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The Plastics BAN List

BETTER ALTERNATIVES NOW

An analysis and call-to-action to phase out the most harmful plastic products used in California

Introduction

Over the last fifty years, plastic has become the packaging material of choice for many of the goods we consume. It's durable, lightweight, easily molded into different shapes and applications for marketing choices, and readily seals out oxygen and other contaminants. And plastic is cheap. It dominates single-serve food and beverage packaging, carry-out shopping bags, and to-go containers and cutlery from restaurants and cafeterias. With Americans leading busier lives and eating on-the-go more than ever, all that plastic is piling up.

"Plastics in the marine environment are of increasing concern because of their persistence and effects on the oceans, wildlife, and, potentially, humans."[i]

This growing reliance on plastic to fuel our "culture of convenience" is not without cost. Globally, an average of eight million tons of plastic escapes collection systems, winding up in the environment and eventually the ocean.[ii] Once there, sunlight and currents shred plastic debris into smaller particles called microplastics, [iii] which attract and concentrate toxic chemicals up the marine food chain and into our bodies. [iv]

Globally, an average of eight million tons of plastic escapes collection systems, winding up in the environment and eventually the ocean.

Recent studies estimate that by the year 2050 there will be more plastic–by weight–than fish in the ocean.[v] Plastic acts as a toxic conveyor belt, sponging pollutants from surrounding air and water into the tissues of everything that eats it.

From plankton to fish, and to humans that eat seafood, plastic pollution is changing the very chemistry of life.[vi] Much of the problem stems from the use of plastic—a material essentially designed to last forever—for applications such as disposable shopping bags and coffee cups, products that are designed to be used for a few minutes and then thrown away.

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While some have focused on improved waste management or more recycling as primary solutions to the problem of marine plastic pollution, production is estimated to increase four-fold by 2050.[vii]

More collection and recycling of plastics can help, but these strategies are unlikely to keep pace with the massive projected increase in the use of plastic—especially for single-use, disposable applications. From our analysis, the most effective strategy to solve the problem of plastic pollution is to drastically reduce the use of single-use, disposable plastic.

Methodology and Analysis

In order to identify the products and packaging that are causing the most harm in the environment and for human health, 5 Gyres, Clean Production Action, Surfrider Foundation and UPSTREAM partnered to create the Plastics "Better-Alternatives-Now" List (BAN). We examined publicly available data sources to determine which plastic applications are the worst from a pollution standpoint (e.g. what's found in the environment). We then cross-referenced the most polluting items with a toxicity analysis of the types of plastic used. Finally, we examined existing recovery systems (if any) to collect the items for reuse, recycling or composting. We decided to start with California as a pilot project to test this methodology.

There are multiple sets of data collected by different organizations that document environmental contamination by product types and/or brand identification. For the Plastics BAN List, data sets from International Coastal Cleanup, Litterati, Marine Debris Tracker, and San Diego Coastkeeper/ Surfrider were referenced. Available data on the top 15 items by count were combined, resulting in a hierarchy from the most common contaminant (food wrappers) to the 15th ranking contaminant (cigarette lighters).

Based on this analysis, we're asking policy makers and business leaders to take immediate action to phase out these harmful plastics in favor of better alternatives, either through regulatory action by government, voluntary efforts by industry, or both.

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Plastic Object	% Pollution in Environment (by unit count)	Likely Plastic-Type (Polymer)	Hazard in Manufacturing	Environmental Persistence	Potential to Accumulate Toxic Chemicals in Environment	Recovery for Reuse, Recycling or Composting	Best Alternatives Now	Better Alternatives Now
Food Wrappers/ Containers	31.14%	Several different plastics*	Several different plastics*	Several different plastics*	Several different plastics*	No recovery system	Bulk purchasing of food in reusable containers	More work needed on bio-benign alternatives
Bottle/ Container Caps	15.50%	Polypropylene (PP - #5)	No chemicals of high concern; **not green chemistry**	High	High	Can be recycled	Functional replacement with reusable bottles	"Leash-the-Lid" technical fix available
Bags	11.18%	Low-Density Polyethylene (LDPE - #4)	No chemicals of high concern; **not green chemistry**	High	High	3% recycled	Functional replacement with reusable bags	Biodegradable shopping bags
Straws, Stirrers	8.13%	Polypropylene (PP - #5)	No chemicals of high concern; **not green chemistry**	High	High	No recovery system	Functional replacement with reusable straws/stirrers	Plant-based biodegradable straws/stirrers
Beverage Bottles	7.27%	Polyethylene terepthalate (PET - #1)	**Some manufacturing steps involve chemicals of high concern**	High	Medium	77% recycled	Functional replacement with reusable bottles	Increase deposit to decrease litter
		High-density polyethylene (HDPE - #2)	No chemicals of high concern; **not green chemistry**	High	High	74% recycled	Functional replacement with reusable bottles	Increase deposit to boost recycling
Utensils	2.79%	Polystyrene (PS - #6)	Includes chemicals of high concern in every manufacturing step	High	High	No recovery system	Functional replacement with reusable utensils	Plant-based biodegradable utensils
Cups & Plates (Foam)	2.02%	Polystyrene (PS - #6)	Includes chemicals of high concern in every manufacturing step	High	High	No recovery system	Functional replacement with reusable cups and plates	Plant-based biodegradable cups and plates
Cigarette Butts	3.66%	Cellulose Acetate Fiber	Unknown	High	Unknown	No recovery system	Plant-based biodegradable cigarette filters	See best alternative
Lids	4.90%	Polystyrene (PS - #6)	Includes chemicals of high concern in every manufacturing step	High	High	No recovery system	Functional replacement with reusable cups	More work needed on bio-benign alternatives
Take-Out/ Away Containers	6.27%	Polystyrene (PS - #6)	Includes chemicals of high concern in every manufacturing step	High	High	Very low amount recycled	Functional replacement with reusable take-out containers; work to change health codes to enable this change	Plant-based biodegradable take-out containers
		Polyethylene terepthalate (PET - #1)	**Some manufacturing steps involve chemicals of high concern**	High	Medium	Very low amount recycled	Functional replacement with reusable containers	Plant-based biodegradable take-out containers
Balloons	1.00%	Several different plastics*	Several different plastics*	Several different plastics*	Several different plastics*	No recovery system	More work needed on bio-benign alternatives	See best alternative
Other Jugs/ Containers	1.13%	Several different plastics*	Several different plastics*	Several different plastics*	Several different plastics*	Product-dependent	More work needed on identifying functional alternatives and incentives for recycling	See best alternative
Cups (Hard Plastic)	3.13%	Polystyrene (PS - #6)	Includes chemicals of high concern in every manufacturing step	High	High	Very low amount recycled	Functional replacement with reusable cups	Plant-based biodegradable cups
		Polyethylene terepthalate (PET - #1)	**Some manufacturing steps involve chemicals of high concern**	High	Medium	Very low amount recycled	Functional replacement with reusable cups	Plant-based biodegradable cups
Personal Care Products	1.05%	Several different plastics*	Several different plastics*	Several different plastics*	Several different plastics*	No recovery system	Product-dependent	See best alternative
Cigarette Lighters	0.84%	Polycarbonate (PC - #7)	Includes chemicals of high concern in every manufacturing step	High	High	No recovery system	Functional replacement with matches or refillable non-plastic lighters	See best alternative

** These products are made from several different types of plastic, and we don't include a full analysis for each in the report.*

Toxicity

The inherent nature of most polymers to persist in the environment is highly problematic. The pollution problem on land and water is further compounded by its toxicity. A ranking of different polymers based on the number of toxic chemicals used in their manufacturing reveals Polystyrene (PS), Polycarbonate (PC), and Polyvinyl Chloride (PVC)—polymers commonly found in packaging—to be of greatest concern.[viii] The polymer Polyethylene Terephalate (PET) scores slightly better in comparison while the polymers Polyethylene (PE) and Polypropylene (PP) score as least hazardous. This ranking does not take into account additives, which are then mixed into polymers to make products, many of which are known to be hazardous and which would increase the toxicity profile of individual plastic products. Understanding the chemical lifecycle of each polymer and its chemical ingredients is important information when assessing how plastic is degrading in the sea and accumulating priority pollutants onto debris surfaces.

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A study of plastic marine debris found particularly high levels of polycyclic aromatic hydrocarbons (PAHs) on both PS foam packaging material as well as PS foam marine debris.[ix] PAHs are known pollutants that are generated by incomplete combustion as

photo-illustration: Querido Galdo

well as used in many plastic manufacturing processes. This study demonstrates both the inherent toxicity of PS foam and its ability to accumulate pollutants in the marine environment. Another study that measured the accumulation of polychlorinated biphenyls (PCBs) and PAHs on different types of marine plastic pollution found that HDPE, LDPE, and PP contained higher concentrations of PAHs and PCBs than other polymers which more readily sank to the bottom of the ocean.[x] Clearly, research shows that plastic debris can be a vector for toxic chemicals in the marine environment.

The combination of toxic chemicals in manufacturing, plastic's persistence in the environment, and the increasing understanding that plastics in the marine environment hold the potential to deliver greater doses of toxic chemicals to marine life, all point to the need to dramatically reduce and redesign the use of plastic packaging. Where it remains in use, packaging should be manufactured using safer, healthier chemicals. It should biodegrade in composting facilities and, ideally, in the marine environment as well.

What's Better?

For most of the items on the Plastics BAN List, the best alternative is to replace harmful plastic products with reusable/refillable products that can provide the same service without using any disposable materials at all. For example, a refillable coffee cup provides the same product–delicious coffee–without the need for a disposable cup or lid. We call this a "functional replacement" of an unnecessary, harmful plastic use.

photo: Wikimedia Commons / Dr Torsten Henning

Hidden Costs

The price tag and logistical challenges of dealing with plastic packaging waste—through collection, recycling, disposal, waterway and beach cleanup, street sweeping, stormwater capture, and outreach and education—are spiraling upwards for cities across the country.

As recycling streams have evolved, existing approaches have been unable to keep pace with the increasing amount of plastics use and resulting litter, disposal and recycling costs.

Cities face escalating costs of managing plastic waste, with nearly a third of plastic packaging escaping existing collection systems. The rapid growth of plastic packaging far outstrips local governments' ability to deal with this waste stream. Producers need to invest in new material designs, drastically reduce the use of plastic packaging and take physical and/or financial responsibility for infrastructure expansion, collection and recycling of essential materials.

In many cases, the next best strategy is to substitute the harmful plastic product for another disposable product that is readily biodegradable in the environment. Compostable materials—materials that biodegrade in commercial composting facilities and meet established standards (ASTM D6400 or D6868)—are widely available as an alternative material for many plastic packaging and food service ware products. Compostable materials include bio-based materials (for example, paper), bio-based plastics (for example, derived from plants), and fossil fuel-based polymers (yes, there are fossil-fuel based plastics that meet the established compostability standards).

Compostable materials have their benefits and challenges. The benefits of compostable materials are that they can be collected, combined with food waste and other bio-based materials, and composted in a commercial composting facility. Additionally, compostable materials made from bio-based feedstocks and green chemistry align with the transition to an economy based on renewable fuels.

But compostable materials do not necessarily address the problems with pollution. While some biodegrade in municipal composting facilities, they typically do not biodegrade in the marine environment or on land. Bio-based materials can also contaminate recycling facilities, many of which will not accept them.

An ideal packaging material would be like the skin of a grape—biodegradable in all environments (compost facilities, on land, and in water). Given the lack of the ideal material for all environments, following the waste hierarchy continues to make sense: reduce (eliminate use in first place), reuse, then recycle and compost.

The Problem with Polystyrene Foam

Better known as Styrofoam, polystyrene foam (or EPS, expanded polystyrene) is often the most abundant item counted in the environment, largely because of its ability to fragment into smaller pieces. However, this causes the count of specific products—cups, plates, take out containers, packaging materials—to be significantly under-represented. The numerical dominance of fragments suggest frequent EPS contamination, yet determining the exact product type and source is much more challenging.

Their ubiquity, durability, and ability to accumulate high levels of persistent pollutants make EPS products extremely harmful. Styrene, a primary component of polystyrene, is a suspected human carcinogen, and has been shown to leach from products into food or beverages. Recycling EPS has been a failure in most cities because of food waste contamination, and its low market value. Replacing EPS is a high priority.

There are natural packaging alternatives—such as mushroom foam and starch-based packing peanuts—as well as compostable plates, cups and bowls, which are becoming more economically viable as a cost-competitive replacement. Schools are getting rid of EPS lunch trays. University and government facilities are replacing EPS packaging. The list of complete or partial polystyrene bans is sweeping the United States—including Seattle, San Francisco, Minneapolis, Miami Beach and Washington, D.C. The tide is turning.

Worst Offenders and Better Alternatives

photo: Wikimedia Commons / Justin Smith

1. Food Wrappers & Containers

Beyond the sheer number of littered cigarette butts, food wrappers and other food packaging are the most prevalent item found in California's environment. From potato chip bags and candy wrappers, to cookie and cracker trays, single-use disposable packaging is everywhere. The impacts are seen on California's beaches and in the trillions of plastic particles floating in the ocean, where they accumulate toxic chemicals and are ingested by marine wildlife.

Better Alternatives

Grocers and food-service establishments can help by encouraging the bulk purchase of snacks and other foods in reusable containers. Made-to-order snacks and baked goods can be delivered with a minimum of non-plastic, biodegradable packaging. Consumers can help by eating less processed, pre-packaged foods and choosing healthier options.

We recognize that plastic helps to provide important product protection through sealing out contaminants that can spoil food. Innovation can play a critical role. Consumer goods and food service companies should invest in truly biodegradable packaging technologies that allow comparable levels of product protection—without harm.

photo: Wikimedia Commons / Project Manhattan

2. Bottle & Container Caps

Because bottle caps float, sea birds often mistake them for food. For some species, such as the Pacific Albatross, plastic ingestion is a major factor in their decline and potential extinction.

Better Alternatives

Clearly, using reusable bottles for water, soda and other beverages solves this problem. For commercial beverages sold in PET (#1), and HDPE (#2), companies can employ "leash-the-lid" technology to ensure that the cap stays attached to the bottle. Advances in recycling technology enable both the bottle and cap (which are made from different plastics) to be recycled together. Manufacturers should begin voluntarily making this change; policymakers can speed the process by advancing "leash-the-lid" legislation.

photo: Flickr / MTSOfan

3. Plastic Bags

Ubiquitous in the environment, plastic bags pose threats to wildlife while polluting our lakes, rivers, beaches, and ocean. Sea otters, turtles, seals, birds, and fish get tangled within plastic bags or mistake them for food. Some animals are strangled, while others fill their stomachs with plastic and can die from starvation. Plastic bags also contaminate recycling streams and lead to costly shutdowns and repairs at recycling facilities.

Better Alternatives

Studies show that plastic bag pollution can be dramatically reduced through policies that place fees on bags or ban their use outright, as well as encouraging reusable bags. Disposable shopping bags made from high-recycled-content paper or other non-plastic, biodegradable alternatives help prevent plastic pollution, but should be pursued only as a last resort. Grocers, retailers and take-out food service establishments can implement in-store policies to encourage reusable bags and phase out disposable plastic ones, while policymakers can make plastic bag pollution history through plastic bag bans.

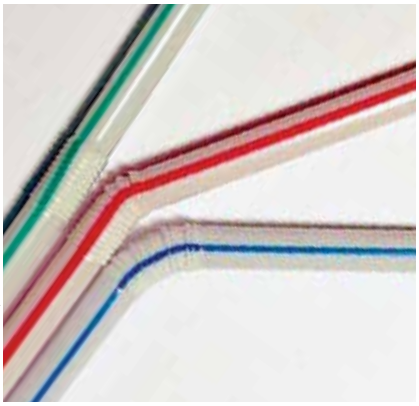

photo: Wikimedia Commons / Trinkhalm

4. Straws & Stirrers

Plastic straws and coffee stirrers are also common throughout California's environment. Like bottle caps, plastic straws float, which threatens wildlife and contributes to the growing ocean plastic epidemic. Californians use an estimated 60 million plastic straws daily.

Better Alternatives

Restaurants and food-service establishments can help by switching to a "straws upon request" policy and by providing reusable glass or metal straws for eat-in dining. For take-out, paper straws can be substituted for plastic, while coffee shops can provide reusable spoons or wooden stirrers. Policymakers should look to plastic straw bans as a way to encourage universal adoption of these changes.

photo: http://www.cpme-pet.org

5. Beverage Bottles

In spite of relatively high recycling rates for PET (#1) and HDPE (#2) plastic beverage bottles (77% and 74% respectively), there are still significant quantities of plastic bottles in California's environment.

photo: Matthew Gollop

Better Alternatives

Much of the waste from bottled water can be eliminated through investing in easy-to-access public drinking fountains and water bottle refilling stations. Soda and juice bottle waste can also be cut down through strategies to encourage refillable containers at soda and juice fountains. Businesses, institutions, universities and schools can all contribute by phasing out bottled water use and encouraging reusable/refillable bottles and cups for water and drinks. For commercially sold drinks in PET and HDPE bottles, policymakers can also help decrease litter and boost recycling by increasing the container-deposit for these bottles. Research shows these policies work: In Michigan, the state with the highest container deposit of 10 cents, container-recycling rates are at 94%, the highest in the country.

photo: Wikimedia Commons / Ziko van Dijk

6. Utensils

Disposable plastic utensils are another common item found in the environment with deadly consequences for marine mammals, sea turtles and birds that ingest the sharp, rigid particles of the degrading plastic forks, knives and spoons.

Better Alternatives

Restaurants and food service establishments can help solve the problem by switching out disposable plastic for washable, reusable utensils. Including potential capital investment and some increased labor costs; research shows that going reusable saves money over disposables. For take-out, restaurants can also encourage customers to use their own utensils, and substitute disposable, biodegradable options such as bamboo for plastic when customers haven't brought their own. Policymakers can speed these changes by banning plastic utensils.

photo: Surfrider Foundation

7. Cigarettes

Because cigarettes are purchased in packs of 20, for the purposes of this report, we assessed their prevalence by the pack. The ubiquity of cigarette butts, despite increases in municipal ordinances to curb smoking in public spaces, suggests that the public still misunderstands what they are made of, as well as their toxicity and persistence. Cigarette butts are made from fibrous cellulose acetate and other plastics; they are non-biodegradable and deliver toxics to the environment.

Better Alternatives

Obviously—for so many reasons—the best alternative is not to smoke. However, for those that do, there are biodegradable cigarette filters that can replace plastic. In light of this design opportunity, cigarette companies should aggressively switch to biodegradable filters, and policymakers should look into requiring cigarette companies to make the switch.

photo: http://www.cnhxcups.com

8. Lids

Coffee and beverage cup lids are another high-pollution item. Coffee lids are typically made from polystyrene; styrene, a primary component of polystyrene, is a suspected human carcinogen, and is shown to leach from products into food or beverages.

Better Alternatives

The best solution is to use reusable coffee cups and lids, which can be encouraged by coffee shops which offer discounts for bringing reusable mugs. Soda lid waste can also be cut down through strategies to encourage refillable containers at soda and juice fountains. The next best alternative would be to substitute with a biodegradable lid.

USDA Photo by Lance Cheung

9. Take-Out Containers

Not surprisingly, plastic take-out containers are some of the most-widely found items in California's environment. Primarily made from polystyrene foam or thermoformed PET, these products are another high-pollution item.

Better Alternatives

Restaurants and food-service establishments can institute strategies to support customers using reusable or bringing their own take-out and take-away containers. For example, restaurants, grocers and food purveyors can provide reusable containers with deposits to bring back to stores, discounts for bringing your own take-out containers, and provide non-plastic biodegradable alternatives for customers that don't have them. Companies should focus on making the switch to these alternatives and pushing for reusable and disposable take-out containers made without toxic chemicals. Policymakers can support this transition by banning polystyrene take-out containers and supporting changes in health-codes to enable the use of reusable take-out containers.

Where Is Producer Responsibility?

One major problem we found with most of the datasets is the lack of specific brand names tied to product waste. This results in a skewed focus on consumer behavior for littering and government responsibility for waste management while neglecting the responsibility of product producers. For example, of the datasets we examined only the mobile app, Litterati, collected brand names listing **McDonalds, Starbucks, Capri Sun, Subway** and **Burger King** as the top five producers of waste stirrers and straws. For cigarette butts the same app listed **Malboro, Camel, Newport, Parliament** and **Maverick** as the top five. Extended Producer Responsibility programs in Europe for product waste have been established for decades yet remain thin on the ground in the United States. It is imperative that corporations step up to the plate, be accountable for product design failures and work on the solutions outlined in this report. This will certainly be an increasing focus as public awareness grows.

How We Merged The Datasets

Four sources for California 2015 pollution surveys were accessed from public documents or databases, including International Coastal Cleanup, Marine Debris Tracker, San Diego Coastkeeper and the Surfrider Foundation, and National Oceanic and Atmospheric Administration. To find common categories of plastic products between these data sets, we made assumptions to split or lump numbers together. This exercise uncovered challenges and opportunities in how to mitigate specific types of pollution.

DATASET MERGER: TOP 15 COMMON CATEGORIES

	OC		CK/SURF		NOAA		MDT		COMBINED % DISTRIBUTION
Plastic Object	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	
Food Wrappers/Containers	65609	31.14%	17,342	36.44%	909	33.66%	470	23.06%	31.08%
Bottle/Container Caps	32654	15.50%	6429	13.51%	401	14.85%	480	23.55%	16.85%
Bags	23562	11.18%	4552	9.57%	729	27.00%	240	11.78%	14.88%
Straws, Stirrers	17129	8.13%	3539	7.44%	107	3.96%	258	12.66%	8.05%
Beverage Bottles	15314	7.27%	3461	7.27%	192	7.11%	15	0.74%	5.60%
Utensils	5886	2.79%	1978	4.16%	72	2.67%	179	8.78%	4.60%
Cups & Plates (Foam)	4251	2.02%	2239	4.71%	29	1.07%	203	9.96%	4.44%
Cigarette Butts	7715.15	3.66%	3,954	8.31%	51.35	1.90%	69.05	3.39%	4.32%
Lids (plastic)	10325	4.90%	2114	4.44%			11	0.54%	2.47%
Take-Out/Away Containers	13209	6.27%							1.57%
Balloons	2099	1.00%	1978	4.16%	9	0.33%	34	1.67%	1.79%
Other Jugs/Containers	2374	1.13%			45	1.67%	40	1.96%	1.19%
Cups	6590	3.13%			45	1.67%			1.20%
Personal Care Products	2203	1.05%			79	2.93%	2	0.10%	1.02%
Cigarette Lighters	1779	0.84%			32	1.19%	37	1.82%	0.96%
TOTALS	**210699.15**	**100.00%**	**47,586**	**100.00%**	**2700.35**	**100.00%**	**2038.05**	**100.00%**	**100.00%**

Finding Better Alternatives Now

Since the early 70s, scientists have been aware of the ecological impacts of plastic on marine ecosystems, starting with the first reports of plastic pollution in the North Atlantic Ocean. A resurgence of interest surfaced at the turn of the century, with increasing reports of plastic pollution in the North Pacific Gyre, the first publications on plastic pollution in the South Pacific and Atlantic and several global estimates both on plastic in the oceans, and plastic pollution entering the world's oceans from land based sources. The list of publications documenting the impacts on marine wildlife/marine food web has grown exponentially, with more papers published in the last five years than the previous 40.

Today, the dialogue on plastic pollution is shifting, from documenting the massive scale of this global problem, to

Photo: City of Los Angeles Stormwater Program and www.constructionweekonline.com

Why California?

Through the leadership of policy-makers, local governments and the organizations in the Clean Seas Coalition, California has become an international leader in addressing plastic pollution. Communities throughout the state have banned the use of plastic bags and polystyrene (Styrofoam) carry-out containers. California was the first state to pass a statewide plastics bag ban in 2014, and has some of the most advanced recycling and composting systems in the world. California citizens are generally environmentally-conscious and take pride in their beautiful state. For these reasons and others, California has a reputation of being the "greenest" state in the U.S.

However, in spite of all this, California still generates a significant amount of plastic pollution. This is not just a blight issue, or a concern for wildlife lovers or people who eat seafood. A 2013 report estimated that the costs to address litter and plastic pollution in California's environment reach nearly $500 million dollars each year. These costs are borne by communities and taxpayers.

deepening the narrative around realistic, scalable solutions that address root causes. The issue of plastic pollution is now on the global agenda of major policymakers, international organizations, and corporations. On the Road to Zero Waste[xi], The New Plastic Economy [xii], and Marine Litter: A Global Challenge[xiii], are only a few to mention.

Every piece of plastic that enters the environment is an example of a design and systems failure that needs to be addressed. A growing consensus is emerging around the importance of upstream solutions to address the problem, from changing product design, to sourcing plastic from bio-based feedstocks rather than fossil fuels, to improving recovery and recycling systems, to challenging our unwitting acceptance of plastic garbage as a troubling but necessary part of modern life.

From our analysis, we believe there are five core strategies that policy-makers, industry and consumers can use to solve plastic pollution now:

REDUCE: Drastically reduce the use of plastic for single-use disposable products and packaging. It makes no sense to use a material designed to last forever for a product that's designed to last a few minutes. The Plastics BAN List identifies the most common plastic pollution that should be targeted for immediate action because of the harm it causes.

REDESIGN: Shift design away from harmful plastics toward a) providing the goods or services in ways that don't use packaging at all, b) substituting with bio-benign materials made from sustainable materials, and c) designing products and packaging for end-of-life, including opportunities for reuse and repair before material recovery for remanufacture.

REUSE & RECYCLE: Scale and replicate Zero Waste reuse, recycling and composting policies and strategies funded in part by the companies that put products into the market in the first place.

REIMAGINE: Support innovation to replace harmful plastic. Innovators are hard at work designing the materials of the 21st century that can provide for humanity's needs without causing harm. We need to support their efforts through investment and adoption.

RETHINK PROGRESS: Shift consciousness to replace the "throw-away society" with a culture of stewardship that questions the role of plastic in our economy and seeks to transition to a Zero Waste future.

Findings and Recommendations

1. Most of the worst offenders are designed for "on-the-go" applications, which are more likely to end up as pollution in the environment. Virtually all of the products on the BAN List are "to-go" products such as takeout containers, coffee lids, beverage bottles, and straws.

2. More recycling will not solve plastic pollution. Nearly all of the 15 products on the BAN List have no economic value in today's recycling systems. They are literally "designed for the dump" and are often contaminants in recycling systems, either damaging equipment and causing costly repairs when they enter recycling facilities (like plastic bags) or ending up as a net cost for recyclers to unload at a loss (like polystyrene) rather than as profitable materials.

3. A majority of the BAN List products are manufactured with toxic chemicals, and none of the plastics used are examples of green chemistry. Many of the products are made from polystyrene, a probable human carcinogen. Other plastics contain harmful additives like PET, which uses a toxic heavy metal (antimony) as a catalyst in the production process. None of the products are manufactured according to green chemistry principles.

4. Better alternatives to BAN List products are available today for nearly every single harmful plastic use. When we conducted an assessment of functional replacements and material substitutions for the harmful plastic products, we found that safer, more sustainable alternatives were widely available today. We do not need to wait for technological "fixes" to solve plastic pollution. We can start by moving to better alternatives now that deliver the same product or service without the harm.

5. More data needs to be collected on pollution in the environment and the identity of responsible producers. Data collection methods should be standardized. We discovered that different entities collected pollution data in different ways. For example, one institution might lump all plastic cups together, while another might differentiate between hard plastic cups and foam cups. It's important for the scientific community to standardize pollution research methods and categories and to increase monitoring of plastic in the environment and to identify the product producers for transparent discussions on producer responsibility.

6. The BAN List is a good place to start for voluntary action by industry and regulatory action by government. If we want to solve plastic pollution—especially in California—we can start with voluntary and regulatory action to replace the worst offenders with better alternatives now. The BAN List methodology can be applied and replicated in other jurisdictions to come up with similar target lists for action. ■

Resources/Citations

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The Plastics BAN List

BETTER ALTERNATIVES NOW

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5 GYRES

The nonprofit 5 Gyres Institute has been fighting plastic ocean pollution since 2009. Beginning in 2010, 5 Gyres began a series of scientific firsts by researching plastic in all five subtropical gyres, as well as the Great Lakes and Antarctica. In 2014, the organization convened eight scientists around the world to publish the first global estimate of plastic pollution in our ocean: 5.25 trillion particles weighing in at 270,000 tons of "plastic smog" worldwide. 5 Gyres' paper on plastic microbead pollution in the Great Lakes inspired a two-year collaborative campaign that culminated in a federal ban on microbeads, which President Obama signed into law in 2015. In August, 5 Gyres embarked on its 17th expedition—this time to research microplastics and nanoplastics in the Arctic Circle. **www.5gyres.org**

CLEAN PRODUCTION ACTION

Clean Production Action believes we can reverse our current production of toxic products and hazardous waste. TO achieve such systemic change we collaborate to design and deliver strategic solutions for green chemicals, sustainable materials and environmentally preferable products. Our GreenScreen® for Safer Chemicals has become an essential tool for global companies to reduce their chemical footprint while our BizNGO Working Group produces pragmatic strategies to identify the barriers and solutions for safer design. In particular, our Plastics Scorecard and the Principles of Sustainable Plastics offer roadmaps to halt the proliferation of harmful polymers in commerce. **www.cleanproduction.org**

SURFRIDER FOUNDATION

The Surfrider Foundation is a non-profit grassroots organization dedicated to the protection and enjoyment of our world's oceans, waves and beaches through a powerful activist network. Founded in 1984 by a handful of visionary surfers in Malibu, California, the Surfrider Foundation now maintains over 250,000 supporters, activists and members worldwide. **www.surfrider.org**

UPSTREAM

UPSTREAM works with non-profit, government and business leaders to solve the environmental problems caused by products and packaging. We leverage strategies and campaigns that impact these problems at the source. We believe the most equitable solutions are found upstream with the companies that design, produce and profit from environmentally harmful products. Today, our focus is on developing sustainable packaging systems and preventing plastic pollution in the environment. **www.upstreampolicy.org**