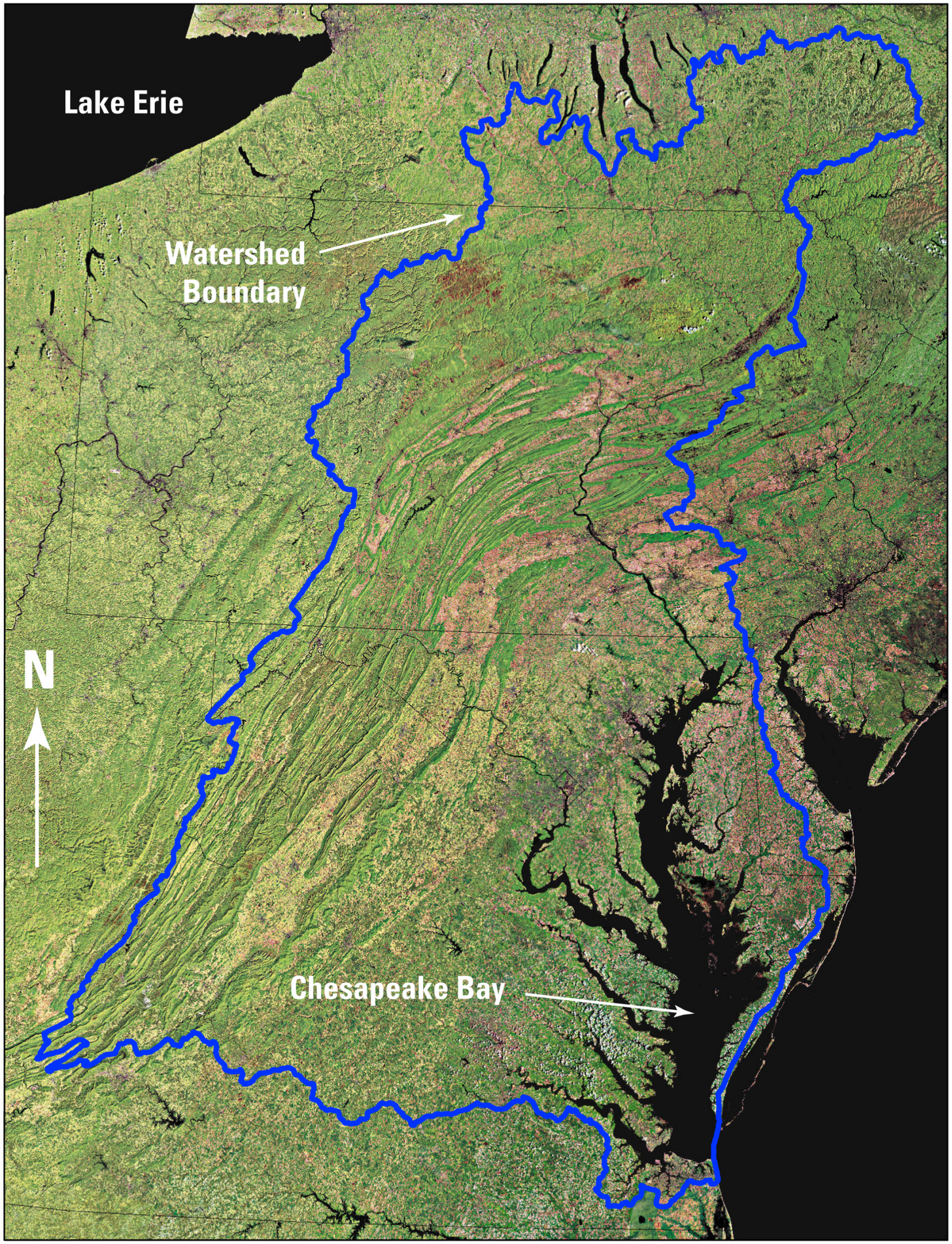
Science, Education, Policy, and Innovation: What's the Recipe?

Or, Being Therapists

Mid-Atlantic Marine Debris Summit, 17 June 2019, Denice Heller Wardrop


Lake Erie
Watershed Boundary
N
Chesapeake Bay

How did we get here?

Why did we fall in love, and how did we fall out of it?

17 June 2019

CAUTION! DO NOT USE THESE BALLS IMMEDIATELY
REASONS WHY—We advise and urge customers the exercise of great care in the treatment of Ivory Billiard and Pocket Balls. When you receive Ivory Balls, do not use them until they have been on hand long enough, (at least a week) to bring them to the temperature of the room. We import the finest soft Zanzibar elephant tusk ivory, which is thoroughly seasoned in our shops before being sent out; but in cold weather, ivory will break and split if used directly upon its reception, no matter how well seasoned it may be. We study the interests of our customers when we advise them to purchase their stock of Ivory balls during the warm weather, so that they shall be thoroughly seasoned and raised to the temperature of the room in which they are used; but in cases where our customers insist upon the shipment of the goods in the dead of winter, they must take all responsibility, and risk of damage on account of cold weather. The balls leave our hands perfectly sound, and of the very best material, but we cannot guarantee them against breaking or splitting at any time of the year, particularly during the winter months. Avoid removing the balls in different temperatures of heat and cold. Sudden changes from cold to warm or warm to cold rooms, will injure and frequently crack them. Draughts from open doors, or open windows, striking the balls while in use on the tables, are more apt to injure them than anything else.
WE ADVISE POSITIVELY AGAINST THE USE OF SWEET OIL FOR THE PRESERVATION OF IVORY.
The oil simply discolors the ivory, and makes the balls sticky and heavy, and causes the balls to deteriorate.
Whenever the balls are removed from the table, after having been in use, they should be wiped with a damp cloth or sponge, and then rubbed thoroughly dry, for which purpose a piece of chamois is best suited. The use of alcohol is preferable to water for cleaning, as it evaporates quickly, and therefore does not affect the ivory, no matter what condition the weather may be.
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GLORIOUS LOVE STORY WITH MUSIC
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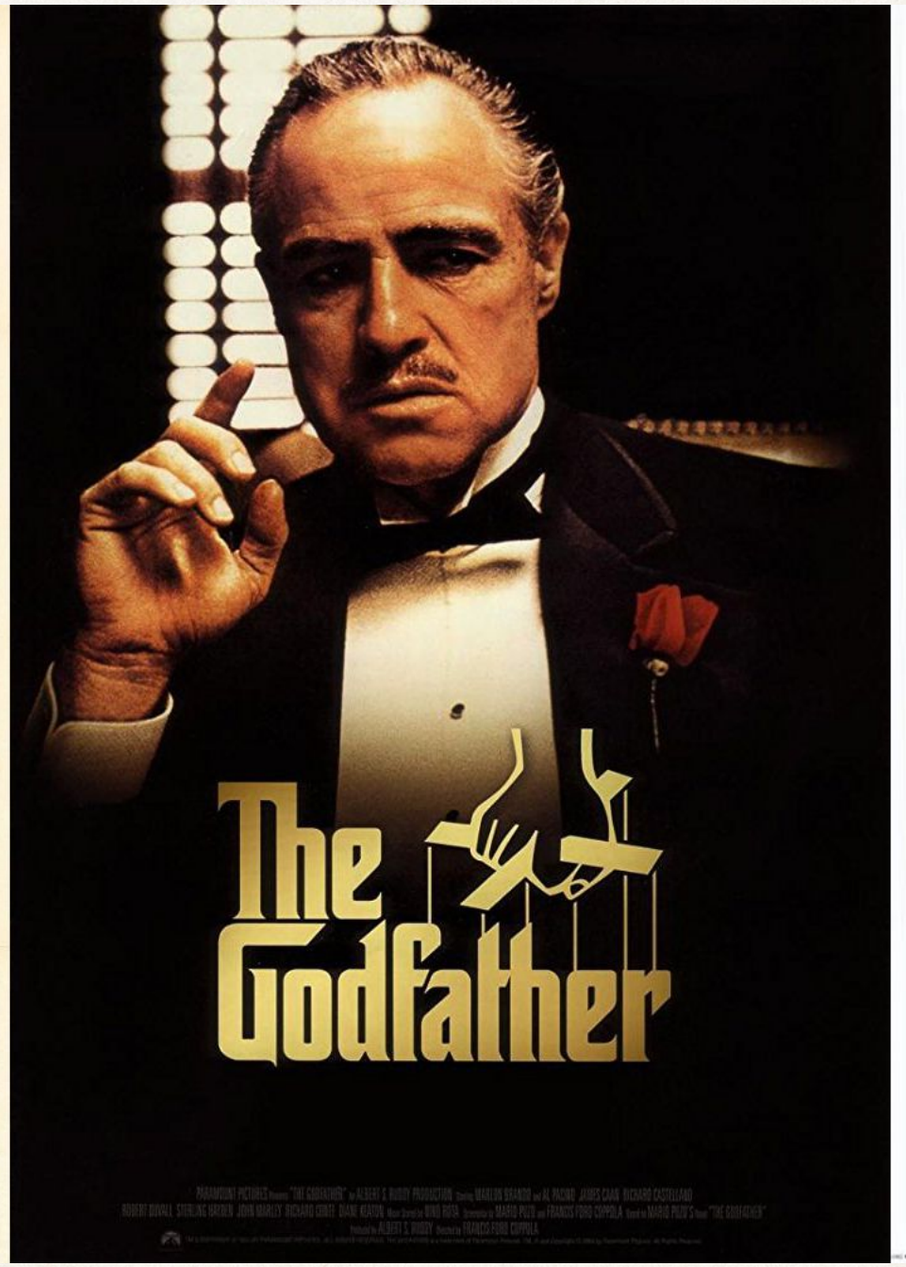
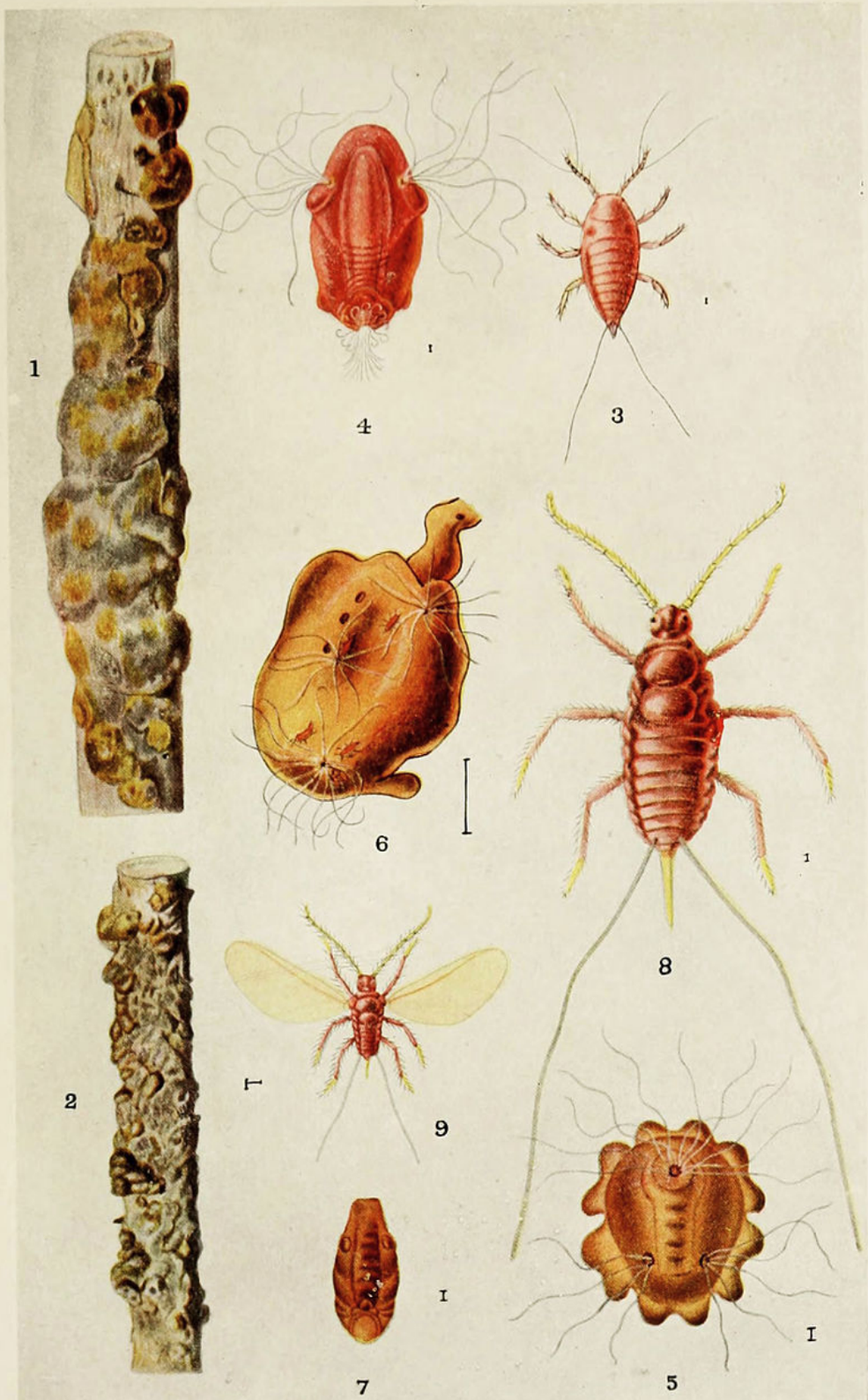
SCREEN PLAY BY IRVING BRECHER AND FRED F. FINKLEHOFFE BASED ON THE BOOK BY SALLY BENSON
A METRO-GOLDWYN-MAYER PICTURE DIRECTED BY VINCENTE MINNELLI PRODUCED BY ARTHUR FREED
Photographed in TECHNICOLOR


The Godfather

Humphrey Ingrid Paul
BOGART·BERGMAN·HENREID
A HAL B. WALLIS PRODUCTION
"Casablanca"
CLAUDE RAINS · CONRAD VEIDT · SYDNEY GREENSTREET · PETER LORRE
Directed by MICHAEL CURTIZ

АСТ-2У3
сделано в СССР
ОТСЕЧКА
1976г



TACHARDIA LACCA

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How can you hit enemies you can't see—through clouds, darkness and fog? The answer is Radar—radio detecting and ranging equipment.

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* * *

Radar is the result of the work of many research groups in this country and abroad. Bell Telephone Laboratories has played an important part in its development. Western Electric today is one of the world's largest manufacturers of Radar.

Western Electric

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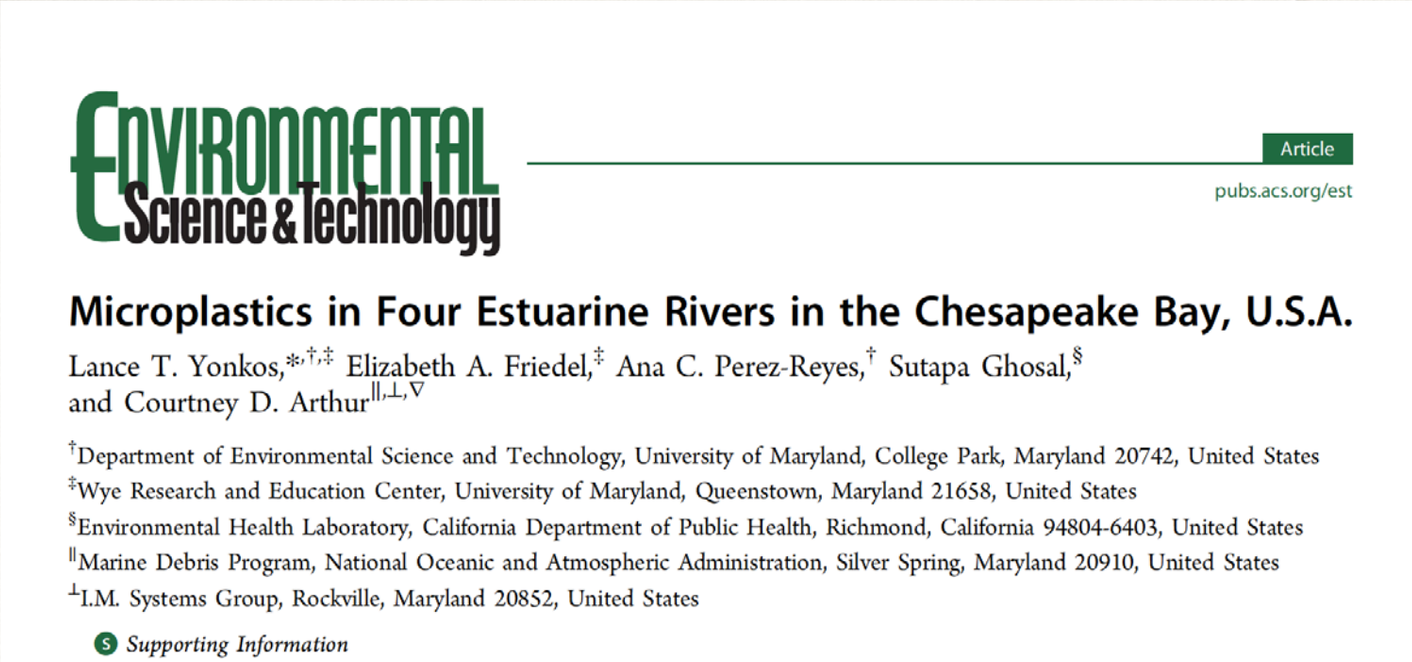
ARMY E NAVY

USE IT UP – WEAR IT OUT –
MAKE IT DO!
OUR LABOR AND OUR GOODS ARE FIGHTING

FADA


Environmental Science & Technology

Article

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Microplastics in Four Estuarine Rivers in the Chesapeake Bay, U.S.A.

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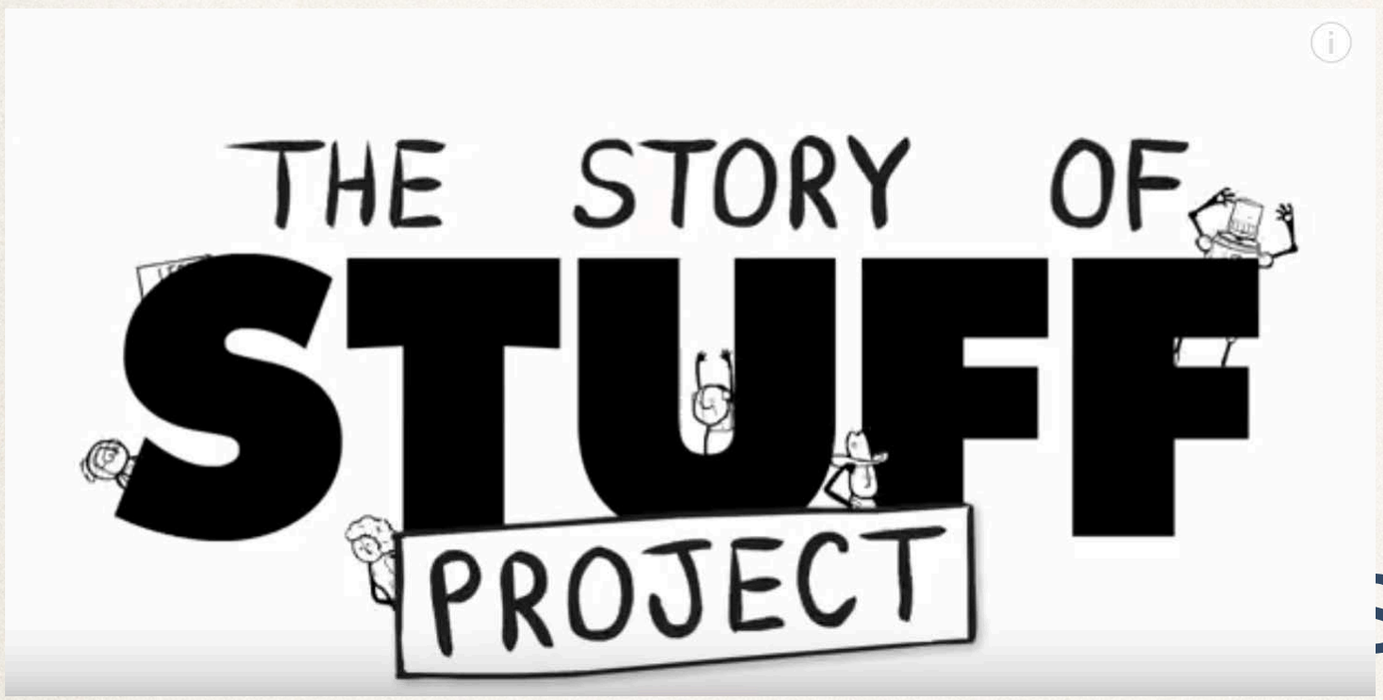
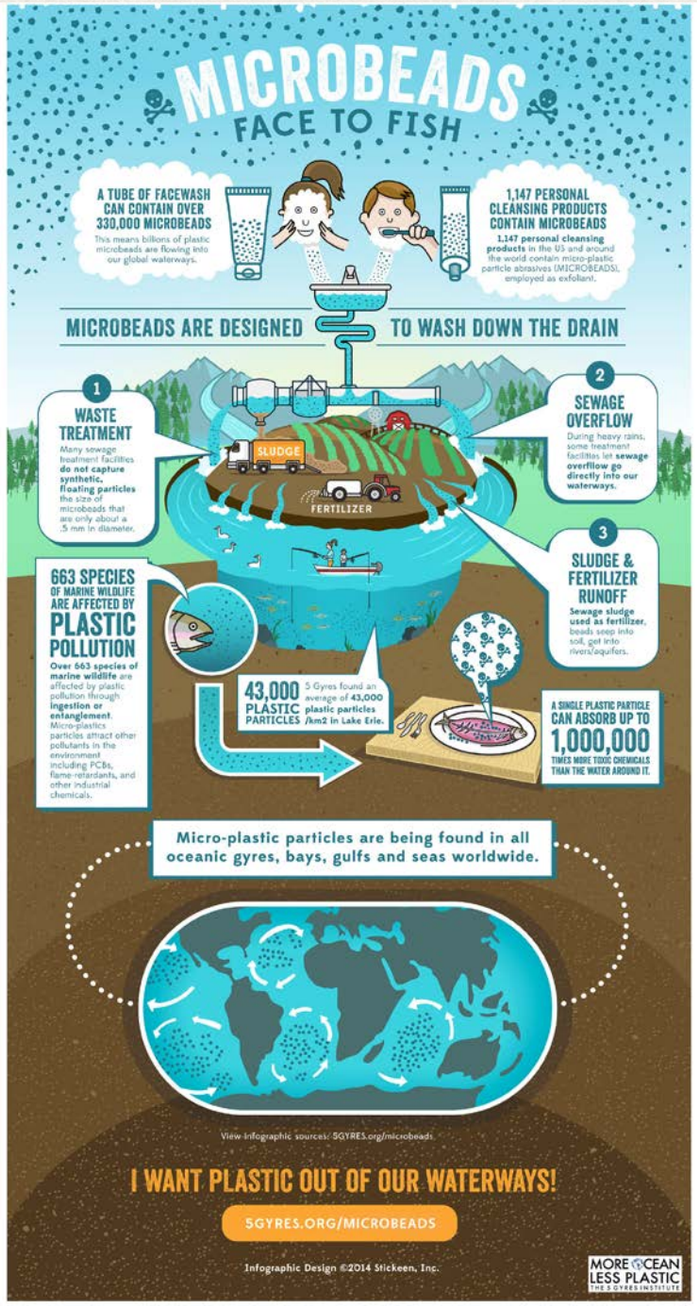
[⊥]I.M. Systems Group, Rockville, Maryland 20852, United States

Supporting Information





channels

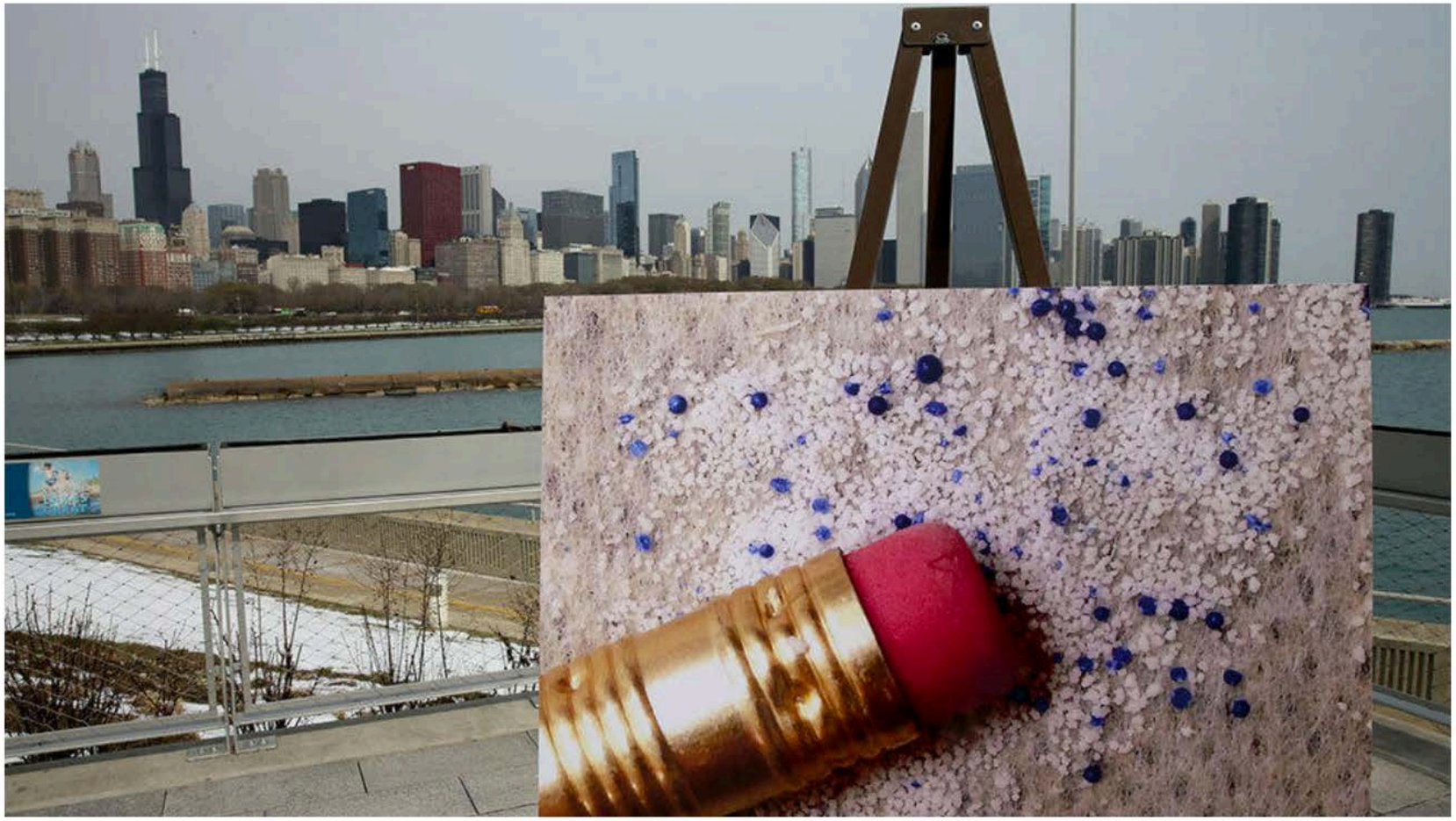
Public education, pressure manufacturers, legislation at state level

On the hunt. The RV *Hesperides* tows along a net designed to skim the ocean surface, catching floating plastic particles (*inset*). JOAN COSTA

Ninety-nine percent of the ocean's plastic is missing

By **Angus Chen** | Jun. 30, 2014 , 3:30 PM

Governor signs bill making Illinois first state to ban microbeads



Enlarged photo of tiny synthetic plastic particles called microbeads placed for a press conference outside the Shedd Aquarium on April 16. (Antonio Perez, Chicago Tribune)

Step 2: Illinois Bill

Not all microbeads, not all sources, plus following definition: ”Synthetic plastic microbead" means any intentionally added non-biodegradable solid plastic particle.

Figure 1. Image of the contents of a sample taken by a manta net with a 333 µm mesh deployed in the Back River for 15 minutes at 2 knots in September of 2015 (Julie Lawson of Trash Free Maryland).

Step 3: Partnerships emerge

In September of 2015, Julie Lawson of Trash Free Maryland and Chelsea Rochman sampled for microplastic debris in the Chesapeake Bay from the Back River to the mouth of the Potomac

LAWRENCE J. HOGAN, JR., Governor Ch. 409

Chapter 409

(House Bill 216)

AN ACT concerning

Environment – Personal Care Products Containing Synthetic Plastic Microbeads – Prohibition on Manufacturing or Sale

FOR the purpose of prohibiting a person from manufacturing for sale or accepting for sale a personal care product or an over–the–counter drug that contains synthetic plastic microbeads on or after certain dates; *requiring the Department of the Environment to adopt certain regulations; requiring the Department to periodically review certain guidelines to ensure that certain methods are being utilized to prevent the entrance of synthetic plastic microbeads into the natural aquatic environment of the State;* defining certain terms; and generally relating to synthetic plastic microbeads.

Step 4: Bay State Legislation

2015 Maryland Delegate Barbara Frush (as Chair of the Environment Subcommittee of House Environment and Transportation) and the other House members of the CBC successfully moved legislation to ban the manufacture and sale of microbeads in a limited number of personal care products. No cosmetics. No sunscreen. Scrubs and other cleaning products were the focus.

“Chesapeake Bay Commission members in Virginia, Maryland, and Pennsylvania are considering legislation that would ban the sale or manufacture of consumer products containing microbeads and want to base their action on science. During the 2015 General Assembly session, for example, CBC member Virginia Delegate David Bulova sponsored HB 1697 that proposed a microbead ban, but failed to pass. The committee hearing the bill expressed a need for additional scientific knowledge of environmental impacts. The Virginia Manufacturing Commission will be considering the issue this year in advance of the 2016 legislative session. Maryland is currently considering similar legislation; Pennsylvania senators are poised to take complimentary action.”

STAC Workshop Proposal for 2015 Funds, Ann Swanson

Public Law 114–114
114th Congress

An Act

To amend the Federal Food, Drug, and Cosmetic Act to prohibit the manufacture and introduction or delivery for introduction into interstate commerce of rinse-off cosmetics containing intentionally-added plastic microbeads.

Dec. 28, 2015
[H.R. 1321]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Microbead-Free Waters Act of 2015.
21 USC 301 note.

SECTION 1. SHORT TITLE.

This Act may be cited as the "Microbead-Free Waters Act of 2015".

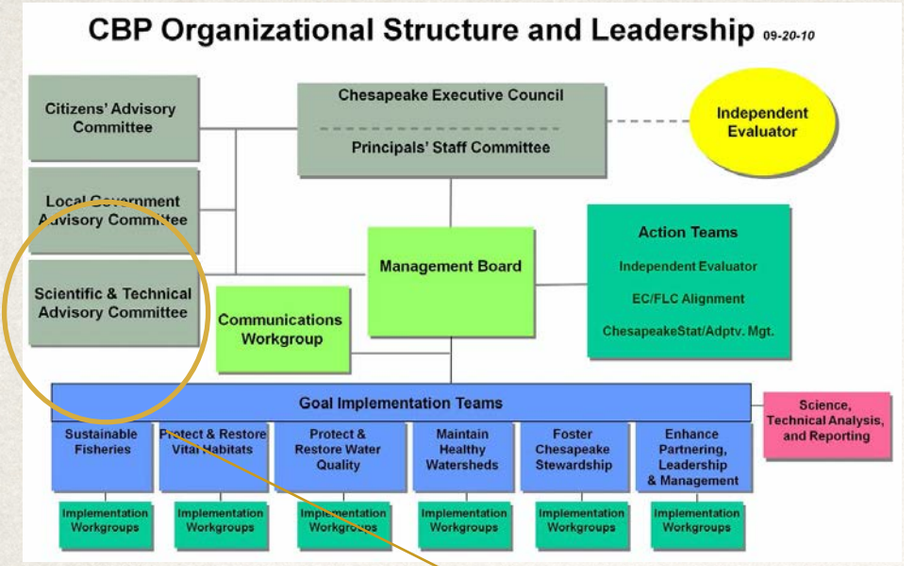
SEC. 2. PROHIBITION AGAINST SALE OR DISTRIBUTION OF RINSE-OFF COSMETICS CONTAINING PLASTIC MICROBEADS.

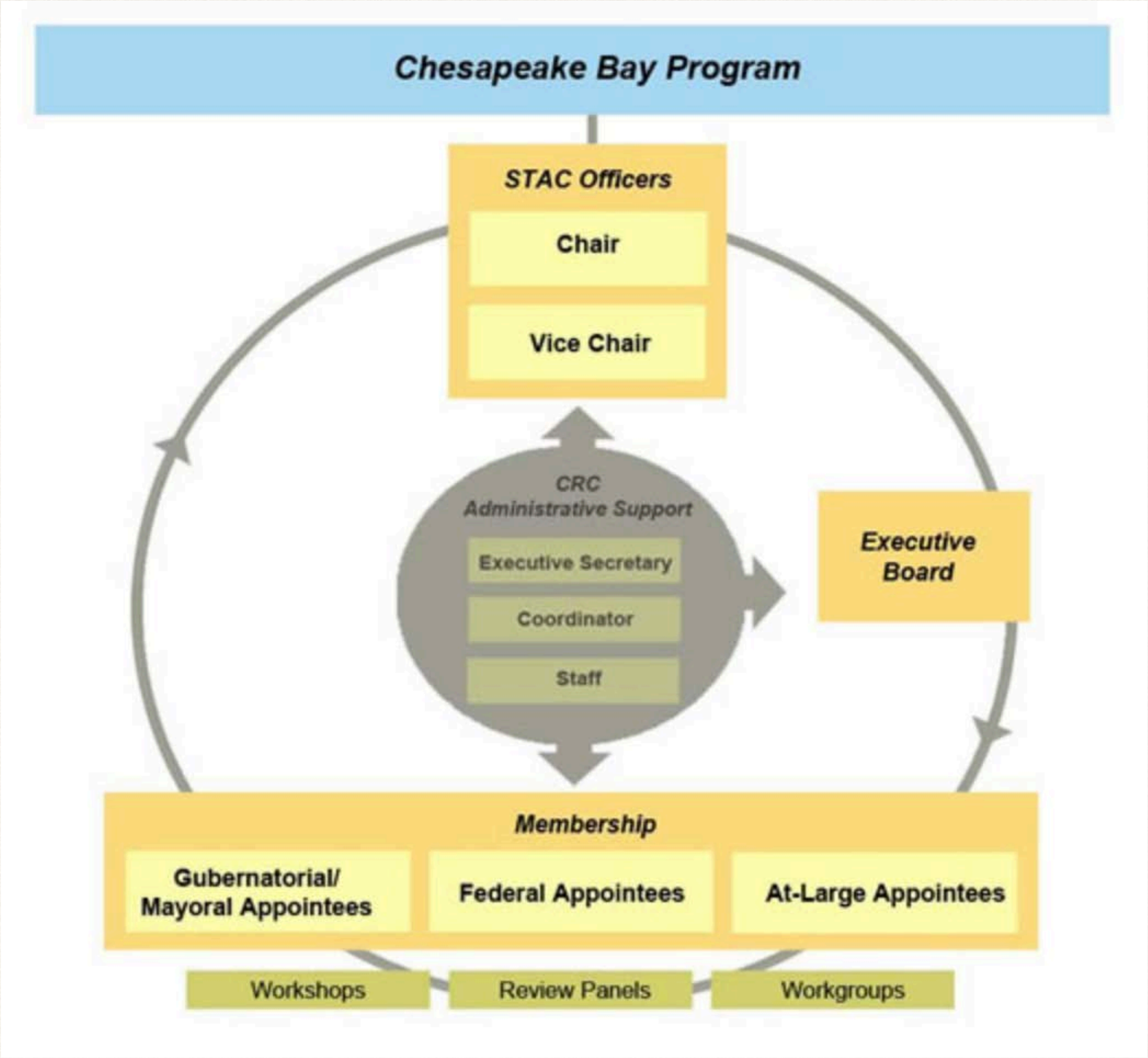
(a) IN GENERAL.—Section 301 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 331) is amended by adding at the end the following:

"(ddd)(1) The manufacture or the introduction or delivery for introduction into interstate commerce of a rinse-off cosmetic that contains intentionally-added plastic microbeads.

Microbead Free Waters Act of 2015

Not all microbeads, not only source. Opportunity to comment on language and definitions.





STAC Tools

What is the appropriate tool?

Custom Process

- Review, not workshop
- Structuring questions were collaboratively developed (scientists, CBC members, additional state legislators)
  - *Fate & transport*
  - *Impact*
  - *Treatment*
  - *Urgency of intervention*

Fate & Transport

- What is the proper definition of ‘degradable’ in regard to microbeads in the aquatic environment, and what factors impact degradability and rate of breakdown?
- Is there a concern that contaminants from the water can adhere to synthetic plastic microbeads?
- What is the potential geographic range of impact, i.e., is their impact quite local (like sediment) or does their buoyancy allow them to travel great distances (more like air)?

Potential Impact

- Are there physical impacts of microplastic to aquatic organisms?
- Is there a risk that synthetic plastic microbeads, both with and without sorbed contaminants, could serve as a vector to aquatic organisms?
- What is the evidence of bioaccumulation and is it worse in certain types of species such as mollusks, filter feeding forage fish, etc.?
- Is there a risk that synthetic plastic microbeads that have sorbed contaminants could serve as a significant health risk for humans?
- Are there any research findings on microplastics specific to the Chesapeake Bay and its tributaries?

Treatment

- What is the expected removal of microbeads/microplastics in conventional wastewater treatment facilities in the Chesapeake Bay watershed? What are the removal mechanisms? What is the fate of the microbeads/microplastics?
- What is the extent of microbead/microplastic discharge from combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs)?
- Are there emerging technologies that could enhance removal of microbeads/microplastics? What is the potential for the implementation of these emerging technologies?
- Does it make sense to place most of the burden of microbead/microplastic control on WWTPs?

Potential Urgency

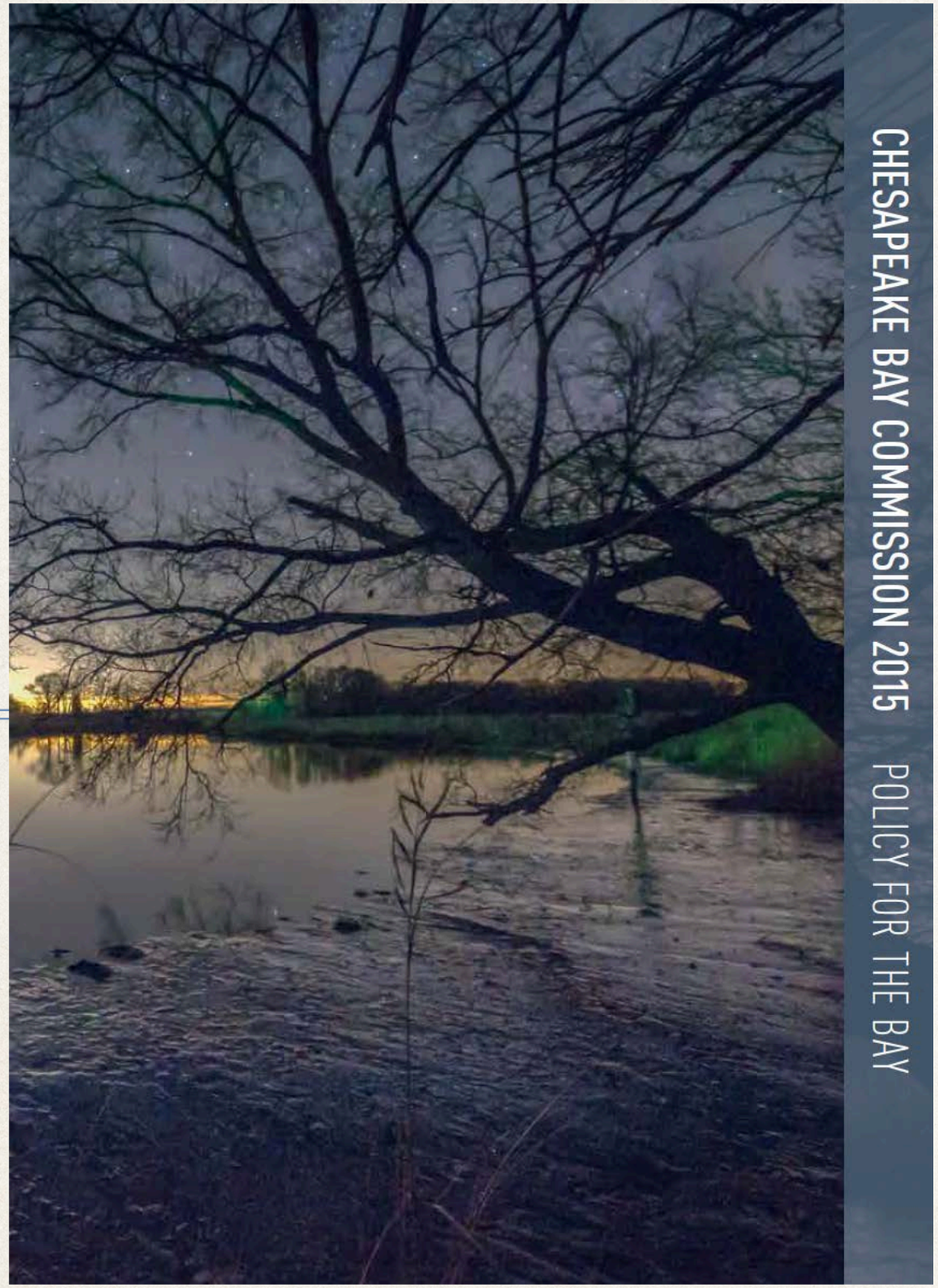
- Is there any evidence of the direction of potential impact, i.e., are microplastics being seen in increasing quantities at local or regional scales?
- Is this really a problem that rises to the level of taking individual state action? That is, is this having an impact (or is this likely to have an impact) on the Chesapeake Bay and its tributaries?

Microbead-Free Waters Act of 2015

- What is beneficial about the federal legislation banning microbeads?
- Does the language in the bill allow for novel innovative scientific solutions now and in the future?
  - *The Act prohibits (at defined future timepoints) “the manufacture and introduction or delivery for introduction into interstate commerce of rinse-off cosmetics containing intentionally-added plastic microbeads”. Plastic microbeads are defined as “any solid plastic particle that is less than five millimeters in size and is intended to be used to exfoliate or cleanse the human body or any part thereof”. Accordingly, the legislation actually would prevent current and future innovative solutions that utilize plastics.*

Recommendations

- Research Gaps
  - *Collection, analysis, and transferability*
- Monitoring
  - *Entry points, multiple media, fate and transport, toxicity*
- Innovations
  - *Initiation of a long-term monitoring study*
  - *Educational outreach programs for the public and industry.*
  - *Further legislation that prevents microplastic from entering aquatic habitats*
  - *Instigating innovation of more sustainable products that are benign by design.*
  - *Better best management practices for waste management*



CHESAPEAKE BAY COMMISSION 2015 POLICY FOR THE BAY

MICROBEADS AND FOOD CHAINS

THE SCIENCE

Microbeads are tiny particles of plastics — polyethylene, polypropylene, and polystyrene — used as abrasives in hundreds of personal care products including soap, body wash, cosmetics and toothpaste. Typically less than a millimeter in diameter, billions of microbeads easily pass through wastewater treatment plants. Those that are captured accumulate in biosolids and can run off in surface water after they are applied to land. Regardless of the pathway, these substances are a growing source of water pollution. Unlike other microplastics, such as those resulting from the degradation of plastic bottles, bags and other litter, microbeads are designed to be washed down the drain and end up in the water.

Small enough to be ingested by aquatic filter feeders and bottom scavengers, microbeads have been found in the guts of mussels and crabs, as well as the fish and birds that eat them. Microbeads cause harmful inflammation and blockages in the digestive tracts of living organisms, and can adsorb toxins, passing them to higher levels of the food chain, causing liver toxicity and disrupting endocrine systems. They can persist in the environment for decades.

The best solution to microbead pollution is to reduce or eliminate the source. A number of major manufacturers are responding to scientific evidence and public pressure and have agreed to replace microbeads with biodegradable plastics or natural alternatives such as pumice, apricot kernels or walnut husks, sea salt, or oatmeal. However, not all manufacturers are following suit, making additional state and federal action necessary.

THE POLICY

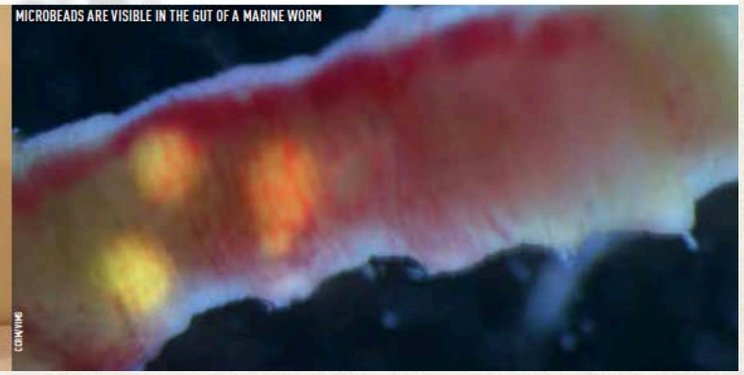
In 2015, Maryland Delegate Barbara Frush and her Commission colleagues successfully strengthened legislation banning the manufacture and sale of microbeads in personal care products. Virginia Commission member Delegate David Bulova introduced a bill prohibiting the sale of certain microbead-containing products. Pennsylvania Commission members Senator Richard Alloway, Senator Gene Yaw and Representative Keith Gillespie are also sponsoring legislation to restrict microbead use.

This multi-state effort helped influence the 114th U.S. Congress to ban microbeads in certain skin care products nationwide. Signed by the President in December, the Microbead-Free Waters Act will phase out their manufacture and use starting in 2017. Although a significant step forward, the Act narrowly applies to "rinse-off cosmetics" and toothpaste, leaving room for Commission members to pursue action on other personal care products.

The Commission called on the Bay Program's Scientific and Technical Advisory Committee to convene experts and compile research findings on the fate, transport, and environmental risk of the breadth of microplastic products and the cost of their removal from drinking water and wastewater. A report of the Committee is expected in early 2016.

As a signatory to the 2014 Chesapeake Bay Watershed Agreement, the Commission championed the goal of ensuring that "the Bay and its rivers are free of effects of toxic contaminants on living resources and human health" and will continue to play a leadership role on microplastics and other emerging contaminants.

MANY PERSONAL CARE PRODUCTS CONTAIN MICROBEADS



MICROBEADS ARE VISIBLE IN THE GUT OF A MARINE WORM

Now what?

- A short, very applied piece in a science journal (e.g., policy review in ES&T.). The parameters of this are a relatively high level of credibility, very applied, that reaches an audience of scientists and policy makers.

- A more substantial piece in a publication oriented to a larger portion of the general public (e.g., Scientific American). The parameters of this are credibility, applied yet allowing a fuller presentation of background, that reaches a larger piece of the general public.

- An extensive white paper on a relevant website, such as that of the Chesapeake Bay Commission or STAC's. The parameters of this are credibility by association with a specific group, extensive content that is flexible, that reaches those interested in Bay-specific issues.

- A traditional review article in a major science journal. Parameters are the highest credibility afforded by peer-review, a full accounting of the scientific basis and status of the issue, and reaching a group of scientists with limited accessibility to the general public.

Environmental Science & Technology

Feature

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Addressing the Issue of Microplastics in the Wake of the Microbead-Free Waters Act—A New Standard Can Facilitate Improved Policy

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[#]Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, Ontario M5S3G5, Canada

Selected Next Step

Written by review team; type of follow-up chosen from a range of options

Ecocyclable https://ecocyclable.wm.edu/

- Natural carbon cycle
- Nontoxic
- Do not lead to accumulation of additives in food chains
- Three environments:
  - *aerobic soil environment;*
  - *anaerobic methanogenic environment (as found in modern landfills and anaerobic wastewater treatments)*
  - *aquatic environment.*

Box 1

A material, including its additives, is ***Ecocyclable*** in a given environment[a] if it satisfies the following criteria for degradability, bioaccumulation, and toxicity:

(1) In a 180-day period[b] in said environment, representative samples (between 100 mg and 25 g, depending on the particular test) of the material degrade[c] to an extent at least 25% of that observed in an equivalent mass of the reference sample, wherein said reference sample has equivalent (or greater) surface area relative to the material sample, and is comprised of either cotton fiber[d] or poly-3-hydroxybutyrate[e]; AND

Within a period of between 180 days and 18 months in said environment, representative samples (between 100 mg and 25 g, depending on the particular test) of the material degrade[c] to an extent at least 90% of that observed in an equivalent mass of the reference sample;

(2) The material and associated additives do not bio-accumulate[f] in representative organisms; and

(3) The material and/or its additives have toxicity[g] that is not significantly (as determined by rigorous statistical testing, $\alpha = 0.05$) greater than that of a comparable composition (size and shape) of either cotton fiber[d] or poly-3-hydroxybutyrate[e] under acute and chronic exposures to environmentally relevant concentrations.

The continuing problem

The problem continues

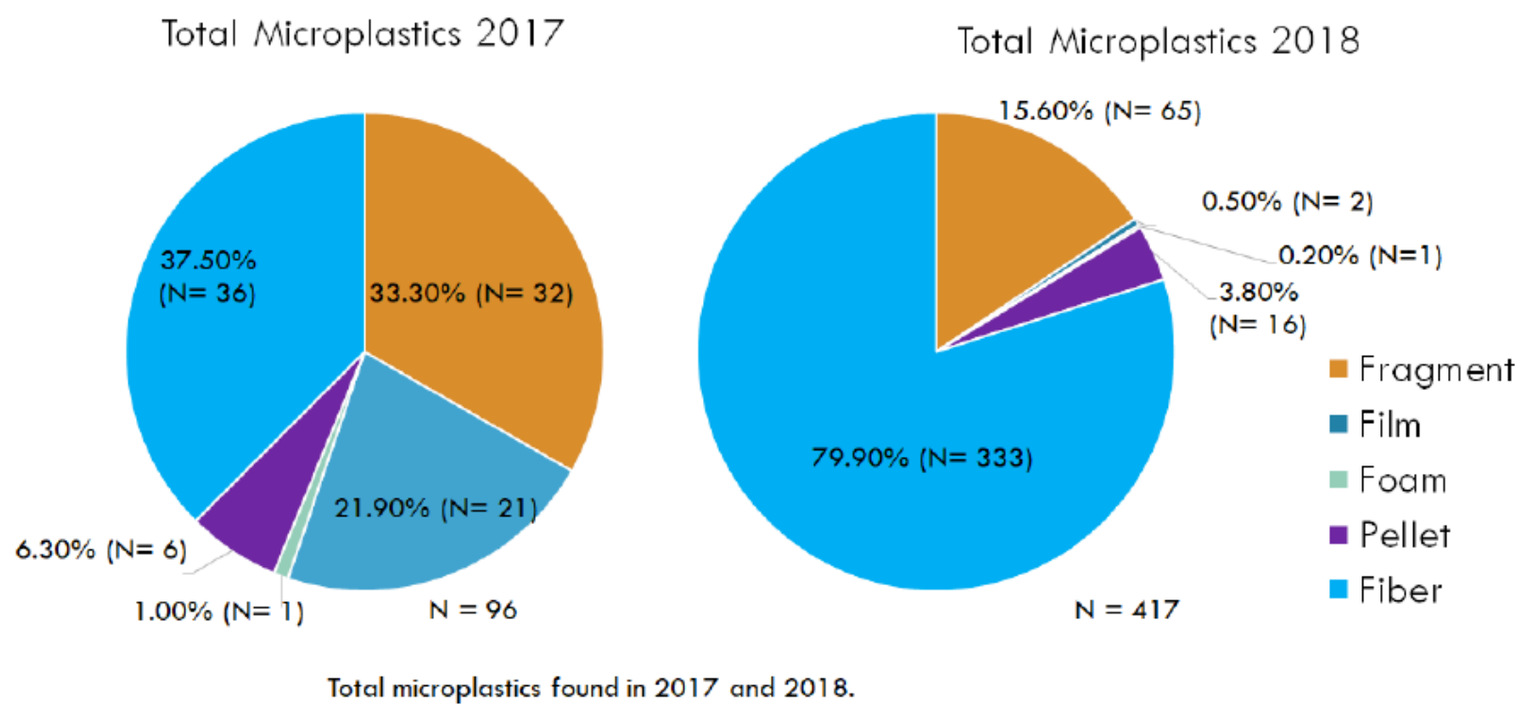


Figure 4: The total number of microplastics found in each year. In 2018 417 individual microplastics were found in the 67 diets. In 2017 96 microplastics were found in 40 diets.

Diet Analysis and Presence of Microplastics in Smallmouth Bass of the Susquehanna River Watershed
A Thesis in Ecology, Susquehanna University
By: Timothy Parks

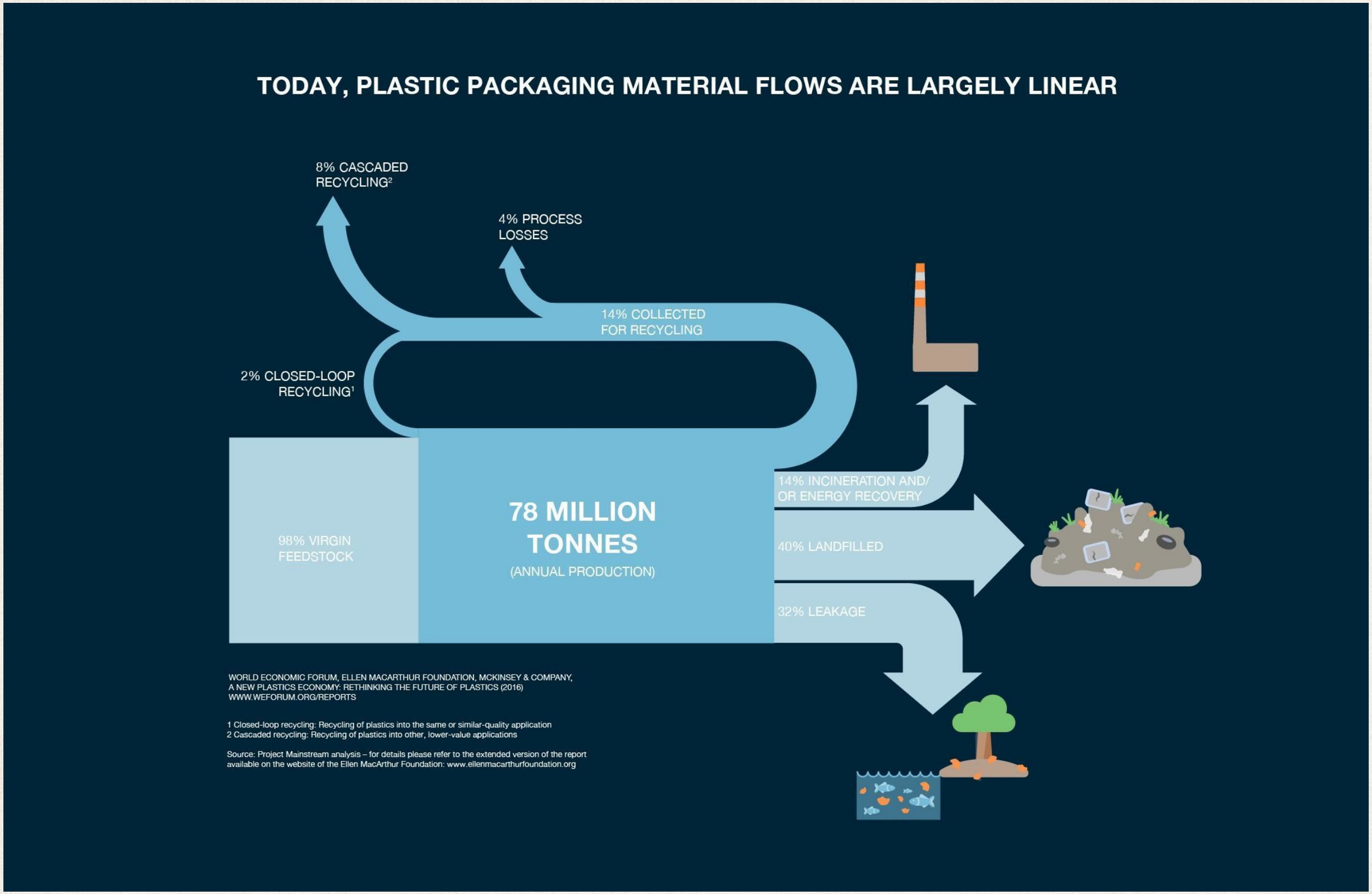
What now?

- STAC Workshop on Microplastics (Matt Robinson)
- Bans on Styrofoam and fire-fighting foam
- Transdisciplinary research on biodegradability

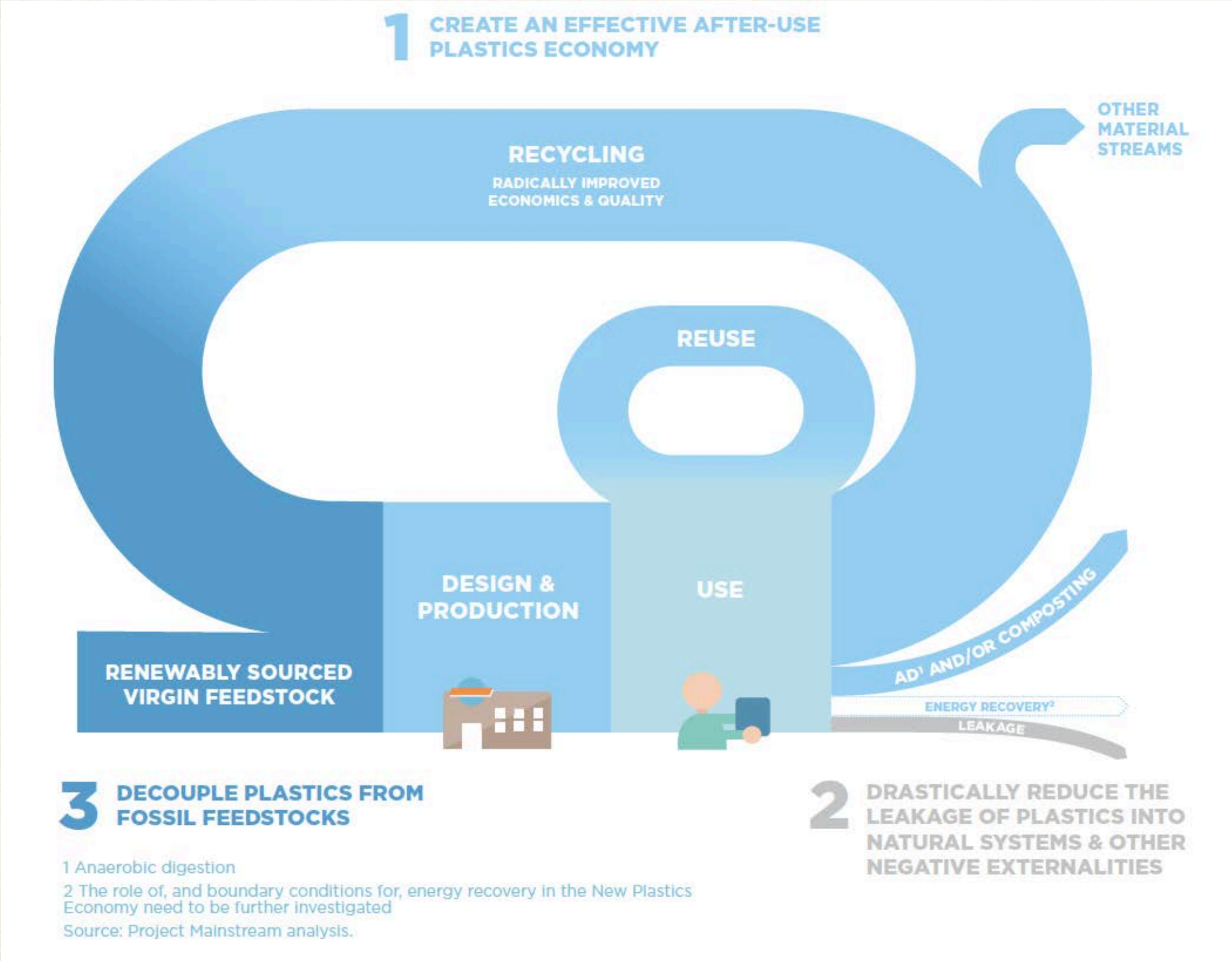
Addiction or Misuse?

- Addiction: Addiction is a complex condition, a brain disease that is manifested by compulsive substance use despite harmful consequence.
- Misuse: to use incorrectly

A new identity to fall in love again



The New Plastics Economy; Ellen MacArthur Foundation, 2015.



The New Plastics Economy; Ellen MacArthur Foundation, 2015.

Where has this led?

- Design
- Recycling technology
- Biodegradability
- Circular economy
- Public pressure

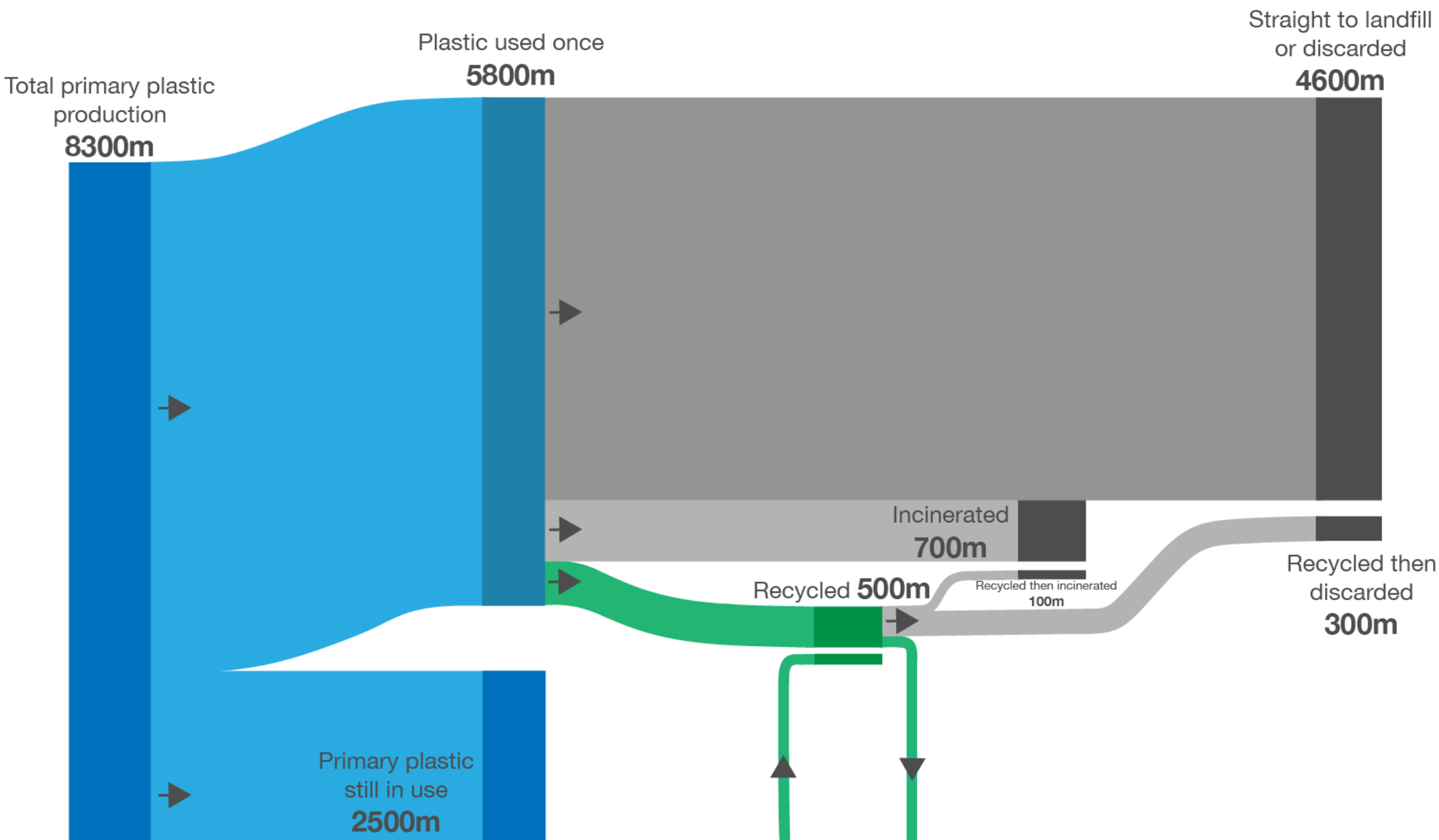
Global plastic production and its fate (1950-2015)

Our World in Data

Global production of polymer resins, synthetic fibres and additives, and its journey through to its ultimate fate (still in use, recycled, incinerated or discarded).
Figures below represent the cumulative mass of plastics over the period 1950-2015, measured in million tonnes.

Balance of plastic production and fate (m = million tonnes)

8300m produced → 4900m discarded + 800m incinerated + 2600m still in use (100m of recycled plastic)



SPURT Recommendations

- S - specific
- P - programmatic partner
- U - urgency
- R - risk
- T - timing and resources

New "Invention" Gets Children To Drink More Milk

JUST DIP AND SIP!

STRAWBERRY, CHOCOLATE OR NEW COFFEE

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Sip plain milk up. See milk change color.

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