance materials for everyday products. Novoloop and Bemis are engaged in a joint development agreement (JDA) to produce a sustainable seam tape product. Seam tape is the go-to waterproofing solution for textiles as it protects the integrity of weather worthy gear, including cold weather and rain gear. Bemis has been interested in a sustainable seam tape that exhibits the same performance as petrochemical materials, a new technology brought through the collaboration between Novoloop and Bemis. Bemis has, in turn, helped Novoloop accelerate its development by providing critical feedback to streamline product development, pricing strategy, and commercialization.

Many of the entrepreneurs we spoke to said they were not finding growth through traditional venture capital investment or the process of acquisition, but rather from corporate agreements to purchase products in advance of production. These advanced commitments serve to de-risk investments into much-needed capital expenditures.

Realizing some of the challenges our roundtable participants were facing, Chamber Foundation staff drew a comparison between where sustainable plastics investment and innovation is today to where cleantech was a decade ago. Cleantech is the term that encompasses the investment into energy technologies that reduce environmental impacts. Solar, water, and wind energy, as well as software to drive efficiencies are all examples of cleantech.

Both cleantech and sustainable plastics promise significant environmental benefits if solutions can be found, but both also require high capital investment, innovation into new designs, and disruptive technologies. Both tend to have longer-term investment time frames as well.

Lessons From Cleantech

The cleantech industry has gone through two investment booms and busts since the beginning of 2000 and is currently experiencing a new resurgence in investment as a result of new models created from analyzing the sector's past failures.

A 2016 study by MIT identified the key factors contributing to cleantech's past failures as the significant capital, long development timelines, and uncompetitive commodity markets, resulting in lower returns-on-investment that were not conducive to the typical VC investment framework of 5–10 year turnarounds.[22] Innovations that struggled the most were technologies that pioneered new materials or processes—necessary innovations to disrupt an established industry.

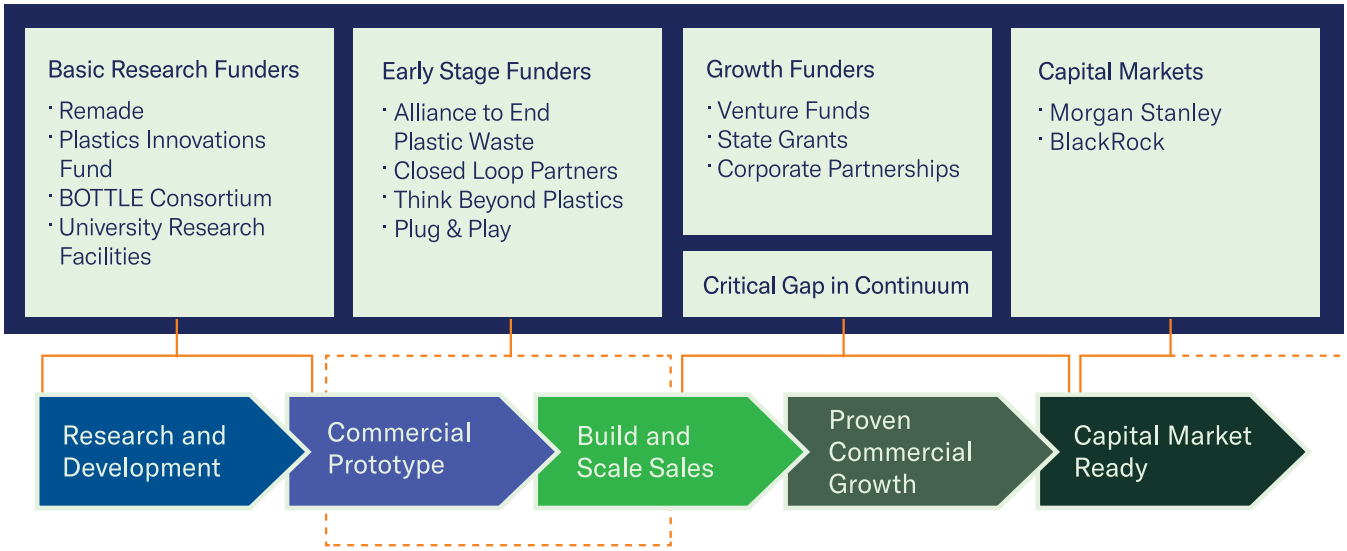
Furthermore, once an innovation had proven itself in the pilot phase, but where more investment was needed to scale, there was a lack of interest by corporations to acquire technology. An important missing aspect of cleantech development was the presence of a market where corporate investors could investigate cleantech options to invest in without necessarily purchasing them. On the other hand, in the biotech space, there was a longer history and background of investment, investigation, and acquisition by larger pharmaceutical firms, which helped small innovators survive through the "valley of death."

When extrapolating these findings to the feedback we received from our roundtables, moving toward sustainable plastics faces many similar challenges. To advance sustainable plastics, society needs innovators to create new materials or new systems to encourage reuse, mechanical and chemical recycling, and/or composting. New materials or product design may require redesigns of product filling lines or other manufacturing technologies. These require significant investments in capital and tolerance for long time frames.[23]

Drawing from cleantech's experiences, we theorize that to promote sustainable plastics, the industry may need a marketplace to bring together a more diverse set of actors and innovation models than what is currently available.

Figure 7 shows the Financing Continuum for sustainable plastics—demonstrating that the greatest risk area for innovators is between their initial attempt to scale and getting ready for traditional capital markets. This is where long- term investments to realize scale and high requirements for capital are required.

Figure 7: Sustainable Plastics Financing Continuum



Cleantech's new attempt at expansion has begun to address the challenge of finding growth funders by creating new models to replace traditional VC funding. There are not many initiatives that focus on American innovations that leverage federal efforts to accelerate advances, especially on programs outside of packaging efforts. However, one organization, Breakthrough Energy Ventures, has mobilized massive enabling investment into clean technologies that typically take 20 years or more to scale. Additionally, they have pledged $1.5 billion from the fund to partner with federal initiatives to advance R&D in this space.

Identifying ways to better diversify growth funders or support further corporate acquisitions may be a much-needed strategy to ensure that promising technologies are not lost.

Enabling Policy

All the participants said that success in advancing a system for sustainable plastics was reliant on complementary policies and practices, and markets to support innovation and investment.

When it comes to plastics, much of the public's attention concentrates on packaging. Our roundtable participants recognized that any programs or policies that deal with packaging waste would depend on how the system was designed. Would it emphasize R&D and investment into promising technologies? Is there a way packaging waste protocols could be designed to recognize the benefits of reusables but also the cost of their eventual recovery? Finally, in agreement with the first two figures in this paper, the participants said that packaging is not the only source of plastics. So how could the industry invest in private sector-led systems for other plastic value chains, such as textiles, durable plastic, and others that both require their own investment but may also benefit from systems developed for packaging?

There was also interest in finding ways to support R&D and innovation tax credits as well as how policy could create incentives for larger firms to invest in or acquire startups to close that gap between concept and full-scale commerciality.

Additionally, the participants mentioned that solutions like recycling, composting, and reuse would not be successful unless accompanying policy provided the necessary regulatory and financial incentives to see these systems grow. This was a key concern for those working with bioplastics who saw great promise but few opportunities for domestic facilities to process their material at end of life.

A number of initiatives announced through the US EPA's National Recycling Strategy may be worth exploring if extended to support sustainable plastics directly. We contend that designing a private sector-led framework to support circular systems will create opportunities for plastics innovators to create products and processes that reduce raw material demand, emissions, and other environmental impacts.

Thoughts and Next Steps

After meeting with participants in the plastics value chain to understand the opportunities and challenges they face in advancing solutions to create a more sustainable plastics system; we believe that there is tremendous innovation and opportunity happening to promote the promise of sustainable plastics. To achieve that promise, however, society must advance a dialogue that is more inclusive of the plastics value chain and the various sectors involved. Engaging investors, government, and industry to share lessons learned would have a significant impact on closing the gap and implementing evidence-based solutions.

We believe that some of the most effective strategies to strengthen a sustainable plastics value chain include:

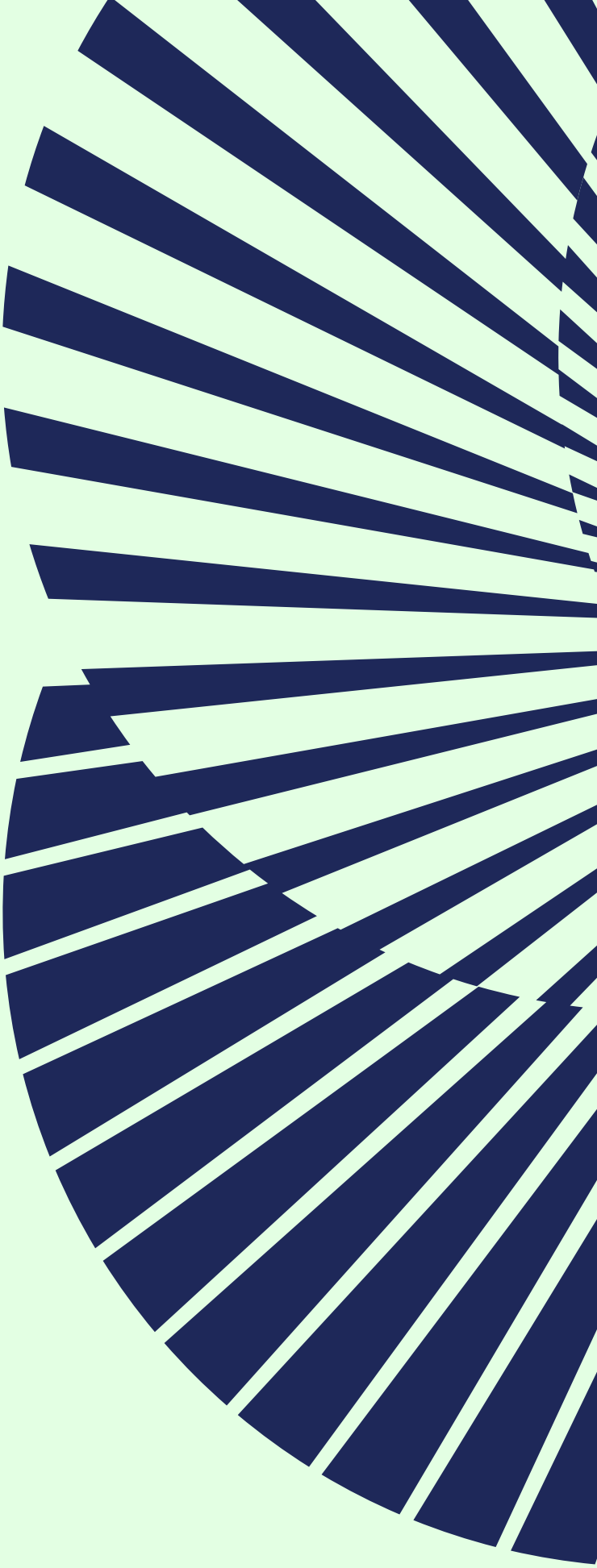
- directing limited resources toward solutions that can address high-volume plastics;
- exploring ways actors can collect and sort multiple end products made from similar resins--textiles, clothing, and packaging; and
- identifying innovative financing models that support longer-term investment time frames; and
- securing additional investment in areas that are particularly under-invested, including textiles and durable goods as well as collection and sortation systems.

While the trends indicate the need to focus on plastic use in fast-moving consumer goods, the industry must remain cognizant that this encompasses much more than just single-use plastic packaging. The pandemic highlighted the challenges in arbitrarily focusing on one solution over another, especially related to single-use items. Finding ways to create a framework to support innovation for all plastics, particularly those related to consumer goods, could significantly support efforts to scale solutions, decrease costs, and increase impact.

Our findings indicate that there would be value in creating a strategy for plastics that incorporates multiple sectors, rather than just one or two industries. That strategy could be incorporated into a private-sector led market that would allow solutions across industries and across plastic streams to be compared among and between each other. Corporations and other non-government and non-academic investors could, by working together, ensure that effective plastic solutions across all types have an opportunity to thrive. Over or undercrowding in any given sector would be much less likely if the supply and demand of all opportunities was represented in an efficient market, all while ensuring that the interactivity of processing, design, and collection of plastic materials could be properly mapped.

The challenges the plastics industry faces in advancing innovation and attracting investment are not unique. Society should take lessons from other sectors facing similar challenges in scaling (biotech) and urgency (cleantech) to work collectively to design a framework to address these challenges.

Finally, in tackling sustainable plastics, it must be considered where the industry is today and what it will look like in the future. Where will growth occur? What are the best opportunities? Where are the opportunities for greatest impact? As the 2021 Google study has demonstrated, without a significant shift to our current plastics trajectory, innovations in the pipeline today will not be sufficient to address the scale of solutions needed to reduce the negative externalities of plastics. The business community agrees that plastic waste does not belong in the environment. Society requires more innovation, more investment, and more collaboration to bring us to a zero plastic-waste future.



Endnotes

1 Our World in Data (2018) Plastics Pollution.

2 Plastics Europe (2020) Plastics—The Facts: Distribution of Global Plastics Production.

3 These included raw material suppliers, converters, brands, and waste management organizations. We also included academics, trades, nonprofits, foundations, and investment/incubators.

4 American Chemistry Council (ACC) (2013) Plastic Resins in the United States.

5 Figure recreated from data from Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science Advances, 3(7), e1700782.

6 Ibid.

7 Ibid.

8 Closed Loop Partners (2021) Transitioning to a Circular System for Plastics.

9 Ellen Macarthur Foundation (EMF) (2017) The New Plastics Economy: Rethinking the Future of Plastics & Catalysing Action

10 US Environmental Protection Agency (EPA) (2018) SMM Facts and Figures.

11 Ibid.

12 Ocean Conservancy (2020) The International Costal Clean Up 2021 Report: We Clean On.

13 US EPA (2018) SMM Facts and Figures.

14 EMF (2017) A New Textiles Economy: Redesigning Fashion's Future.
Fast fashion is defined as inexpensive clothing produced rapidly by mass-market retailers in response to the latest trends.

15 World Resources Institute (WRI) (2017) Apparel Industry's Environmental Impact in Six Graphics.

16 EMF (2017) A New Textiles Economy: Redesigning Fashion's Future.

17 While we sought to diversify those in attendance, the majority of those who responded to our invitation fairly represented the packaging value chain. Unfortunately, we had no attendees from the textiles or automotive industries. Considering the size and demand for plastics, as well as the global focus on plastics packaging, our attendance trends are not surprising.

18 Examples include the Alliance to End Plastics Waste, Closed Loop Partners, and other specific initiatives such as A Circular Economy for Flexible Packaging (CEFLEX) or Materials Recovery for the Future.

19 A number of initiatives are trying to do just that, either through federal government research initiatives like REMADE and PIC or externally through initiatives like PACE.

20 Google (2021) Closing the Plastics Circularity Gap. Chemical Recycling will result in a 20% reduction, Mechanical Recycling will reduce plastics in the environment by 19%, Plastic Tax will have a 13% impact by encouraging material substitution, Inventory Management will reduce plastics by 5% through better planning, and Consumer Incentives, such as education and awareness, will reduce plastics by 1%.

21 Google (2021) Closing the Plastics Circularity Gap. Google further notes that the most effective strategy in its study—chemical recycling—has yet to scale and still requires significant investment to reach its potential by 2040.

22 Gaddy, Sivaram & O'Sullivan (2016) Venture Capital and Cleantech: The Wrong Model for Clean Energy Technology

23 Closed Loop notes that it takes on average 16 years for chemical recycling technology to advance from concept to commerciality.

24 Closed Loop Partners (2021) Transitioning to a Circular System for Plastics.

This report was prepared for the U.S. Chamber of Commerce Foundation by Sustainability and Circular Economy Fellow Kyla Fisher, in coordination with Peter Fadoul, Manager, Sustainability and Circular Economy Program at the U.S. Chamber of Commerce Foundation. For any questions, please contact cccsustainability@uschamber.com.