Environmental and Human Health Impacts of Plastics

St. Margaret's Episcopal Church
Washington, DC
October 4, 2026



Diane Bild, MD, MPH
Member, Physician and Scientist Network Addressing Plastics and Health (P-SNAP)

What I'll Cover

- Introductions
- The Plastic Waste Problem
- Plastics and Health
- What we can do
- Discussion



The Physician and Scientist Network Addressing Plastics and Health

- Our Mission
  - We elevate medical and scientific voices to expose the health harms of plastic and drive reduction and regulation.

Plastic has become ubiquitous



Plastic has some amazing and useful properties:

- Waterproof and air-tight
- See-through
- Light weight
- Non-breakable
- Flexible
- Moldable
- Inexpensive





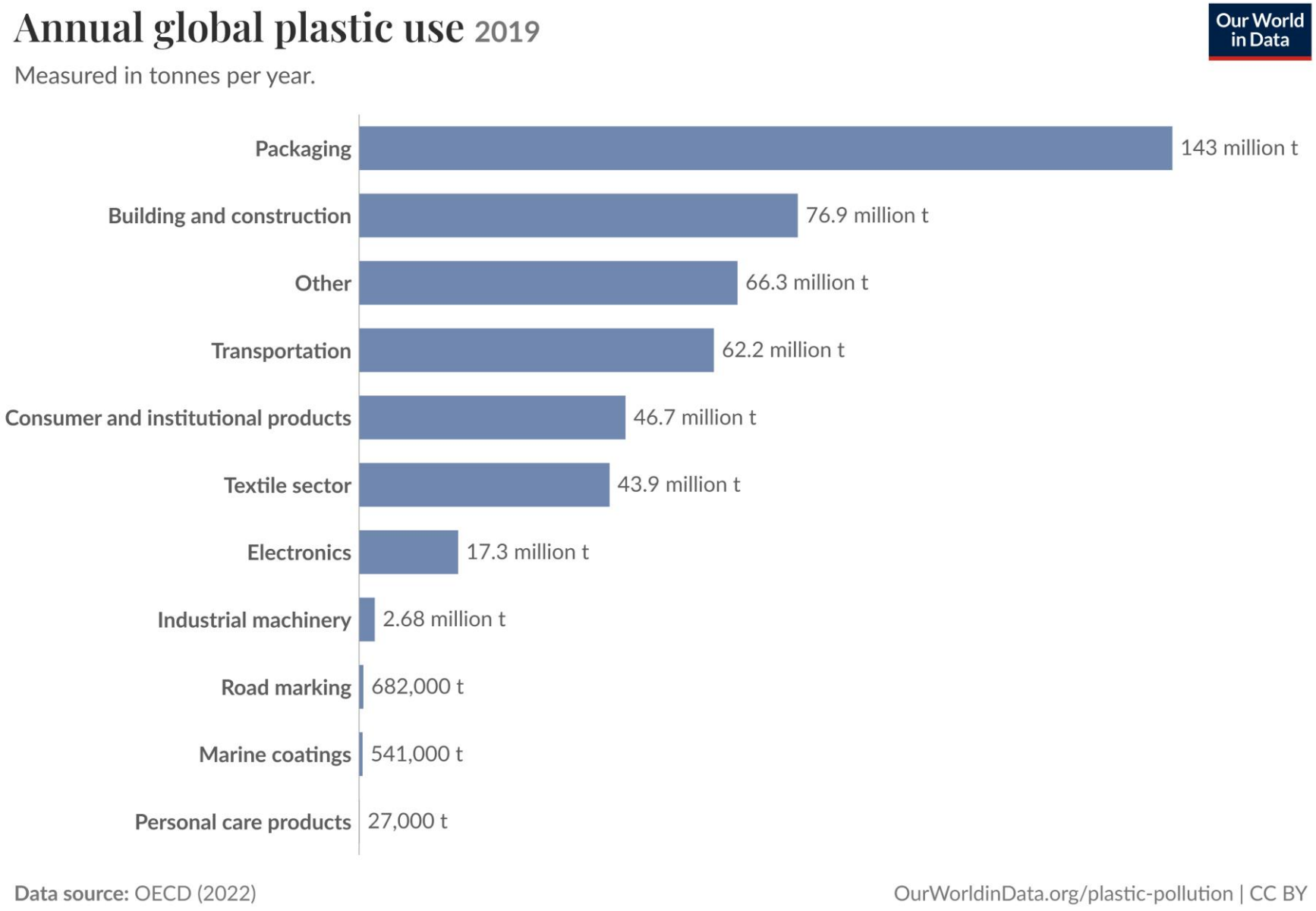




But . . . unnecessary plastic!







OECD (2022) – processed by Our World in Data. “Transportation” [dataset].
OECD, “Global Plastics Outlook – Plastics use by application” [original data].

However, we have gone overboard (figuratively and literally)!

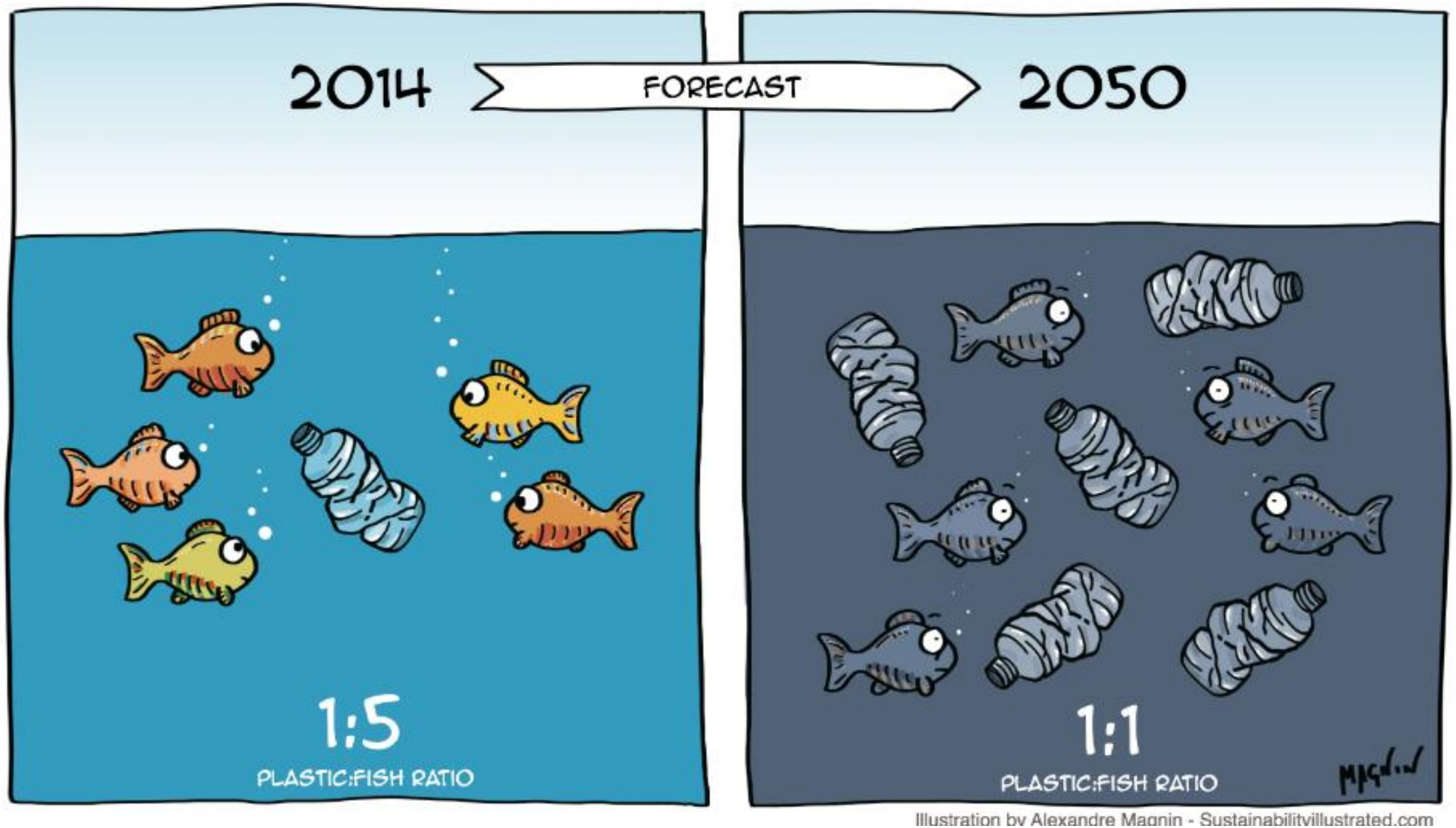


Source: https://www.theguardian.com/environment/2021/jun/10/takeaway-food-and-drink-litter-dominates-ocean-plastic-study-shows

Have you heard about the “Great Pacific Garbage Patch”?



It’s 99% plastic



Source: *The New Plastics Economy: Rethinking the Future of Plastics,* World Economic Forum and the Ellen MacArthur Foundation, 2016

Are you aware of places where our plastic has been dumped?



Plastic . . .



- Is made from fossil fuel
- Production and disposal are associated with greenhouse gases and toxins
- Ingestion (inhalation, absorption) may have serious health consequences
- Virtually lasts forever

Test your knowledge!



BEYOND PLASTICS
MoCo Maryland

How much has annual worldwide plastic production increased since 1950?

A – quadrupled

B – 50-fold

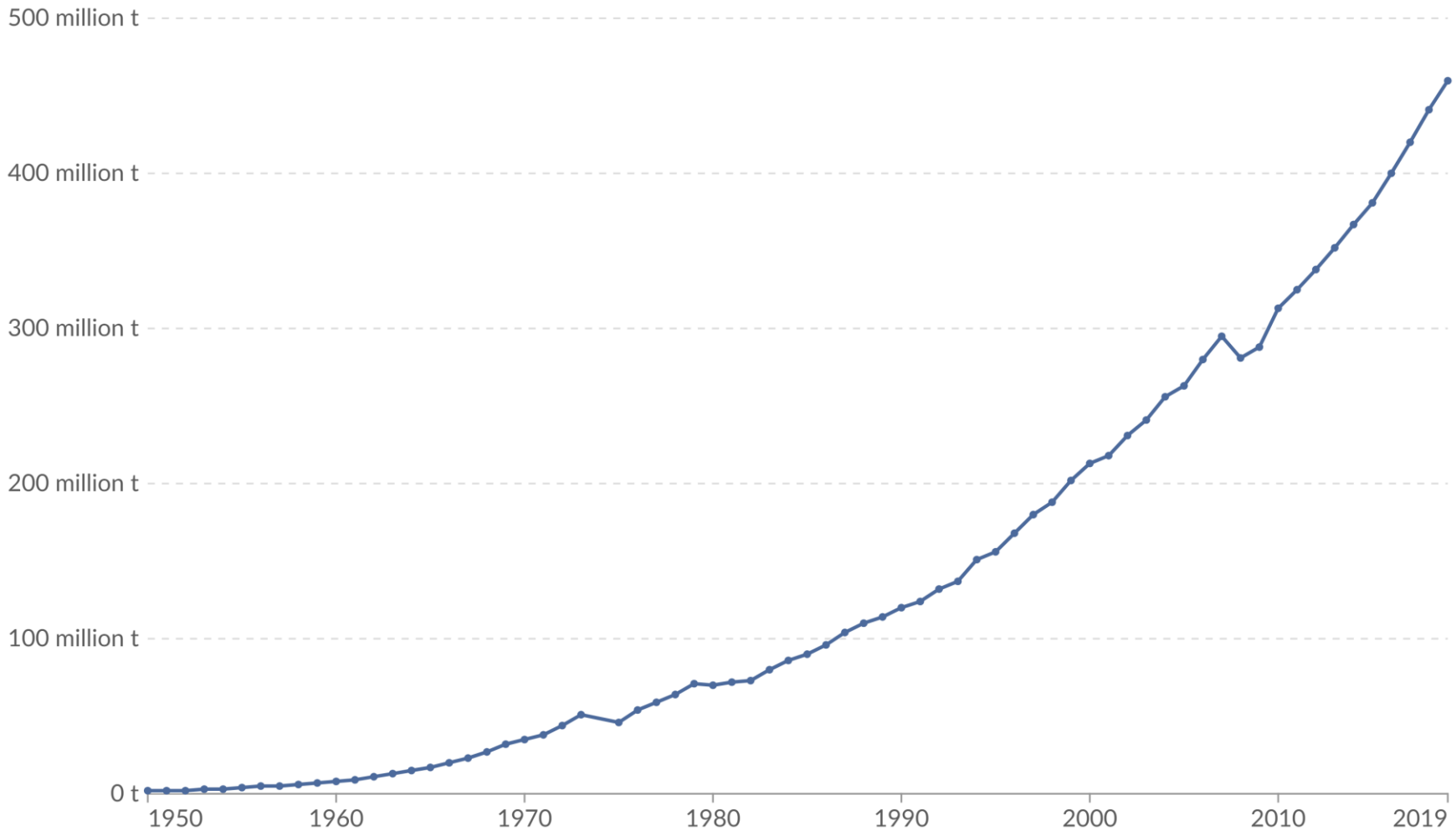
C – 100-fold

D – 200-fold



Global plastics production

Annual production of polymer resin and fibers.



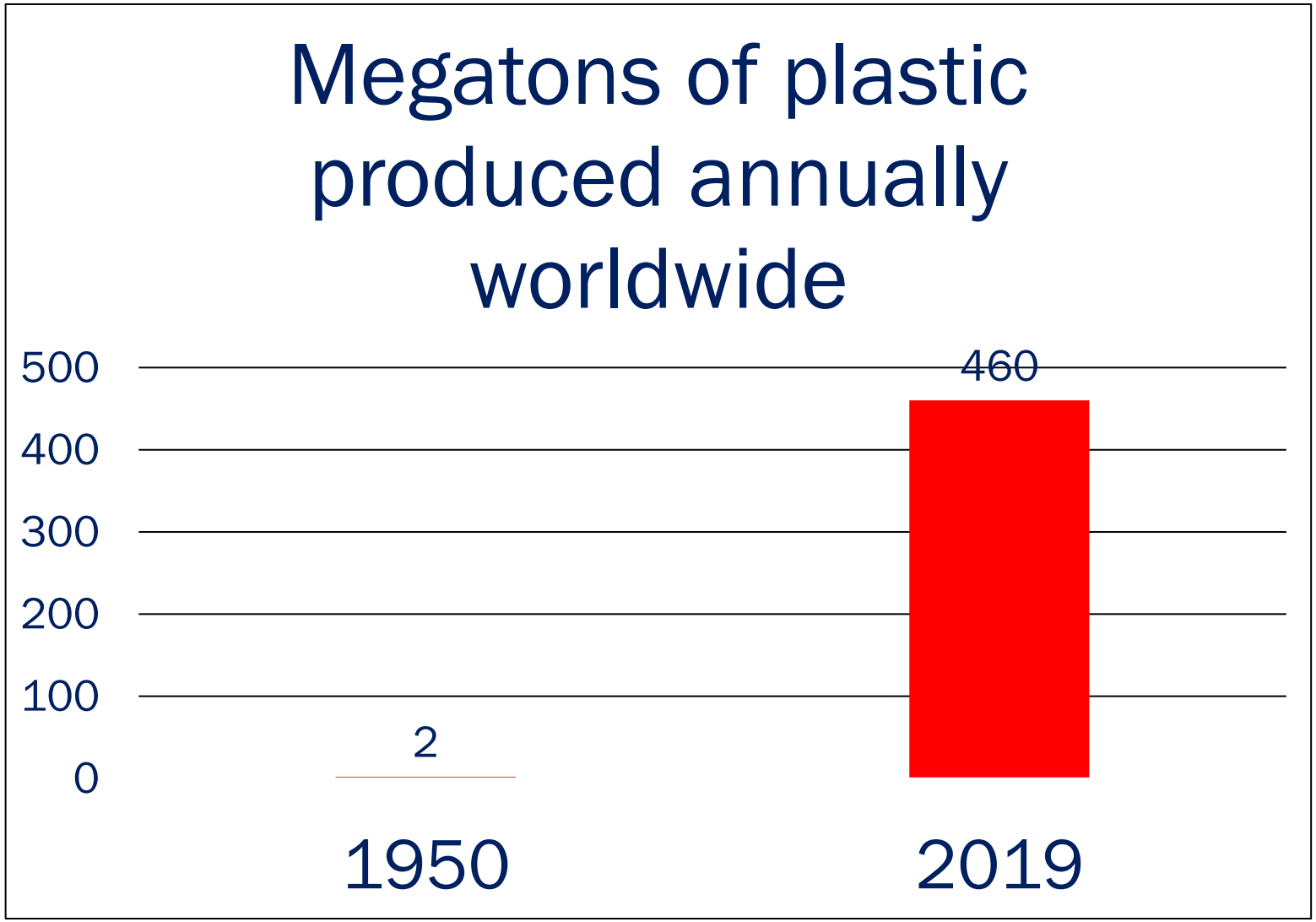
Data source: Geyer et al. (2017); OECD (2022)

OurWorldinData.org/plastic-pollution | CC BY

Answer:

D (>200-fold)

and that's not the worst of it!



Note: A megaton=1 million tons

Landrigan PJ, et al. The Minderoo-Monaco Commission on Plastics and Human Health. Annals of Global Health. 2023; 89(1): 23, 1–215. DOI: https://doi.org/10.5334/aogh.4056

Cumulative Plastic Waste Disposition, with Projections

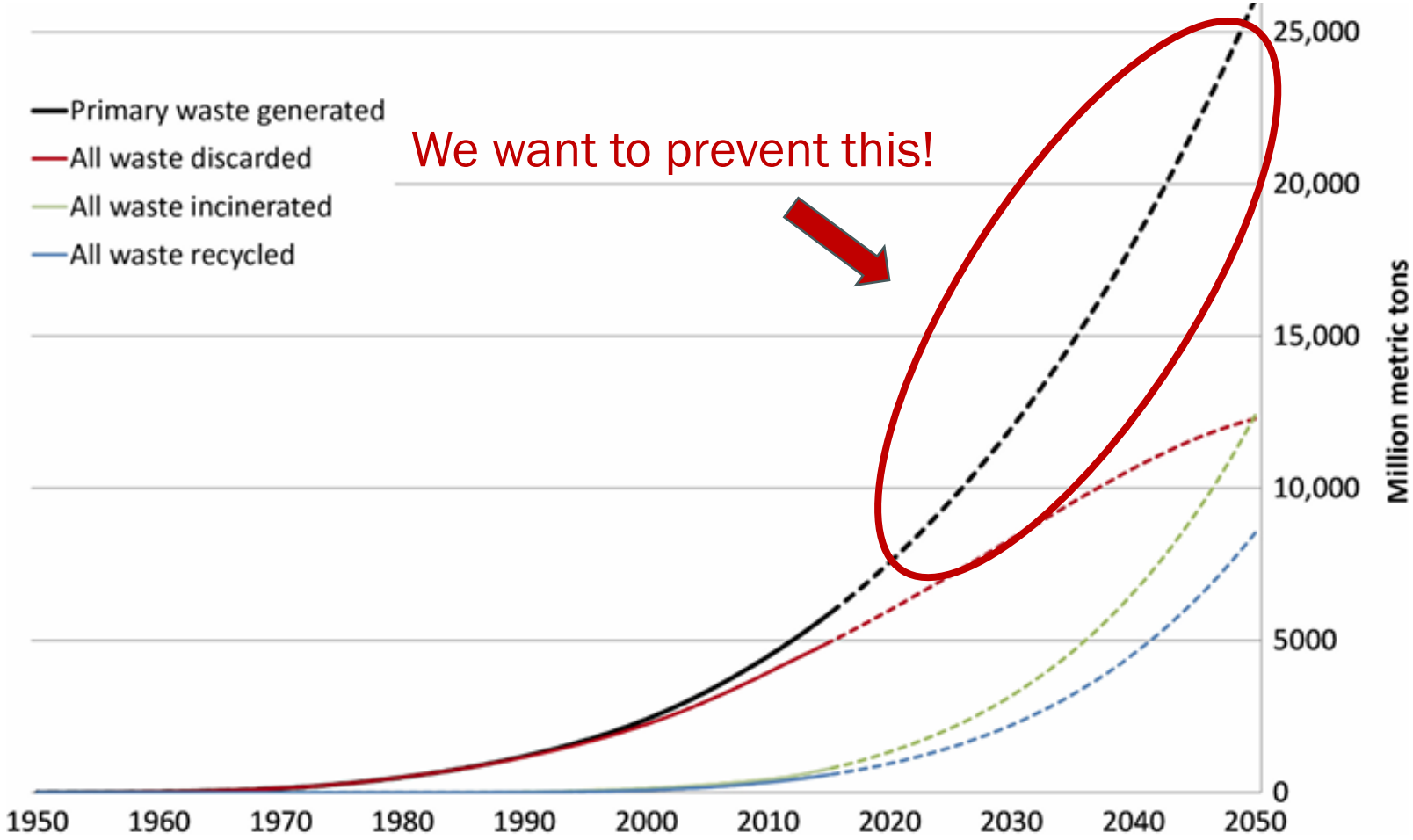


Fig. 3. Cumulative plastic waste generation and disposal (in million metric tons). Solid lines show historical data from 1950 to 2015; dashed lines show projections of historical trends to 2050.

Geyer, Jambeck, Law Sci. Adv. 2017;3:e1700782 19 July

Is <u>that</u> why “There’s a great future in plastics”?



(Maybe not so great ☹)

What percent of plastic is recycled in the US?





What percent of plastic is recycled in the US?

A – 9%

B – 12%

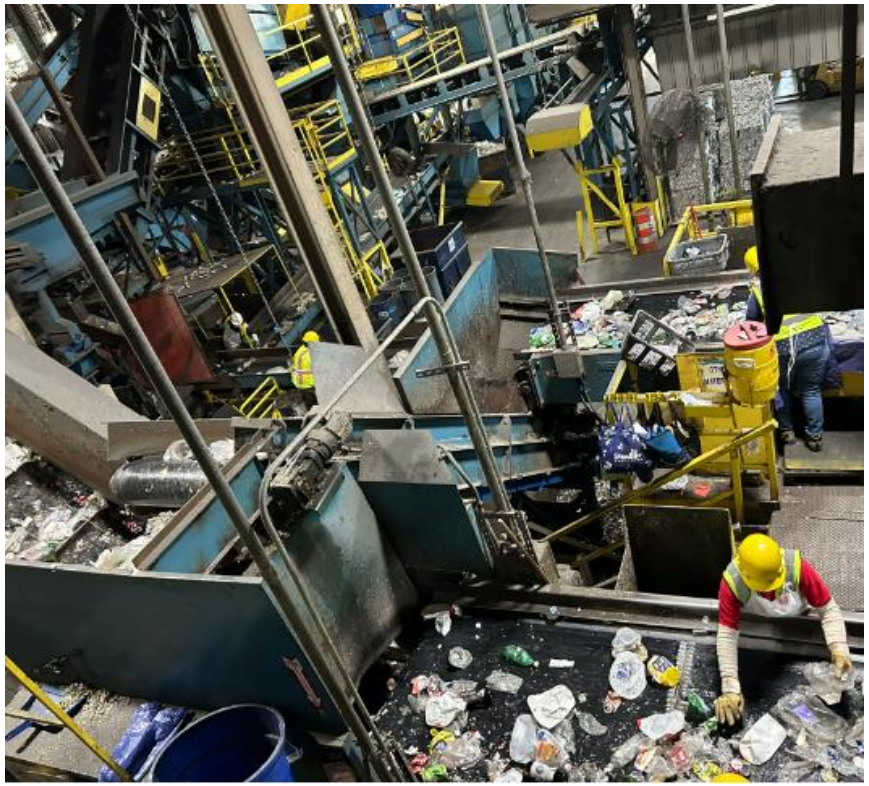
C – 25%

D – 40%



BEYOND PLASTICS
MoCo Maryland

What percent of plastic is recycled in the US?



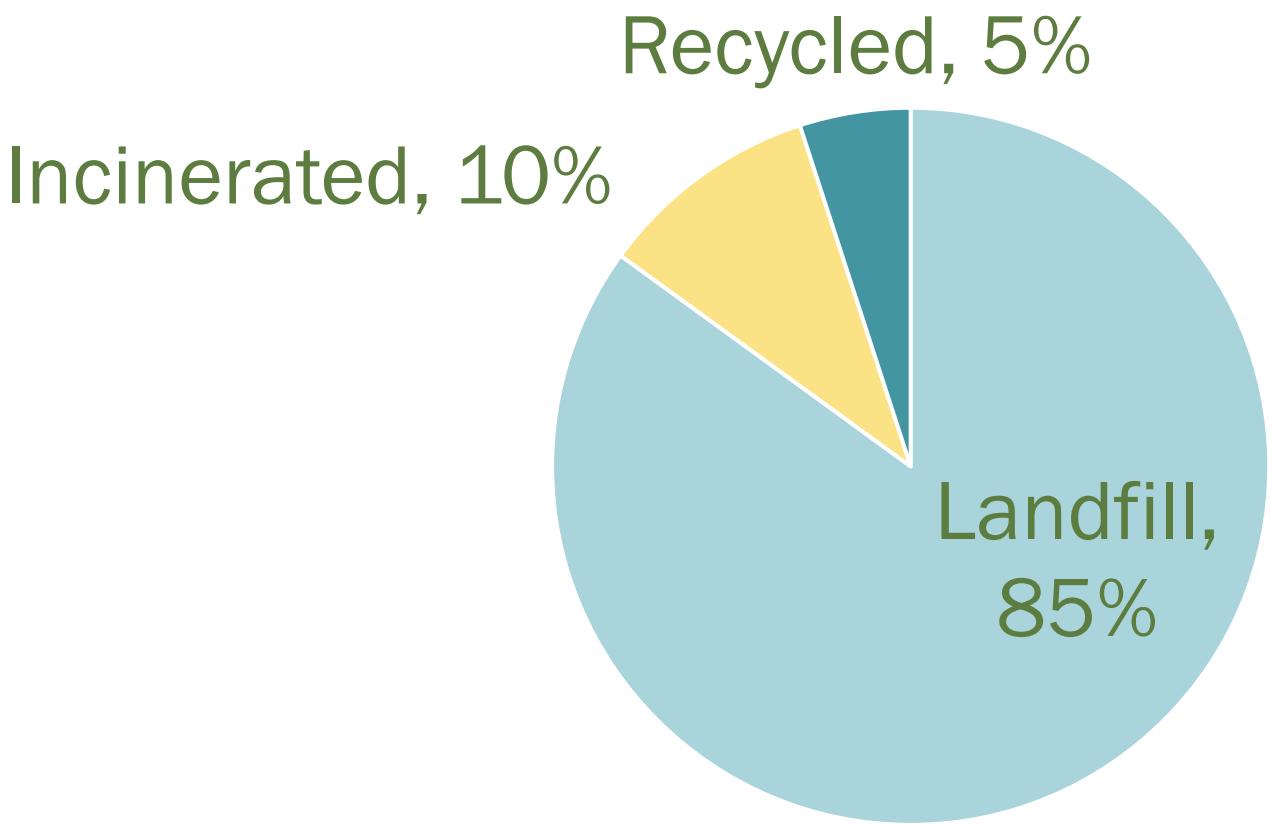


9%

According to the EPA, 2018

https://www.epa.gov/sites/default/files/2020-11/documents/2018_tables_and_figures.pdf

Disposition of plastics, 2021



https://www.beyondplastics.org/plastics-recycling-rates, 2022

When was plastic, as we know it, invented?

A – 1885

B – 1907

C – 1926

D – 1942

When was plastic, as we know it, invented?

A – 1885

B – 1907

C – 1926

D – 1942





In 2023, the town of East Palestine, Ohio, experienced a freight train derailment. What substance was spilled?

A – Arsenic

B – Vinyl chloride

C – Benzene

D – Ethylene glycol



Answer: Vinyl chloride

Vinyl chloride is a known carcinogen and is used to made polyvinyl chloride (PVC).



https://www.cancer.gov/about-cancer/causes-prevention/risk/substances/vinyl-chloride

Polyvinyl chloride









In 1956, the editor of *Modern Packaging*, Lou Stouffer said "The future of plastics is in the trash can." Why?

A - He was encouraging the manufacture of single-use plastics

B - He recognized that the environment would suffer from non-biodegradable trash

C – He thought trash cans should be made from plastic

In 1956, the editor of *Modern Packaging*, Lou Stouffer said "The future of plastics is in the trash can." Why?

A - He was encouraging the manufacture of single-use plastics



How many plastic bags are used in the US annually?

A - 600 million

B - 1 billion

C - 10 billion

D - 100 billion

E - 300 billion



How many plastic bags are used in the US annually?

D – 100 billion, almost one per day per adult



https://www.cnn.com/2023/01/12/business/walmart-plastic-bag-bans-grocery-stores/index.html

Artist: Mary Ellen Croteau from her series “Bag World”

Plastic bag recycling





So let's recycle those plastic bags!

- ABC News in Chicago 2023 put trackers on 46 plastic bags and dropped them at recycling bins at Walmart and Target stores nationwide
- 23 → landfills or trash incinerators
- 7 → transfer stations that do not recycle plastic
- 6 → remained at the store
- 3 → unknown
- 3 → Malaysia and Indonesia
- 4 → recycling facilities

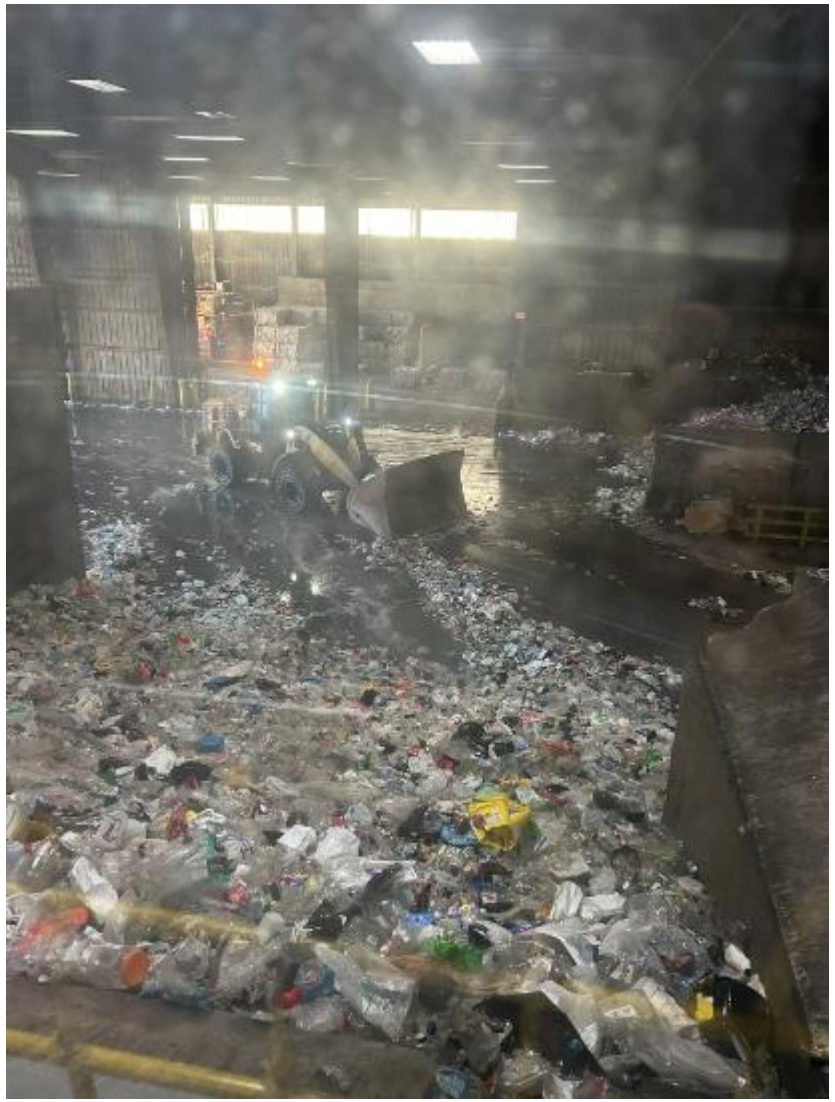
https://tinyurl.com/yeypah6s

What about recycling?



Do you know how we manage our trash?





Recycling Center, Montgomery County

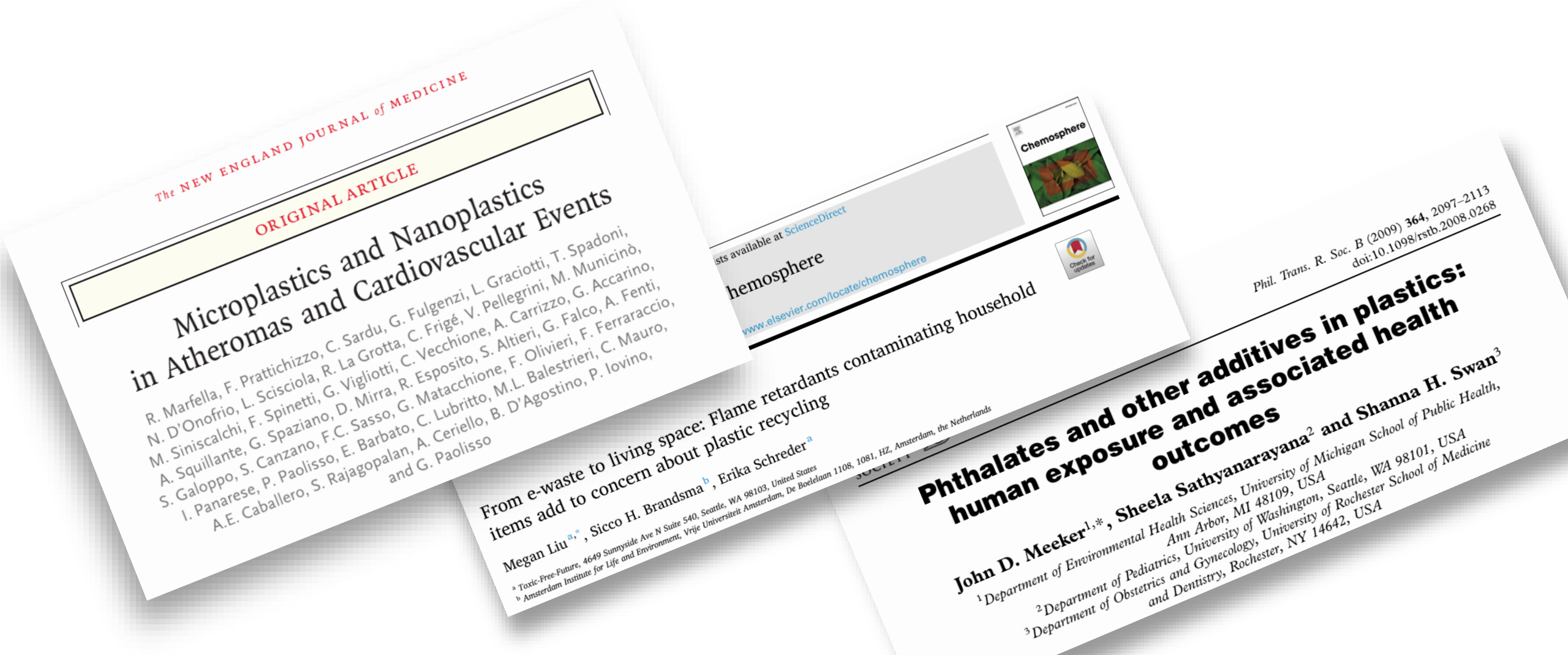
1	2	3	4	5	6	7
PET	HDPE	PVC	LDPE	PP	PS	OTHER
POLYETHYLENE TEREPHTHALATE	HIGH-DENSITY POLYETHYLENE	POLYVINYL CHLORIDE	LOW-DENSITY POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	OTHER
WATER BOTTLES; JARS; CAPS	SHAMPOO BOTTLES; GROCERY BAGS	CLEANING PRODUCTS; SHEETINGS	BREAD BAGS; PLASTIC FILMS	YOGURT CUPS; STRAWS; HANGERS	TAKE-AWAY AND HARD PACKAGING; TOYS	BABY BOTTLES; NYLON; CDS
						

Source: Reworld

Plastic Recyling Process



Potential ill health effects of microplastics



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Microplastics and Nanoplastics in Atheromas and Cardiovascular Events

R. Marfella, F. Prattichizzo, C. Sardu, G. Fulgenzi, L. Graciotti, T. Spadoni, N. D'Onofrio, L. Scisciola, R. La Grotta, C. Frigé, V. Pellegrini, M. Municinò, M. Siniscalchi, F. Spinetti, G. Vigliotti, C. Vecchione, A. Carrizzo, G. Accarino, A. Squillante, G. Spaziano, D. Mirra, R. Esposito, S. Altieri, G. Falco, A. Fenti, S. Galoppo, S. Canzano, F.C. Sasso, G. Matacchione, F. Olivieri, F. Ferraraccio, I. Panarese, P. Paolisso, E. Barbato, C. Lubritto, M.L. Balestrieri, C. Mauro, A.E. Caballero, S. Rajagopalan, A. Ceriello, B. D'Agostino, P. Iovino, and G. Paolisso

sts available at ScienceDirect

hemosphere

ww.elsevier.com/locate/chemosphere

Chemosphere

Check for updates

From e-waste to living space: Flame retardants contaminating household items add to concern about plastic recycling

Megan Liu[a,*], Sicco H. Brandsma[b], Erika Schreder[a]

[a] Toxic-Free-Future, 4649 Sunnyside Ave N Suite 540, Seattle, WA 98103, United States
[b] Amsterdam Institute for Life and Environment, Vrije Universiteit Amsterdam, De Boelelaan 1108, 1081, HZ, Amsterdam, the Netherlands

Phil. Trans. R. Soc. B (2009) 364, 2097–2113
doi:10.1098/rstb.2008.0268

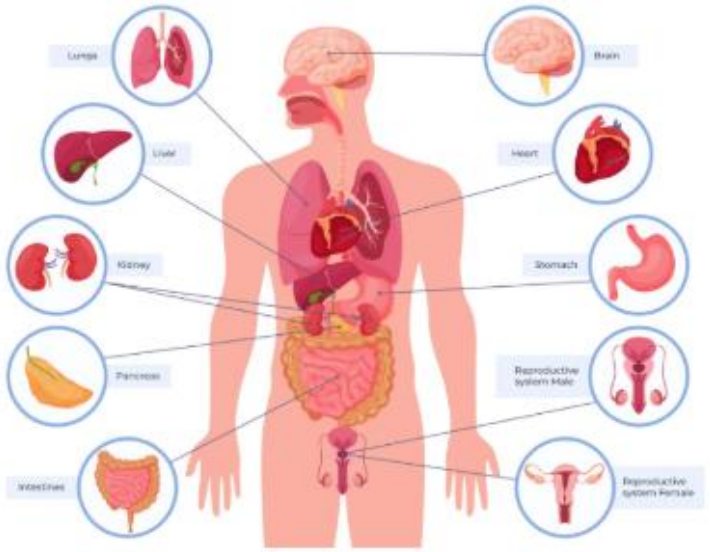
Phthalates and other additives in plastics: human exposure and associated health outcomes

John D. Meeker[1,*], Sheela Sathyanarayana[2] and Shanna H. Swan[3]

[1]Department of Environmental Health Sciences, University of Michigan School of Public Health, Ann Arbor, MI 48109, USA
[2]Department of Pediatrics, University of Washington, Seattle, WA 98101, USA
[3]Department of Obstetrics and Gynecology, University of Rochester School of Medicine and Dentistry, Rochester, NY 14642, USA

Plastics found in the human body

Where are the microplastics?



Lung - May 2021

Meconium - June 2021

Sputum - Jan 2022

Blood - May 2022

Breast Milk - June 2022

Liver - Aug 2022

Urine - Dec 2022

Veins - Feb 2023

Testes/Semen - March 2023

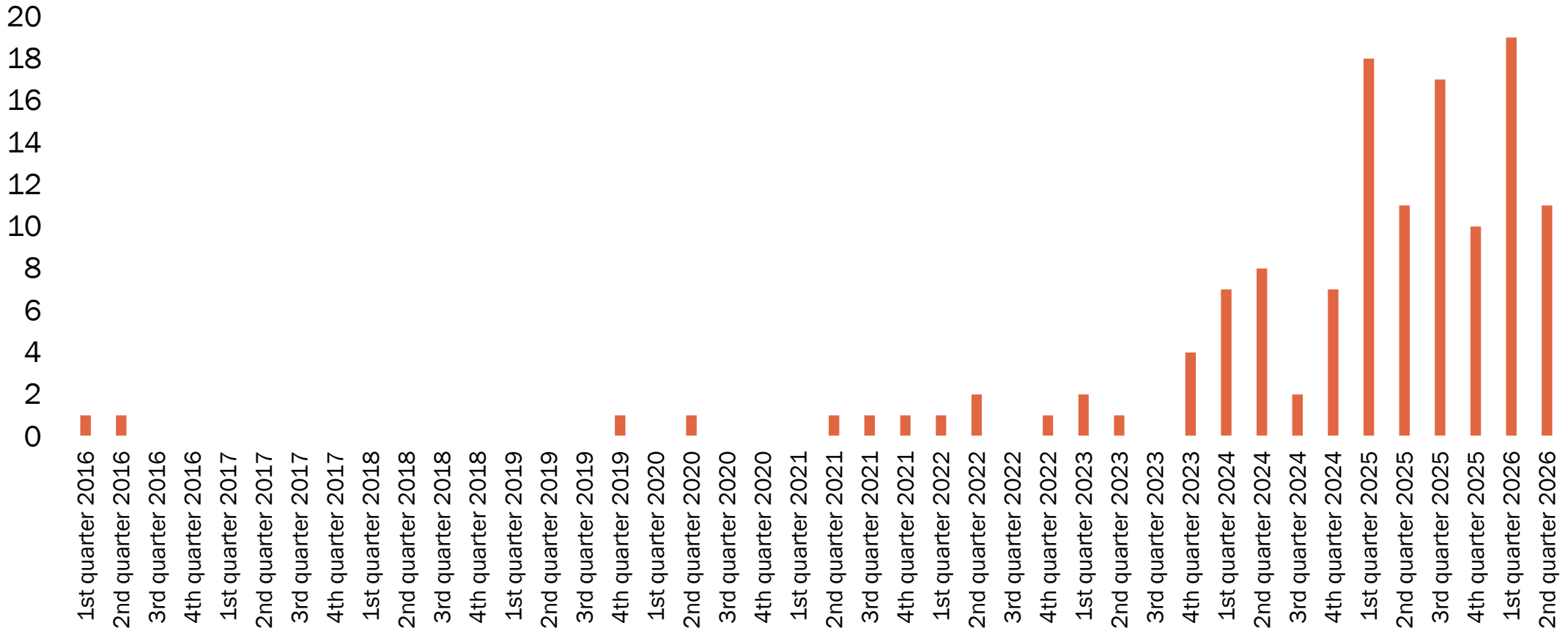
Heart Tissue - Aug 2023

Kidney - Feb 2024

Brain – Feb 2025

Source: Megan Wolff 2025

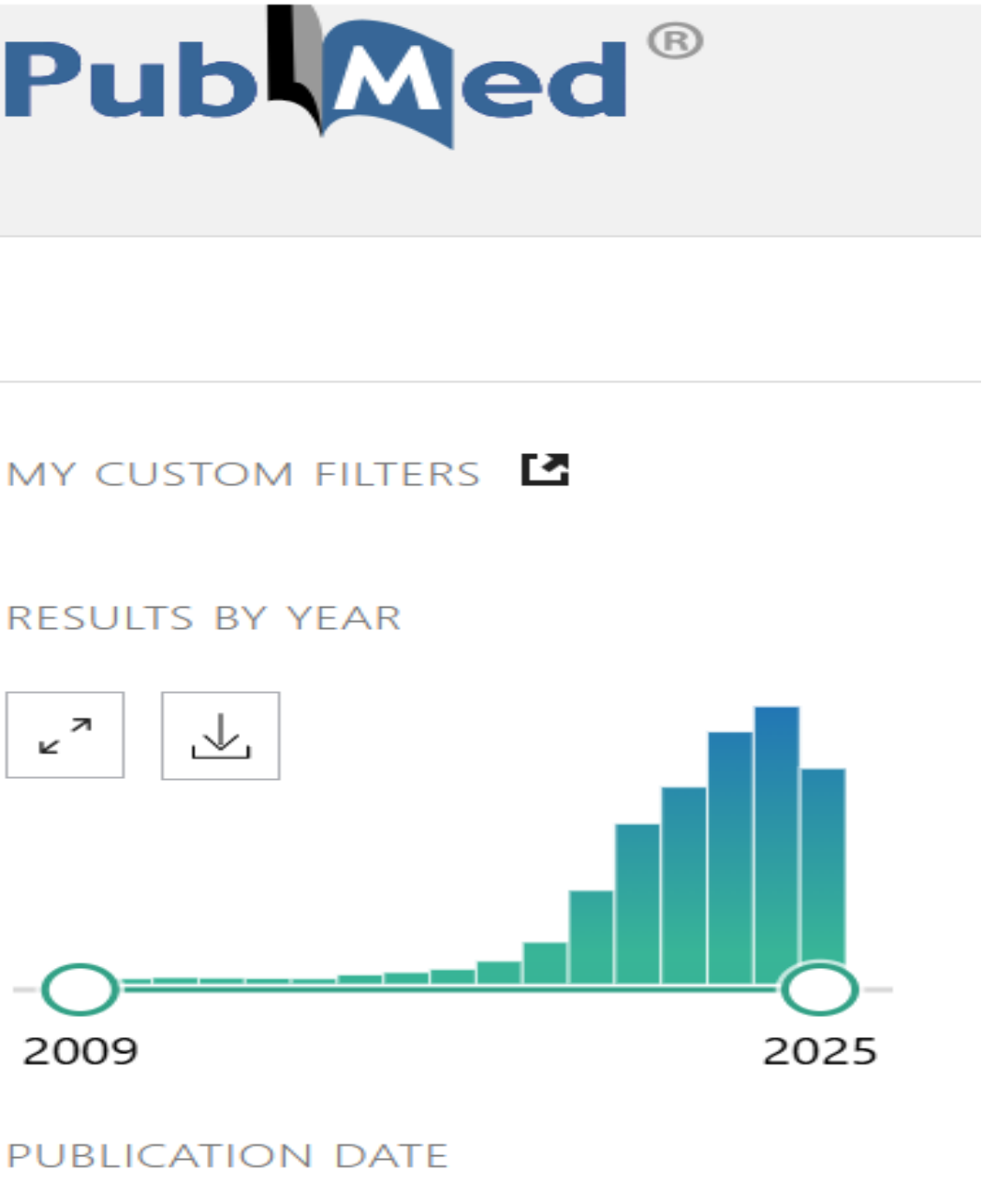
Articles including “microplastics” in Washington Post, 2016-present



Data reviewed 7/27/2026

Similar analysis in PubMed – keyword=microplastics

Conducted 9/20/25



Concern about black plastic

ELSEVIER

Chemosphere

Volume 365, October 2024, 143319



From e-waste to living space: Flame retardants contaminating household items add to concern about plastic recycling

Megan Liu [a], Sicco H. Brandsma [b], Erika Schreder [a]

Concern about black plastic

- Researchers obtained 203 items from stores in Seattle or ordered online 2020-2022
- Included sushi trays and various utensils (slotted spoons, spatula, etc.) and also toys
- 85% of the samples contained flame retardants
- Publish erratum Feb 2025: “. . . the calculated daily intake remains an order of magnitude lower than the U.S. BDE-209 reference dose”



Published Sep 2024 https://www.sciencedirect.com/science/article/abs/pii/S0045653524022173

Leaching of substances from plastic containers

Disposable plastic materials release microplastics and harmful substances in hot water

Guoqiang Liu, Jian Wang *, Mengjie Wang, Rongrong Ying, Xuwei Li, Zhewei Hu, Ya Zhang *

Environmental Protection Key Laboratory of Soil Environmental Management and Pollution Control, Nanjing Institute of Environmental Sciences, Ministry of Ecology and Environment of China, Nanjing 210042, China

Science of the Total Environment 818 (2022) 15168

Leaching of substances from plastic containers - highlights

- Millions of submicron and microparticles were produced from hot water soaking of plastics.
- Increasing time or abrasion on plastics enhanced the release of microplastic particles.
- Organic chemicals and heavy metals were detected in leachate from heat-treated plastics.

One tip: Don’t heat food in plastic containers



Should we worry about this . . . ?



Micro- and nanoplastics and heart disease

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Microplastics and Nanoplastics in Atheromas and Cardiovascular Events

R. Marfella, F. Prattichizzo, C. Sardu, G. Fulgenzi, L. Graciotti, T. Spadoni, N. D'Onofrio, L. Scisciola, R. La Grotta, C. Frigé, V. Pellegrini, M. Municinò, M. Siniscalchi, F. Spinetti, G. Vigliotti, C. Vecchione, A. Carrizzo, G. Accarino, A. Squillante, G. Spaziano, D. Mirra, R. Esposito, S. Altieri, G. Falco, A. Fenti, S. Galoppo, S. Canzano, F.C. Sasso, G. Matacchione, F. Olivieri, F. Ferraraccio, I. Panarese, P. Paolisso, E. Barbato, C. Lubritto, M.L. Balestrieri, C. Mauro, A.E. Caballero, S. Rajagopalan, A. Ceriello, B. D'Agostino, P. Iovino, and G. Paolisso

ABSTRACT

BACKGROUND

Microplastics and nanoplastics (MNPs) are emerging as a potential risk factor for cardiovascular disease in preclinical studies. Direct evidence that this risk extends to humans is lacking.

METHODS

We conducted a prospective, multicenter, observational study involving patients who were undergoing carotid endarterectomy for asymptomatic carotid artery disease. The excised carotid plaque specimens were analyzed for the presence of MNPs with the use of pyrolysis–gas chromatography–mass spectrometry, stable isotope analysis, and electron microscopy. Inflammatory biomarkers were assessed with enzyme-linked immunosorbent assay and immunohistochemical assay. The primary end point was a composite of myocardial infarction, stroke, or death from any cause among patients who had evidence of MNPs in plaque as compared with patients

The authors' full names, academic degrees, and affiliations are listed in the Appendix. Dr. Marfella can be contacted at raffaele.marfella@unicampania.it or at the Department of Advanced Medical and Surgical Sciences, University of Campania "Luigi Vanvitelli," Piazza Miraglia, 2, 80138, Naples, Italy.

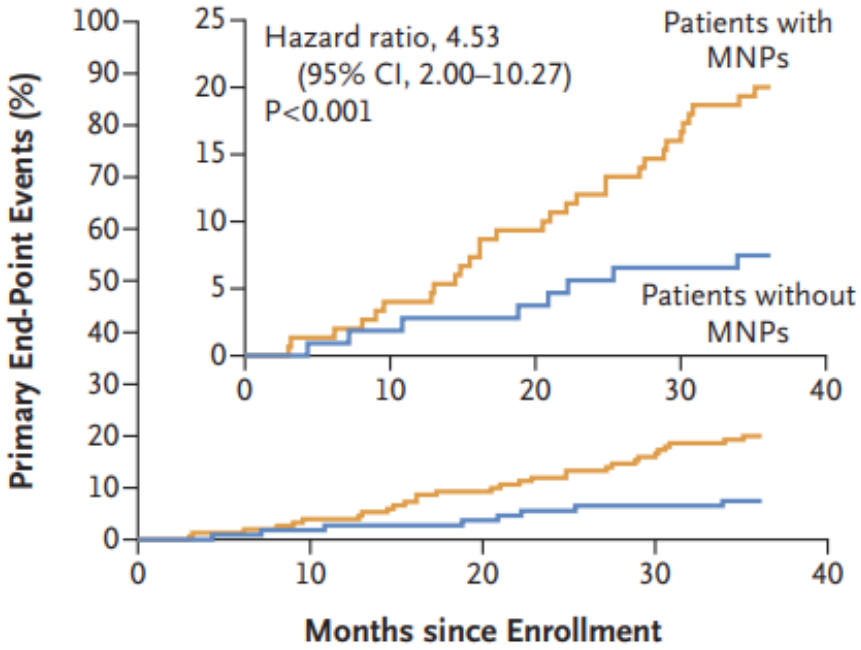
Drs. Marfella, Prattichizzo, Iovino, and G. Paolisso contributed equally to this article.

N Engl J Med 2024;390:900-10.
DOI: 10.1056/NEJMoa2309822
Copyright © 2024 Massachusetts Medical Society.

Micro- and nanoplastics and heart disease

- 304 patients who underwent endartectomy; 257 completed follow-up
- Excised carotid artery plaque was analyzed for plastic
- Polyethylene was detected in 150 patients (58.4%); 31 patients (12.1%) also had measurable amounts of polyvinyl chloride
- Electron microscopy revealed visible, jagged-edged foreign particles among plaque macrophages
- Patients with MNPs had a 4.5 higher risk of heart attack, stroke, or death over 34 months of follow-up

Micro- and nanoplastics and heart disease



No. at Risk

Patients with MNPs	150	144	136	126	120
Patients without MNPs	107	105	103	99	99

Figure 4. Associations between the Presence of MNPs and Cardiovascular Events.

Shown is the cumulative incidence curve of the composite outcome — nonfatal stroke, nonfatal myocardial infarction, or death from any cause. The results were estimated with the use of Cox regression analysis with adjustment for age, sex, body-mass index, total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides, creatinine, diabetes, hypertension, and previous cardiovascular events in the group of patients with evidence of MNPs in plaque and the group of patients with no evidence of MNPs in plaque. The inset shows the same data on an expanded y axis.

Micro- and nanoplastics and heart disease

- Did the plastic “cause” heart disease?
- The patients with and without MNPs were quite similar in terms of other risk factors for cardiovascular disease and medications
- Was the plastic a culprit, *per se*, or was there an accompanying chemical that caused CVD?

Plastics and Health

Up to 30-50% of a plastic can be additives

Five types of plastic additives



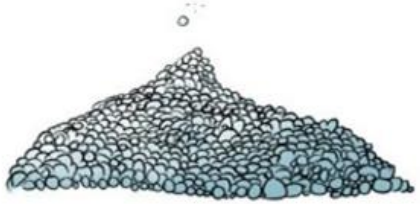
Functional

Includes, for example, stabilizers, antistatic agents, flame retardants, plasticizers, lubricants, slip agents, curing agents.



Colourants

Substances such as dyes or pigments added to give colour to plastic. Some of them are added to give a bright transparent colour.



Fillers

Added to change and improve physical properties of plastics. They can be minerals, metals, ceramics, bio-based, gases, liquids, or even other polymers.



Reinforcement

Used to reinforce or improve tensile strength, flexural strength and stiffness of the material. For example: glass fibres, carbon fibres.



NIAS

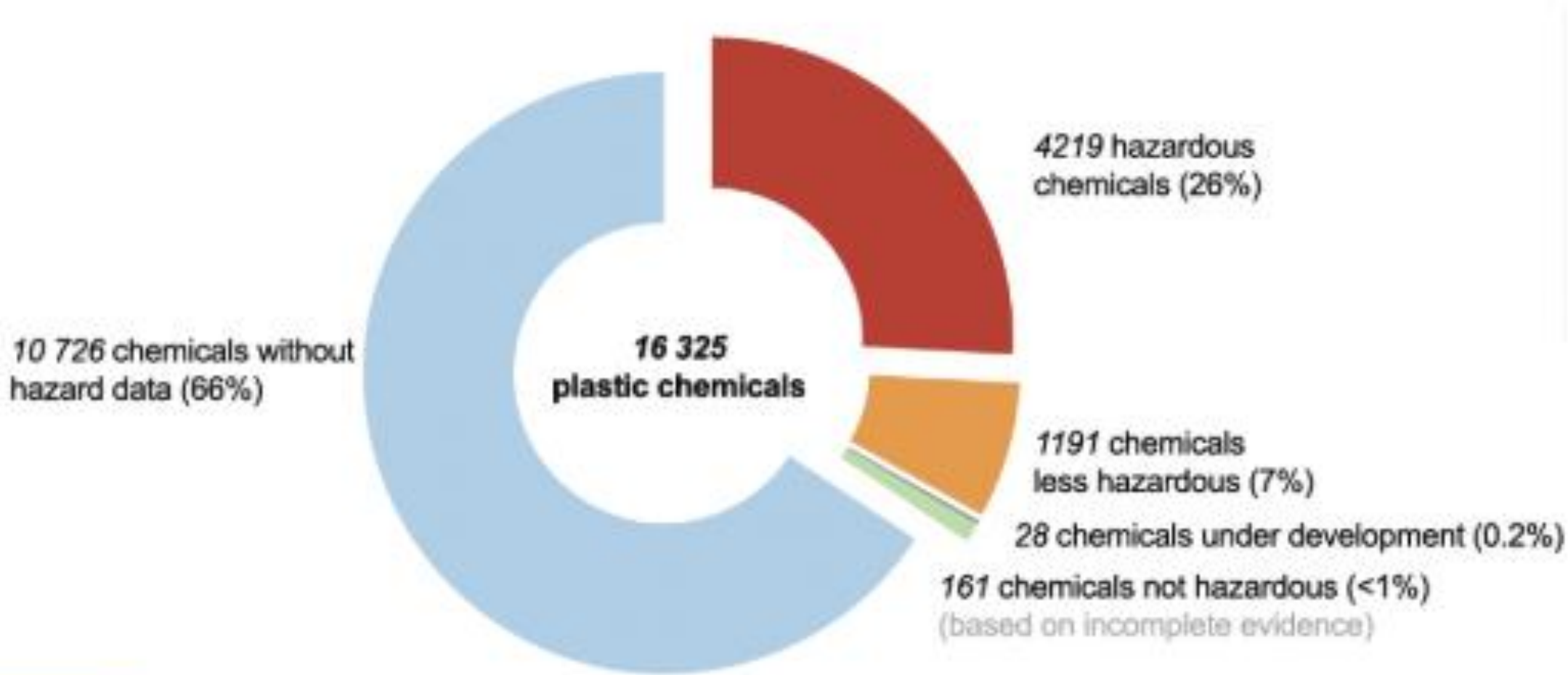
Non-intentionally added substances. They arrive in products from processes such as reaction by-products or breakdown products.

Source: Hansen et al. (2013). Illustration by GRID-Arendal (2020).

Flame retardants → Reduce flammability
Phthalates → Soften
Bisphenols (BPA) → Harden (polycarbonate reusable water bottle)
PFAS → Create water & grease resistance, slip agent/lubricant

Source: Megan Wolff 2025

Researchers have identified 16,325 chemicals in plastics.



PlastChem

March 2024

Phthalates and human health (2022)

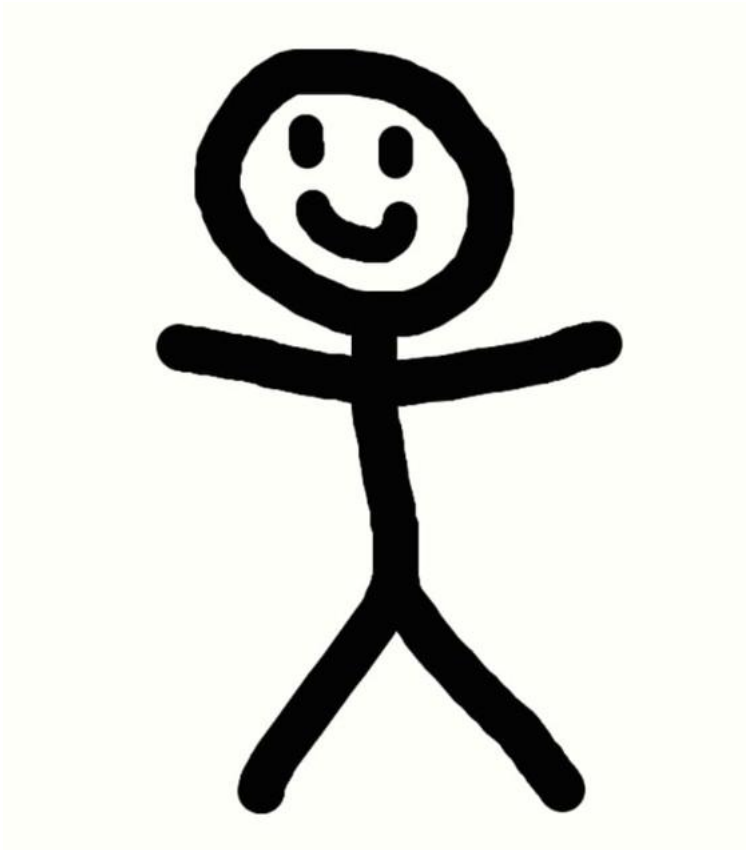
- Overview of available evidence
- “Robust” evidence for an association with lower semen quality, neurodevelopment, and risk of childhood asthma.
- “Moderate to robust” evidence for impact on anogenital distance in boys.
- “Moderate” evidence for an association with low birthweight, endometriosis, decreased testosterone, ADHD, Type 2 diabetes and breast/uterine cancer.
-

Human health impacts of exposure to phthalate plasticizers: An overview of reviews - ScienceDirect

So what can we do?



Personal and Societal





Personal Actions

- To protect our health
- To reduce pressure to create more plastic
- To help establish new norms

Personal action



Use this



Not this!

Societal action

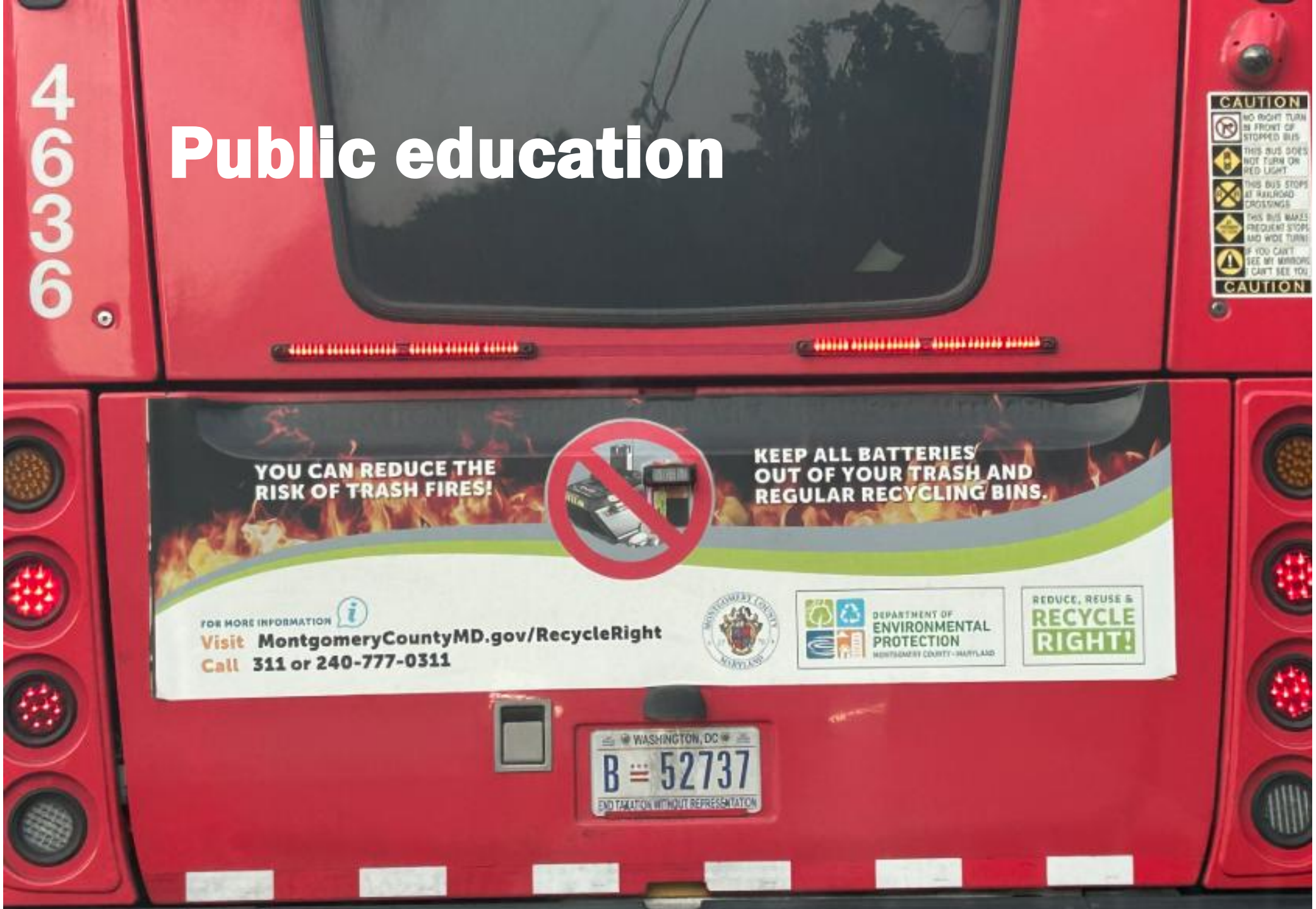
- Research
- Public education
- Legislation
- Industry pressure/legal action



Research

- Quantify the major entryways of plastic into the human body and determine how to minimize
- Determine the relative toxicity of plastic types and develop/promote non-toxic forms
- Develop alternatives to the food supply chain





Public education

EDUCATION & OUTREACH







Legislative Action – Ban plastic shopping bags

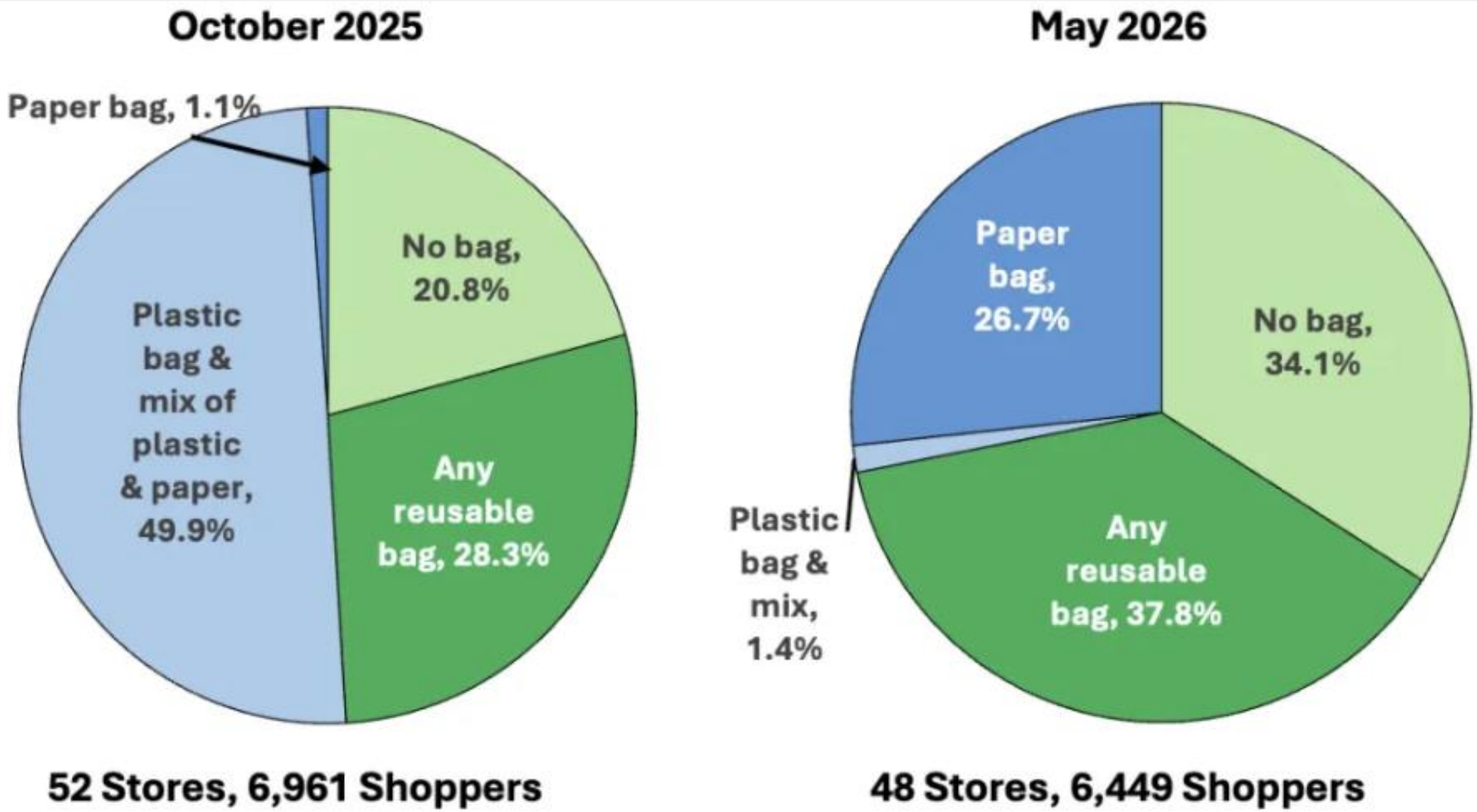
- Enacted in over 500 jurisdictions around the country
- They are highly effective!



Figure 1. The impact of the Bring Your Own Bag Law on shoppers' bag use

(Montgomery County, excluding Gaithersburg)

Distribution of Shoppers According to their Carryout Bag Choice (%)



52 Stores, 6,961 Shoppers **48 Stores, 6,449 Shoppers**

Stores: Food Lion, Giant, Harris Teeter, Safeway, Weis Market

Maryland Sierra Club

Legislative Action

- Bottle deposit bills
- Polystyrene bans
- Extended producer responsibility bills

BEYOND PLASTICS
MoCo Maryland

“Skip the Stuff” - Rethinking SUPs



- Created from fossil fuels
- Used for 15 minutes, then existing virtually *forever.*
- Many jurisdictions have enacted ordinances that require restaurants to **only** provide plastic utensils upon request

NEW

IMPORTANT NOTICE FOR RETAIL BUSINESSES IN MONTGOMERY COUNTY

"BRING YOUR OWN BAG" LAW

SCAN TO LEARN MORE

Effective January 1, 2026

Montgomery County passed a new law that affects how your business may provide carryout bags to customers. Please review the following information carefully to ensure your business is in compliance.

CHANGE IS IN THE BAG

Industry pressure



Break Free From Plastic Brand Audit Report 2018

Support campaigns against producers

Top Brands Responsible for Plastic Waste

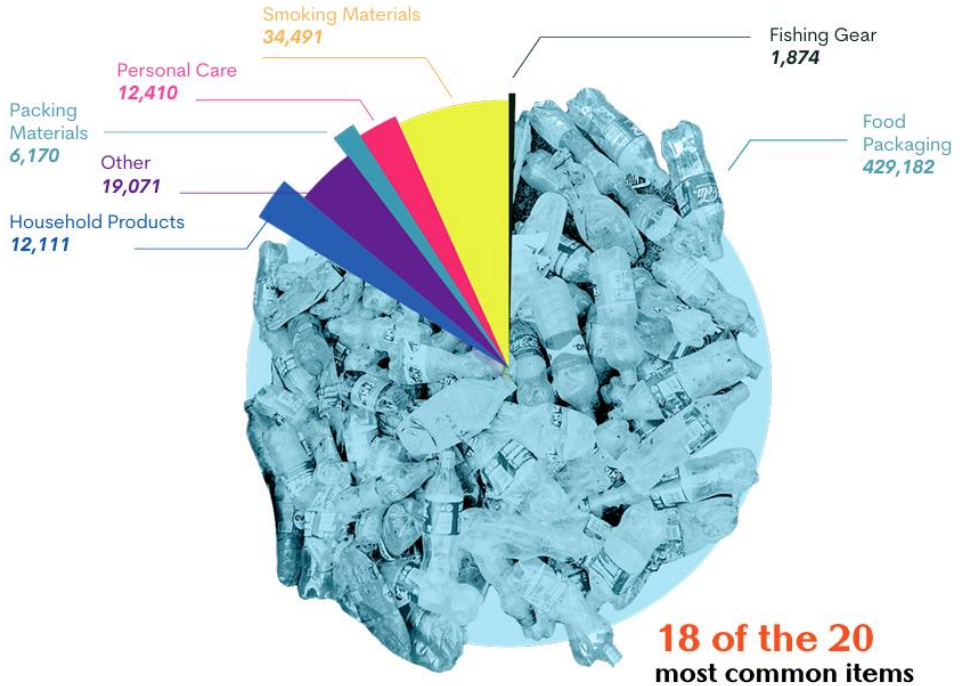


Break Free From Plastic Brand Audit Report 2018

2023 Brand Audit

Top 10 Global Corporate Plastic Polluters of 2023

Ranking	Company	Countries	Total Count	Most Common Item	Most Common Brand
1	The Coca-Cola Company	40	33,820	Bottles (17,703)	Coca-Cola (16,931)
2	Nestlé	33	9,931	Bottles (4,586) and Food Wrappers (3,451)	Nestlé Water[1] (4,586)
3	Unilever	31	4,485	Detergents (1,439), Sachets (700), and Bottles (492)	Surf Excel (1,440)
4	PepsiCo	30	34,780	Food Wrappers (11,080) and Bottles (13,861)	Lay's (7,336)
5	Mondelēz International	26	8,094	Food Wrappers (7,219) Candy Wrappers (100), Food	Center Fruit (3,936)



18 of the 20 most common items recorded were food packaging, primarily beverage bottles, food wrappers, and food containers.

BFFP Brand Audit Report 2023.pdf - Google Drive

Legal Action

SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF SAN FRANCISCO

THE PEOPLE OF THE STATE OF CALIFORNIA, ex rel. ROB BONTA, ATTORNEY GENERAL OF CALIFORNIA, Plaintiff, **v.** **EXXON MOBIL CORPORATION; AND DOES 1 THROUGH 100, INCLUSIVE,** Defendants.	Case No. **COMPLAINT FOR ABATEMENT, EQUITABLE RELIEF, AND CIVIL PENALTIES; PRELIMINARY AND PERMANENT INJUNCTION** **JURY TRIAL DEMANDED** **(1) PUBLIC NUISANCE;** **(2) GOVERNMENT CODE SECTION 12607;** **(3) WATER POLLUTION;** **(4) UNTRUE OR MISLEADING ADVERTISING;** **(5) MISLEADING ENVIRONMENTAL MARKETING; AND** **(6) UNLAWFUL, UNFAIR, OR FRAUDULENT BUSINESS PRACTICES.**

State of California vs. Exxon-Mobil

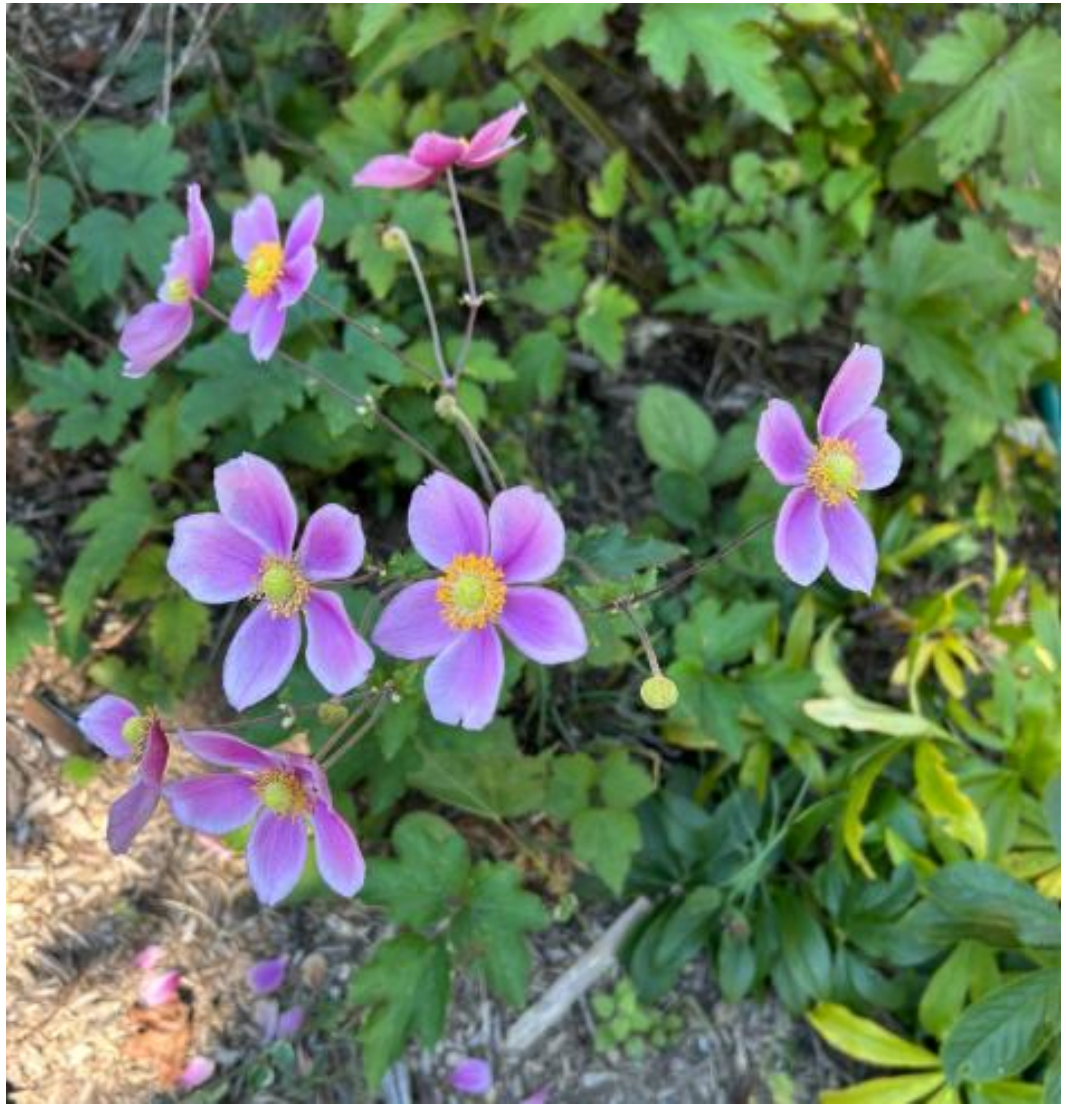
- Public nuisance
- Water pollution
- Untrue or misleading advertising
- Misleading environmental marketing

Take-home Lessons

- The plastic problem is a relatively recent one, which suggests it's addressable!
- Plastic recycling is not the answer; we must reduce use and prevent further production.
- Individual actions are important, but we need systemic solutions.

SPEED BUMP DAVE COVERLY





Thank you!

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