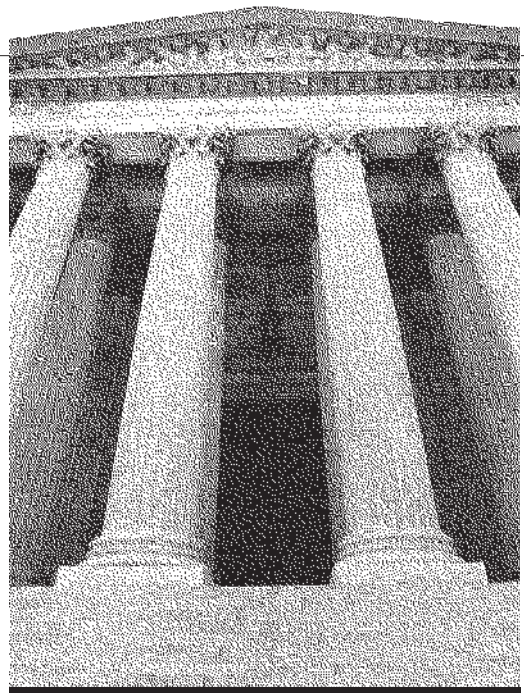

THE DEBATE

Can We Make Plastic Sustainable?

PLASTICS show up in almost every part of our economy, from medicine to transportation to water infrastructure. But the material's benefits have come at a great environmental cost. Each year, close to 10 million tons of plastic is released into the oceans. The United States, which produced more plastic waste than any other country in 2016, only recycles about 9 percent of its plastic. Meanwhile, plastic production is projected to double by 2040.

Recent efforts have called greater attention to this issue. In November, EPA released its first-ever National Recycling Strategy to address key hurdles in the domestic recycling system for plastics and other materials. The following month, a congressionally mandated report from the National Academies of Sciences, Engineering, and Medicine called for a national strategy to reduce ocean plastic waste.

Reducing plastic pollution will require lowering resource consumption and creating a closed loop system for recycling. It will also require plastics that aren't harmful to human and ecological health. Can we get there?

We ask experts from a range of backgrounds: Can we have the benefits offered by plastic without the harms to the environment and human health? What practices or policies should we prioritize to reduce plastic pollution? And how can abating plastic waste help address climate, sustainability, and environmental justice concerns?

"We need a national policy and research strategy designed to address all stages of the plastic lifecycle"

Margaret Spring
Chief Conservation and Science Officer
Monterey Bay Aquarium

"If we are successful in cleaning up our oceans, it will not be because we sorted our trash into the appropriately colored bins"

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Member of Congress (D-IL)
U.S. House of Representatives

"We can no longer ignore the damage of toxic chemicals used in plastics and emitted during manufacturing processes"

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"In any policy considerations, let's remember that using lightweight plastics typically helps drive down greenhouse gas emissions"

Joshua Baca
Vice President, Plastics
American Chemistry Council

"Plastics generate hazardous microplastics, so limiting production will be necessary"

Scott Coffin
Research Scientist
California State Water Resources Control Board

A National Strategy for Ocean Plastics

By Margaret Spring

THE 20th century invention of plastics has produced a 21st century deluge of plastic pollution. This global problem spans from increased production of the materials to their problematic disposal. From 2020 to 2021, I chaired a National Academies of Sciences, Engineering, and Medicine expert committee, charged by Congress—pursuant to the bipartisan Save Our Seas 2.0 Act and funded by the National Oceanic and Atmospheric Administration—to determine the U.S. role in global ocean plastic pollution.

Our committee concluded that the United States must substantially decrease our contribution to global plastic waste, including by producing less plastic. To do so, the nation needs a comprehensive federal policy and research strategy, with interventions at every stage of the plastic lifecycle.

This recommendation is supported by the report's findings, which showed the United States is a major contributor to global plastic pollution. In addition to being the largest generator of solid waste, in 2016, we were the top generator of plastic waste, responsible for about 42 million metric tons. While the United States has a strong waste management system relative to many countries, a 2020 study in *Science Advances* by Law, et. al, estimated that plastic solid waste still "leaks" from municipal solid waste at a rate of 1.13-2.24 MMT per year as of 2016. This places our nation as the third to twelfth largest contributor of plastic pollution in the coastal environment. These are likely conservative estimates, as the country lacks data to quantify plastic pollution from transportation, stormwater, and industrial discharges.

The United States also contributes to plastic pollution as a producer and exporter. In 2019, North America produced almost 20 percent of total global plastic, second to Asia, with U.S. production capacity projected to increase. Since the 1990s, U.S. exports of plastic products have been increasing, and we continue to export plastic waste.

This waste is also found across the country in lakes, rivers, in the air, and on land, harming both wildlife and people. The vast majority of plastics lost to the natural environment are persistent contaminants, because they do not readily biodegrade. Additionally, plastic debris can kill or injure wildlife that ingest or become entangled in it. We are learning more about the impacts of microplastics—small plastic particles that travel through air, water, and the food web—on ecosystems and human health. If the amount of plastic pollution continues to increase, these negative consequences will worsen.

There is no single solution, and current federal action is insufficient. We cannot continue to rely on an overwhelmed waste management system or highly inefficient efforts to clean up plastic waste in the marine environment. Nor can we recycle our way out of this growing problem. Today the United States recycles less than 9 percent of its plastic waste. There is limited demand for recycled materials, and current processes and infrastructure are grossly inadequate for the overwhelming volume and complexity of plastics discarded, typically after a brief use.

The path forward is a national systemic strategy designed to address all six stages of the plastic lifecycle:

1) reduce plastic production; 2) innovate in materials and product design; 3) produce less plastic waste; 4) upgrade waste, recycling, and composting programs and infrastructure; 5) increase capture of plastic waste before and after it enters the environment; and 6) decrease direct dumping of plastic waste into the ocean.

A national plastic waste reduction strategy will require high-level federal leadership and coordination. Existing laws and programs, including many at EPA and NOAA, can form the backbone, but the strategy must prioritize actions around all six intervention areas, set national goals, and fill knowledge and policy gaps. Federal leadership is critical to mobilize cross-sectoral collaboration and gather ideas from state and local policy laboratories, which have enacted innovative measures to reduce plastic waste.

Reducing plastic pollution provides co-benefits beyond decreasing waste. It supports innovation and economic opportunity and addresses unequal economic burdens. It also helps achieve U.S. and global climate goals—according to the UN Environment Programme, emissions from plastic production and waste generation are projected to account for at least 15 percent of the global carbon budget by 2050 if current practices continue. Cutting pollution also helps mitigate the disproportionate impacts of plastic production on BIPOC (Black, Indigenous, and people of color) communities, and advances justice.

The time to act is now, and momentum is building. Congress has demonstrated bipartisan support, government and multisector plans are under development, and global treaty discussions on plastic pollution are underway, with the United States finally at the table. We need a national strategy to support negotiations with G7 nations that already have plans of action. The European Union recently banned 10 single-use plastic products under its plastic strategy, and both the EU and Canada have embraced a circular economy approach to address climate change and plastic pollution.

If the United States takes leadership on ocean plastic waste now, Americans can benefit economically from innovation, help shape global design and production trends, and achieve an enormous environmental benefit for generations to come.

Margaret Spring is chief conservation and science officer at Monterey Bay Aquarium. She chaired the Committee on U.S. Contributions to Global Ocean Plastic Waste convened by the National Academies of Science, Engineering and Medicine.

We Need Policy Action, Not Recycling

By Mike Quigley

WE'RE drowning in plastic. It's quite literally everywhere—from our parks, to our oceans, to our bodies—but when we search for a life raft, we find hundreds of articles telling us how we can individually "reduce, reuse, and recycle" our way out of the 10 million tons of plastic entering our oceans each year. Corporations and systemic inertia have placed the onus of plastic waste on the consumer, when in reality little can be done by an individual without collective action.

The concept of reduction to curb plastic pollution seems simple: use less single-use plastic, and less will need to be processed or end up in the environment. It urges consumers to carry reusable water bottles and straws made of bamboo inside of their canvas shopping bags rather than relying on plastic water bottles, straws, and bags. According to the Container Recycling Institute, each shopper who replaces plastic water bottles with reusable ones saves anywhere between 300 to 1,460 containers from entering landfills or the ocean annually. As for plastic sacks, 100 billion bags pass through the hands of U.S. consumers every year.

Clearly, people's actions matter, but can individual action ever be enough? There is a tremendous amount of single-use plastic waste, and so many plastics that never touch the end consumer, that to claim that these actions alone can make an appreciable difference feels akin to deception.

So much of what is created today is not meant to last. From our clothes, to our electronics, to the cars we drive, our economy thrives on an unending desire for more. This trend of planned obsolescence leads to environmental consequences. We know that many plastics are harmful if used repeatedly, and some simply can't be reused in the conventional sense.

"Recycling" is a corporate innovation. The promise that plastic bottles would become shoes, fleeces, car parts, or anything else as long as consumers took the appropriate steps to get bottles to the recycling facility was always spurious. As far back as 1974, people within the plastic industry wrote that there was very little evidence that recycling would be economically viable. But when the oil industry continued to make more than $400 billion per year on plastic production, they chose not to go public with their findings. Instead, they continued with the knowledge that every piece of plastic would be more likely to end up in the ocean or a landfill than ever repurposed.

For years, the products we rigorously cleaned and sorted for recycling were actually bought by China at the rate 4-5 million tons per year. This continued until 2018, when China said it no longer wanted the material. Since then, municipalities have been saddled with millions of tons of plastic waste they have no ability to process. And with no market for plastic refuse, more and more of it has ended up where it doesn't belong.

The problems of climate change and plastic pollution have a lot in common: our choices as consumers, voters, and neighbors impact demand and public policy, but collective action is necessary to effectively address the crisis. As an elected lawmaker in a representative democracy, my job is to instigate that collective action. It is with this in mind that Congress has begun to propose solutions to the mounting and urgent problem of plastic pollution.

There are targeted solutions and there are broad solutions—both are necessary to fight a problem that threatens to spiral further out of control. Legislation like my Reducing Waste in National Parks Act is a solution for a specific set of circumstances that can make a small difference. This bill would ensure our treasured reserves do not become landfills by banning the sale of all single-use plastics in national parks where practical.

A great solution to the larger problem is the Break Free From Plastic Pollution Act, introduced by Senator Jeff Merkley (D-OR) and Representative Alan Lowenthal (D-CA). Drafted over many months with the perspective of both scientists and policymakers, this bill would revolutionize how we approach plastic waste by holding producers fiscally responsible for the collection and management of products after consumer use. This way, corporations could no longer place the onus squarely on consumers, but instead be required to find innovative ways to complete the lifecycles of their products. Collective action could also mean engaging in tax incentives for alternatives to plastic, known as "Clean Tax Cuts," which can drive up investment for, and drive down the cost barrier to, creative solutions.

If we are successful in cleaning up our oceans and passing a world that we can be proud of to future generations, it will not be because we correctly sorted our trash into the appropriately colored bins. Instead, it will mean that the collective force of our society succeeded in taking action through policy to protect our natural habitats and our environment. This is our responsibility and our moral obligation.

Mike Quigley is the U.S. representative for Illinois's 5th congressional district.

The Marriage of Toxic Chemicals and Plastic

By Boma Brown-West

LONG before plastic waste litters our land and waterways, it has already caused serious environmental and human health impacts because of its oft-ignored linkage to toxic chemicals. We cannot craft a sustainable future for plastic until we address the toxic chemicals emitted during plastic manufacturing and used in plastic products and packaging.

The problem starts early in the production process. Among all refineries and petrochemical facilities in the United States, the top 10 most polluting are ones that make chemical feedstocks for the plastics industry. Industrial plants that manufacture polymers and chemical additives that go into plastics emit large volumes of hazardous air pollutants. The carcinogen ethylene oxide, the most hazardous of these pollutants, is used to make many products, including plastic water bottles, and is emitted into the atmosphere in large volumes during production.

The people who live on the fenceline of petrochemical facilities—often low-wealth communities and communities of color—bear the brunt of these emissions. In the Houston Ship Channel, for example, some residents live within five kilometers of more than 40 petrochemical plants. These neighborhoods suffer from disproportionately higher rates of asthma, other respiratory illnesses, and cancer.

The plastic products we use every day, from toys to shampoo bottles, contain toxic chemicals too. For example, phthalates, which are ubiquitous because they enhance the flexibility of many types of plastic, increase the risk of endocrine, reproductive, and developmental disorders. They have been detected in the bodies of over 95 percent of Americans, according to the Centers for Disease Control and Prevention's National Health and Nutrition Examination Survey. Polybrominated diphenyl ethers were used for decades as flame retardants in many plastic-containing products like furniture and electronics. PBDEs are linked to health issues that include cancer and neurodevelopmental disorders.

Food is another source of exposure. Toxic chemicals in the packaging and handling equipment used at every stage of the food production system pose a risk to our health and the environment. For instance, phthalates migrate into dairy products not only from food packaging like plastic yogurt containers, but also from the tubing used when milking cows. According to EPA, contaminated food is responsible for more than 80 percent of our exposure to the endocrine disruptor perchlorate, in part because the chemical is used as an anti-static agent for dry-food plastic packaging in food facilities and stores. CDC studies indicate perchlorate is present in the body of every American.

Per- and poly-fluorinated alkyl substances, known as the "forever chemicals," persist in the environment for decades and are associated with health issues such as cancer, immune disorders, and developmental disorders. Virtually all Americans have PFAS in their bodies. Though often associated with paper packaging, these chemicals are a major part of plastic packaging production, present in hundreds of millions of polyethylene and polypropylene containers, including those used for food.

When we recycle plastic conventionally, these toxic chemicals remain. Chemical recycling will also not solve the problem, as the process returns plastic materials to a virgin-like state—before the typical downstream conversion and manufacturing steps when chemical additives would be introduced.

So where do we go from here? Within their jurisdictions, EPA and the Food and Drug Administration need to move faster at re-evaluating the safety of existing chemicals in commerce. New data exists on several ubiquitous chemicals in plastic, demonstrating their serious environmental and chronic health effects. It's time to follow the data and restrict or ban use of the most harmful chemicals. We also need our safety agencies to implement stronger mechanisms that ensure new chemicals don't produce similar or worse impacts.

To reduce harm to fenceline communities, we need EPA to close dangerous loopholes in the Clean Air Act that allow polluting facilities to operate without proper emission controls. State agencies also need to enforce company violations with more rigor and conduct more thorough permitting reviews, particularly when new facilities or expansions are planned near communities that are already surrounded by industrial plants.

Companies along the entire plastics supply chain—including oil companies, chemical manufacturers, converters and producers, brand manufacturers, and retailers—must acknowledge that toxic chemicals are part of their environmental impact. To improve, they must reduce their production, use, and emissions of toxic chemicals. The first step is identifying where toxic chemicals exist across their value chain—in their final products, upstream and final packaging, manufacturing processes, and, importantly, their supply chain.

If plastic is to play any role in a healthy and sustainable future, we can no longer ignore the damage of toxic chemicals used in products and emitted during manufacturing processes. We must determine, once and for all, if and how plastic can be decoupled from toxic chemicals.

Boma Brown-West is director of consumer health at Environmental Defense Fund.

Continually Improving Sustainability

By Joshua Baca

WE make plastics. Proudly. Our scientists and engineers create the essential materials that enable multiple industries to combat climate change. And we're focused on doing even better by reducing our carbon footprint in making—and remaking—these materials.

The ongoing evolution from metals, glass, and paper to plastics has raised questions about environmental impacts, in particular waste in our environment and climate effects. While most people agree that plastics make it possible to create better and safer lives, many also ask, "But what about the environment?" People want to know if we can retain the societal benefit of plastics *and* combat climate change, all the while keeping plastics out of our rivers and oceans.

As America's plastic makers, we believe we can. At the same time, we can also build on plastics' significant contributions to sustainability.

On our climate impacts, we're focused on tackling greenhouse gas emissions from plastic production. Overall, carbon emissions per pound of plastic produced have been dropping. On top of that, we're engaged in an all-of-the-above strategy to dramatically reduce or eliminate our carbon footprint. We have delivered on similar commitments in the past, including large reductions in hazardous air emissions from plastic facilities.

Most importantly, we're continually working on materials that enable carmakers, home builders, food manufacturers, aircraft makers, water suppliers, and low-carbon energy producers—a huge swath of our economy—to create solutions to drive down emissions.

The evolution to plastics is occurring in large part due to the efficiency of plastics as a material, which allows us to do more with less. Many industries are using plastic to help achieve their sustainability goals, such as by increasing fuel efficiency, and reducing food waste and GHG emissions.

While studies vary a bit, lifecycle studies—including a 2016 report by Trucost—typically show that use of plastic products and packaging results in approximately 2.5 times less GHG emissions than common alternatives. Likewise, switching back to alternative materials would increase GHG emissions by 2.5 times.

These highly effective materials significantly improve the efficiencies in industries that are key to combating climate change. Lightweight yet strong plastic vehicle components reduce weight and improve fuel efficiency in our cars and trucks. Plastic building insulation improves energy efficiency in our homes and buildings. Long-lasting plastic pipes streamline the movement of water and resist corrosion. Plastic composite wind-turbine blades improve the ability to generate wind power. Plastics protect and improve solar energy panels. Aircraft makers are turning to lightweight plastic composites to improve fuel efficiency (and combat jet lag!). Lightweight, efficient plastic food packaging helps reduce food waste and its immense contribution to GHG emissions. The list goes on.

Frankly, the global community cannot realistically meet its climate change commitments without the help of plastics. In any policy considerations, let's remember that the use of lightweight plastics typically helps drive down GHG emissions.

On waste impacts, the use of plastics should not be "one and done." Plastics are made to be remade. We're working to create a circular economy in which plastics are reused rather than discarded, keeping them in our economy and out of our environment.

We're investing in new and game-changing technologies that can dramatically increase the types and amounts of plastics that can be recovered for reuse and recycling. Major plastic makers are revising business models and production processes to take advantage of these advanced recycling technologies. We want to recover and remake as much plastic as possible. These technologies can transform how numerous plastics are made by replacing virgin fossil resources with used plastics, improving sustainability, conserving resources, and further driving down GHG emissions.

To smooth the way, we actively support federal and international policies to develop low-carbon, circular solutions that help keep waste out of our environment. In the United States, we've called on Congress to support "5 Actions for Sustainable Change," a plan the American Chemistry Council released in July that will help usher in a circular economy. Among other provisions, these actions would require recycled content in plastic packaging and raise private funding to help fix our nation's broken recycling infrastructure—we can't recycle the plastics we don't collect.

We've also called for an international agreement to end plastic waste in the environment. Governments worldwide should push for negotiations on a treaty that would accelerate a transition to a circular economy by creating universal access to waste collection, and expanding the infrastructure to collect and repurpose plastics. This treaty should require all nations to agree to eliminate plastic waste while providing flexibility to meet the needs of individual nations. Multiple governments, including the United States, have announced support for the United Nations Environment Assembly to approve negotiations on such a treaty at its February meeting.

While we're proud of the materials we make and our contributions to sustainability, we know we can do even better. And we would welcome considerably more attention paid to plastics and sustainability.

Joshua Baca is vice president of plastics at American Chemistry Council.

Accounting for Plastic's True Costs

By Scott Coffin

PLASTICS provide undeniable benefits to society through their versatility, durability, light weight, and low cost. However, these same properties have also caused widespread and irreversible impacts to health and ecosystems that are not reflected in the price of the materials. An aim of the 2030 Agenda for Sustainable Development adopted by all United Nations member states is to "protect the planet from degradation . . . so that it can support the needs of the present and future generations." To meet this goal, we must internalize the negative impacts of plastics into their costs so that they may provide essential services to well-being in a sustainable manner.

During plastic's inception, environmental considerations were paramount. The first synthetic polymer was invented to replace ivory in 1869, largely eliminating the need to slaughter wild elephants to make products such as billiard balls. Yet in 2021, weathering plastics were identified as a planetary boundary threat due to their contamination of the globe, permanent nature, and disruptive impacts on Earth system processes, as described by Arp et al. in *Environmental Science & Technology*.

Plastic's transformation from miracle to menace can be explained in part by a colonialist strategy—out-of-sight, out-of-mind. For decades, the "take-make-waste" approach to single-use plastics carried on with minimal public concern from middle- and upper-class consumers, who were largely unaware of the pollution generated by plastic. Disturbing images of both plastic's accumulation in watersheds (and even in human placenta in the form of microplastics), as well as pollution burdens on low-income residents and communities of color from manufacturing plants (e.g., "Cancer Alley" in Louisiana), raised alarm bells. Then in 2017, China banned the import of low-quality, mixed plastics, and waste started piling up across Europe and North America. While many countries (including the United States) decided to simply send their waste to lower-income nations in the Global South, China's policy revealed to the world that the existence of single-use plastic under the current business model is dependent on the availability of land to assimilate pollution.

If the environmental impacts of single-use plastics were included in their cost, the feedstock extraction and manufacturing required for plastics would not be economically viable. Technical and economic barriers are responsible for plastic's abominable 9 percent global recycling rate, despite industry deferring blame to consumers. Because most plastic products are designed for functionality instead of recyclability, they are often too complex to be separated and recycled (such as multilayer packaging), can only be down-cycled into less valuable products like polyester, or contain hazardous chemicals that would contaminate new products (e.g., phthalates in children's toys). The industry promises to reduce some technical barriers through a process called "chemical recycling"; however, implementation may be minimal without economic incentives to use recycled plastic over cheaper virgin feedstocks.

A thriving and regenerative economy is possible without the impacts that fossil fuel-derived plastics and other chemicals incur. The European Union's Chemicals Strategy for Sustainability aims to ensure "chemicals are produced and used in a way that maximizes their contribution to society . . . while avoiding harm to the planet and to current and future generations." This "safer by design" strategy requires green chemistry innovation by the industry and rapid, effective policies.

Sustainable chemical strategies require reliable metrics for measuring all impacts of a chemical to avoid shifting the burden of harm from one planetary-scale issue, sector, or population to another. A clear understanding of the complex interconnectedness of environmental issues will be necessary. For example, replacing fossil fuel-based plastics with bio-based materials may increase agriculture's competition for space with natural ecosystems and result in biodiversity loss, or deplete nutrients and cause food insecurity.

Plastics, whether fossil fuel- or bio-based, generate hazardous microplastics, so limiting production will be necessary to preserve ecosystem functioning and human health. Before conducting lengthy impact evaluations, the first question to ask of any chemical is, "Is this necessary?" In other words, is it possible to achieve the function provided in another way, including by redesigning the entire system? For example, the University of California determined that single-use plastics are nonessential for dining. Instead, the schools will provide reusable food service items in all 10 campuses starting in 2022.

Plastic pollution is a rapidly increasing planetary threat, and incremental, piecemeal changes such as improvements in efficiency will be insufficient to stem the tide. A global, measurable, and binding treaty with actionable targets and equitable resource allocation is necessary to address the multiple interrelated planetary health crises, and sustainably transition our consumption patterns, chemical feedstocks, and materials economy. There is still time to decide if society will make these changes voluntarily or out of necessity due to environmental collapse and public health crises. To achieve a sustainable circular economy, we need a range of policy tools—and we need to start accounting for all the costs of plastic.

Scott Coffin is a research scientist at the California State Water Resources Control Board, where he focuses on microplastics and constituents of emerging concern in drinking water.