

UC SANTA BARBARA

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## A Plastic Planet

More than 8 billion metric tons. That's the amount of plastic humans have created since the large-scale production of synthetic materials began in the early 1950s. It's enough to cover the entire country of Argentina, and most of the material now resides in landfills or in the natural environment.

Such are the findings of a new study led by UC Santa Barbara industrial ecologist [Roland Geyer](#). The research, which appears in the journal [Science Advances](#), provides the first global analysis of the production, use and fate of all plastics ever made, including synthetic fibers.

"We cannot continue with business as usual unless we want a planet that is literally covered in plastic," said lead author Geyer, an associate professor at the [Bren School of Environmental Science & Management](#). "This paper delivers hard data not only for how much plastic we've made over the years but also its composition and the amount and kind of additives that plastic contains. I hope this information will be used by policymakers to improve end-of-life management strategies for plastics."

Geyer and his team compiled production statistics for resins, fibers and additives from a variety of industry sources and synthesized them according to type and consuming sector. They found that global production of plastic resins and fibers increased from 2 million metric tons in 1950 to more than 400 million metric tons in 2015, outgrowing most other man-made materials. Notable exceptions are steel and cement. While these materials are used primarily for construction, the largest market for plastics is packaging, which is used once and then discarded.

“Roughly half of all the steel we make goes into construction, so it will have decades of use; plastic is the opposite,” Geyer said. “Half of all plastics become waste after four or fewer years of use.”

And the pace of plastic production shows no signs of slowing. Of the total amount of plastic resins and fibers produced from 1950 to 2015, roughly half was produced in the last 13 years.

“What we are trying to do is to create the foundation for sustainable materials management,” Geyer added. “Put simply, you can’t manage what you don’t measure, and so we think policy discussions will be more informed and fact-based now that we have these numbers.”

The researchers also found that by 2015, humans had produced 6.3 billion tons of plastic waste. Of that total, only 9 percent was recycled; 12 percent was incinerated and 79 percent accumulated in landfills or the natural environment. If current trends continue, Geyer noted, roughly 12 billion metric tons of plastic waste — weighing more than 36,000 Empire State Buildings — will be in landfills or the natural environment by 2050.

“Most plastics don’t biodegrade in any meaningful sense, so the plastic waste humans have generated could be with us for hundreds or even thousands of years,” said co-author Jenna Jambeck, an associate professor of engineering at the University of Georgia. “Our estimates underscore the need to think critically about the materials we use and our waste management practices.”

Two years ago, the same research team published a study in the journal *Science* that measured the magnitude of plastic waste going into the ocean. They found that of the 275 million metric tons of plastic waste generated in 2010, an estimated 8 million entered the world’s oceans. That study calculated the annual amount of plastic waste by using solid waste generation data; the new research instead uses plastic production data.

“Even with two very different methods, we got virtually the same waste number — 275 million metric tons — for 2010, which suggests that the numbers are quite robust,” Geyer said.

“There are people alive today who remember a world without plastics,” Jambeck said. “But plastics have become so ubiquitous that you can’t go anywhere without

finding plastic waste in our environment, including our oceans.”

The investigators are quick to caution that they do not seek to eliminate plastic from the marketplace but rather advocate a more critical examination of plastic use.

“There are areas where plastics are indispensable, such as the medical industry,” said co-author Kara Lavender Law, a research professor at the Sea Education Association in Woods Hole, Massachusetts. “But I do think we need to take a careful look at our use of plastics and ask if it makes sense.”

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