The Multiple Challenges of Plastic

Dr. Fabian M. Dayrit

Emeritus Professor, Ateneo de Manila University
Vice-President, National Academy of Science and Technology- Philippines

Hotel Jen, Manila, November 12, 2019

philstar.com/headlines/2019/11/11/1967729/duterte-favor-ban-single-use-plastic-palace

philstar GLOBAL

Duterte in favor of ban on single-use plastic — Palace

Alexis Romero (The Philippine Star) - November 11, 2019 - 12:00am

MANILA, Philippines — President Duterte may certify as urgent the passage of a measure seeking to ban single-use plastics, Malacañang said yesterday.

Presidential spokesman Salvador Panelo noted that the President is in favor of a ban on the use of plastics, seen as one of the contributors of pollution.

The Multiple Challenges of Plastic

Understanding Plastic

Managing Plastic Waste

How to Prevent Plastic Pollution

New Plastics in a Circular Economy

The Multiple Challenges of Plastic

Understanding Plastic

Managing Plastic Waste

How to Prevent Plastic Pollution

New Plastics in a Circular Economy

Plastic and our Lifestyle

Plastic is part of our daily lives

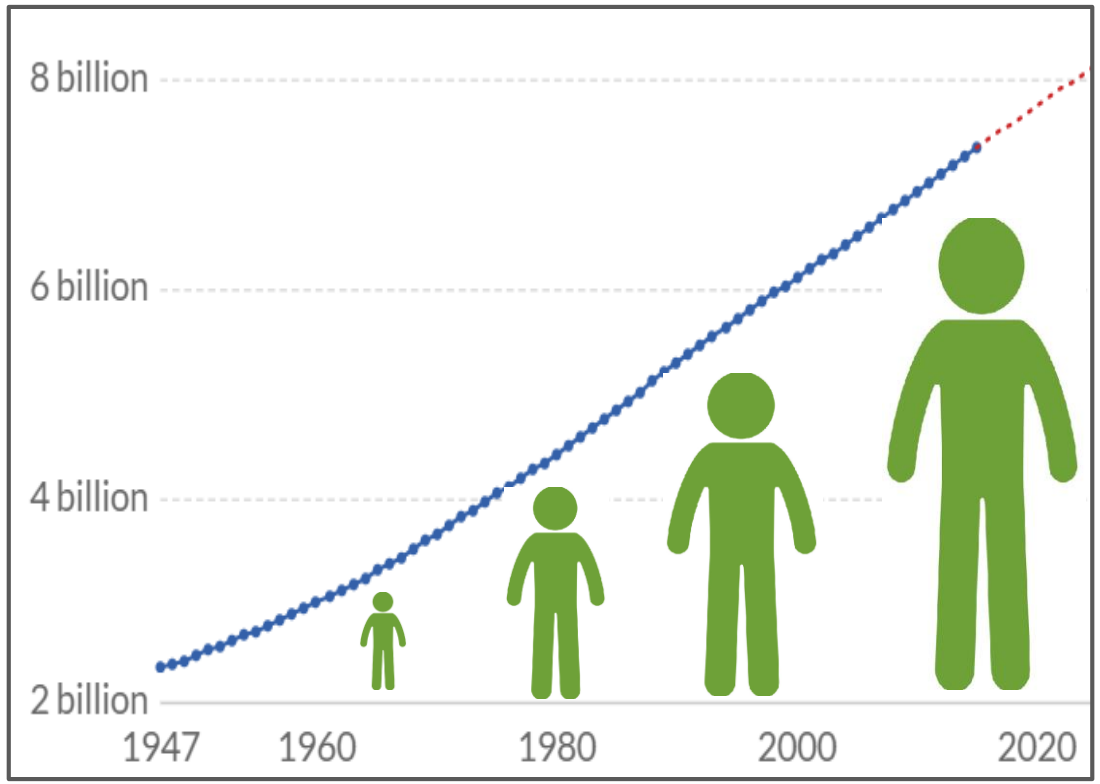
Plastic and our Lifestyle

The poor use a lot of plastic.

The rich use a lot of plastic.

Each person uses as much plastic as his weight

Global Population



(Source:Medium Projection, UN Population Division, 2015)

Global plastic production

(Source: Statista, PlasticsEurope)

7.5 billion people x 40 kg plastic/person = 300 million tons of plastic

The rise of plastics

- Can be designed for desired **shapes**, **properties** and **functions**.
- At first, plastics were used as **alternatives** to natural materials (leather, wood, cotton).
- Today, plastics have **replaced** most natural materials and created **new applications**.

Plastics and the Industrial Revolutions

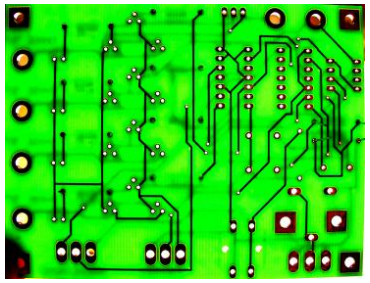
Second Industrial Revolution: coal, petroleum →*plastics*

Coal tar ⟶ **Bakelite**

Petroleum ⟶ **Nylon**

Third Industrial Revolution:
electronics, computerization

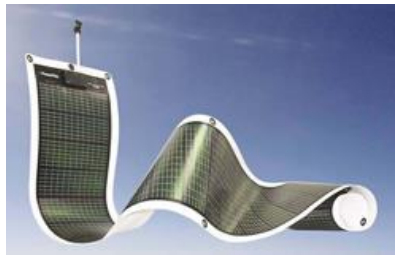
Plastic coated wires



Printed circuit board

Fourth Industrial Revolution: www, IoT, 3-D printing, nanotechnology

Satellites



Flexible solar cells

The Multiple Challenges of Plastic

Understanding Plastic

Managing Plastic Waste

How to Prevent Plastic Pollution

New Plastics in a Circular Economy

The basis of plastics are polymers

Acrylonitrile butadiene styrene (ABS)
Acrylic (AC)
Epoxy resin (thermoset) (EP)
Fiberglass (FG)
Perfluorinated polymers (PTFE)
Polyamide (PA, Nylon)
Polycarbonate (PC)
Polycaprolactone (PCL)
High density polyethylene (HDPE)
Low density polyethylene (LDPE)

Polyethylene terephthalate (PETE)
Polyglycolide (PGA)
Polylactide (PLA)
Polypropylene (PP)
Polystyrene (PS)
Polyurethane (PU)
Polyvinyl alcohol (PVA)
Polyvinyl chloride (PVC)
Silicone polymers (Si)

Recycling plastics is a challenge

- There are 2 types of plastics:
  - **Thermoplastics** (**TP**): generally recyclable
  - **Thermoset** (**TS**): generally not recyclable

Polyacrylonitrile (PAN)
Polyamide (nylon)
Polycarbonate
Polyvinyl alcohol (PVA)
Silicon
Styrene acrylonitrile (SAN)
… and many more

Not recyclable

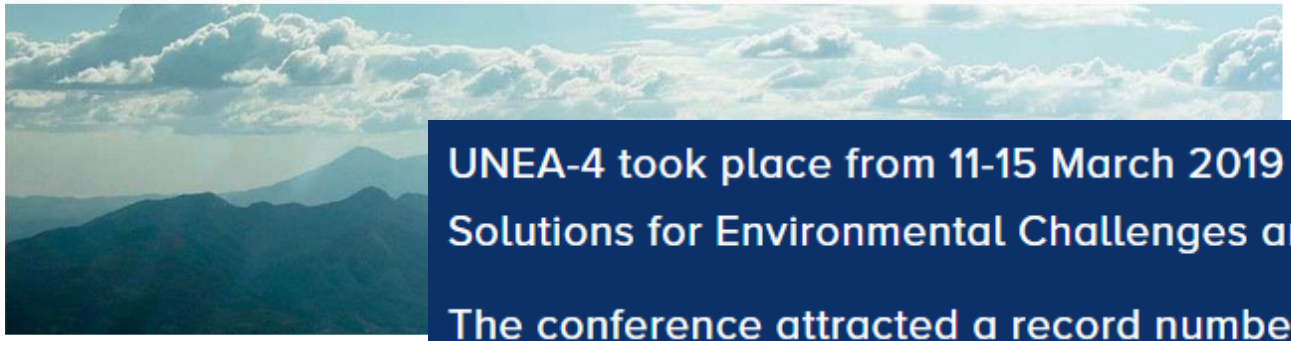
Acrylic polymers
Polymer adhesives
Bakelite
Epoxy resin
Perfluorinated polymers (PTFE)
Polyurethane
Vulcanized rubber
… and many more

DELIA PAUL
Thematic Expert for Poverty Reduction, Rights and Governance (Malaysia/Australia)

19 March 2019

SHARE THIS

UNEA-4 Commits to Global Environmental Data Strategy, Reducing Single-use Plastics



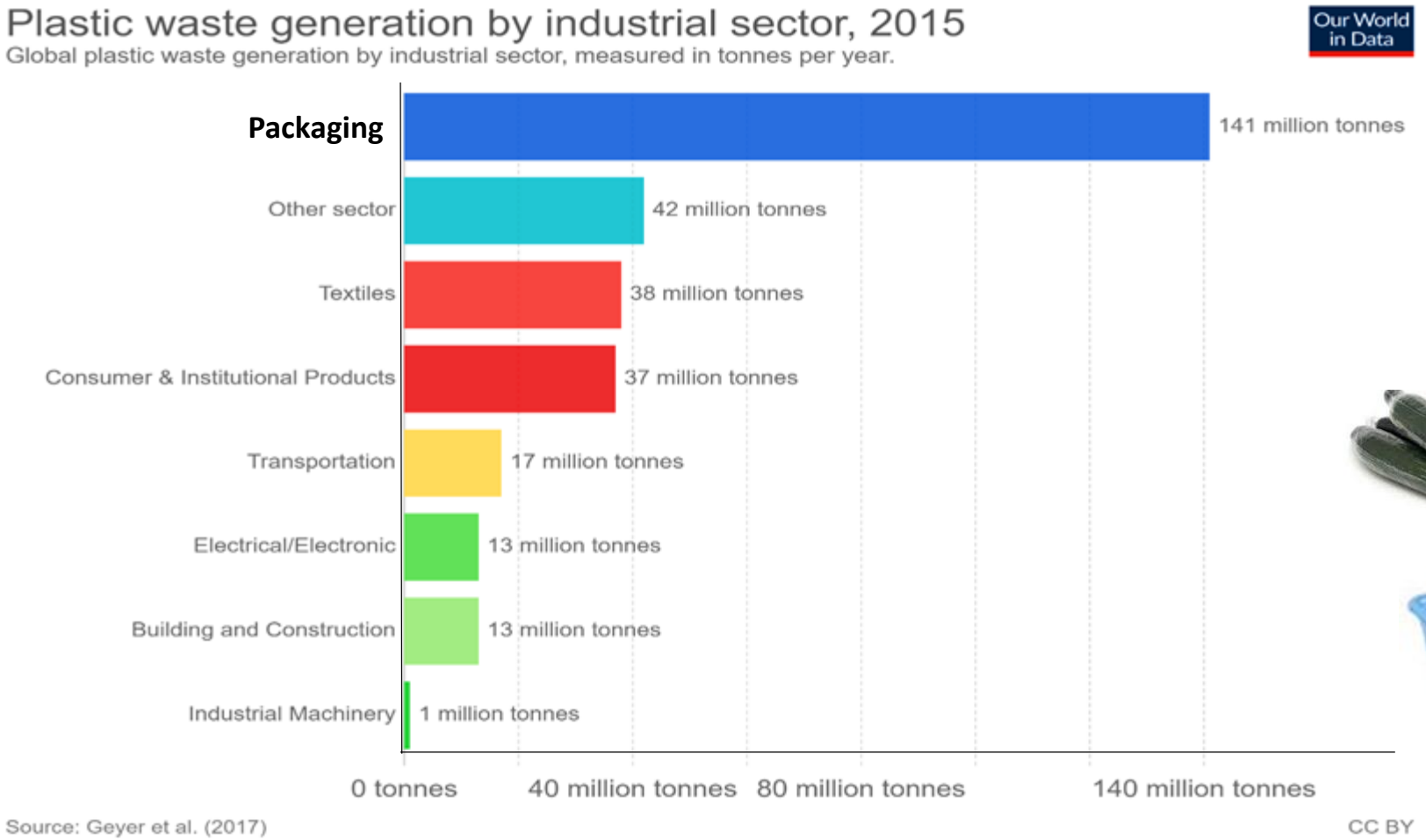
> *A Global Pact for the Environment would endow citizens with a set of rights to a healthy environment and the means to fight anti-environment behaviors worldwide.*

UNEA-4 took place from 11-15 March 2019 in Nairobi, Kenya, on the theme, 'Innovative Solutions for Environmental Challenges and Sustainable Consumption and Production'.

The conference attracted a record number of participants, with five Heads of State and Government, 157 environment ministers and deputy ministers, and almost 5,000 participants from 179 countries attending the Assembly and related events during the week.

Ministers adopted a Ministerial Declaration that commits to significantly reduce single-use plastic products by 2030, and to support a UNEP global environmental data strategy by 2025, along with 26 resolutions and decisions.

Removing single-use plastic for packaging is only the first step!



Life Cycle Analysis: Which is more environmentally sustainable?

Paper bags vs. Plastic bags

- LCA studies conclude that plastic bags have a smaller environmental impact than paper bags.
- The key to reducing environmental impact of plastic bags is to reuse as many times as possible. (ref: Acd. Uriarte)

☑ **Plastic bags**

India

(imagu.net)

GMA NEWS ONLINE
YOUR NEWS AUTHORITY

SCITECH

Filtered By: Just In

Roads built of recycled plastics? They will soon be constructed in PHL

Published March 11, 2019 6:19pm

By DONA MAGSINO, GMA News

The 3Rs are not enough to address the problem of plastic waste

(Getty images)

The Multiple Challenges of Plastic

Understanding Plastic

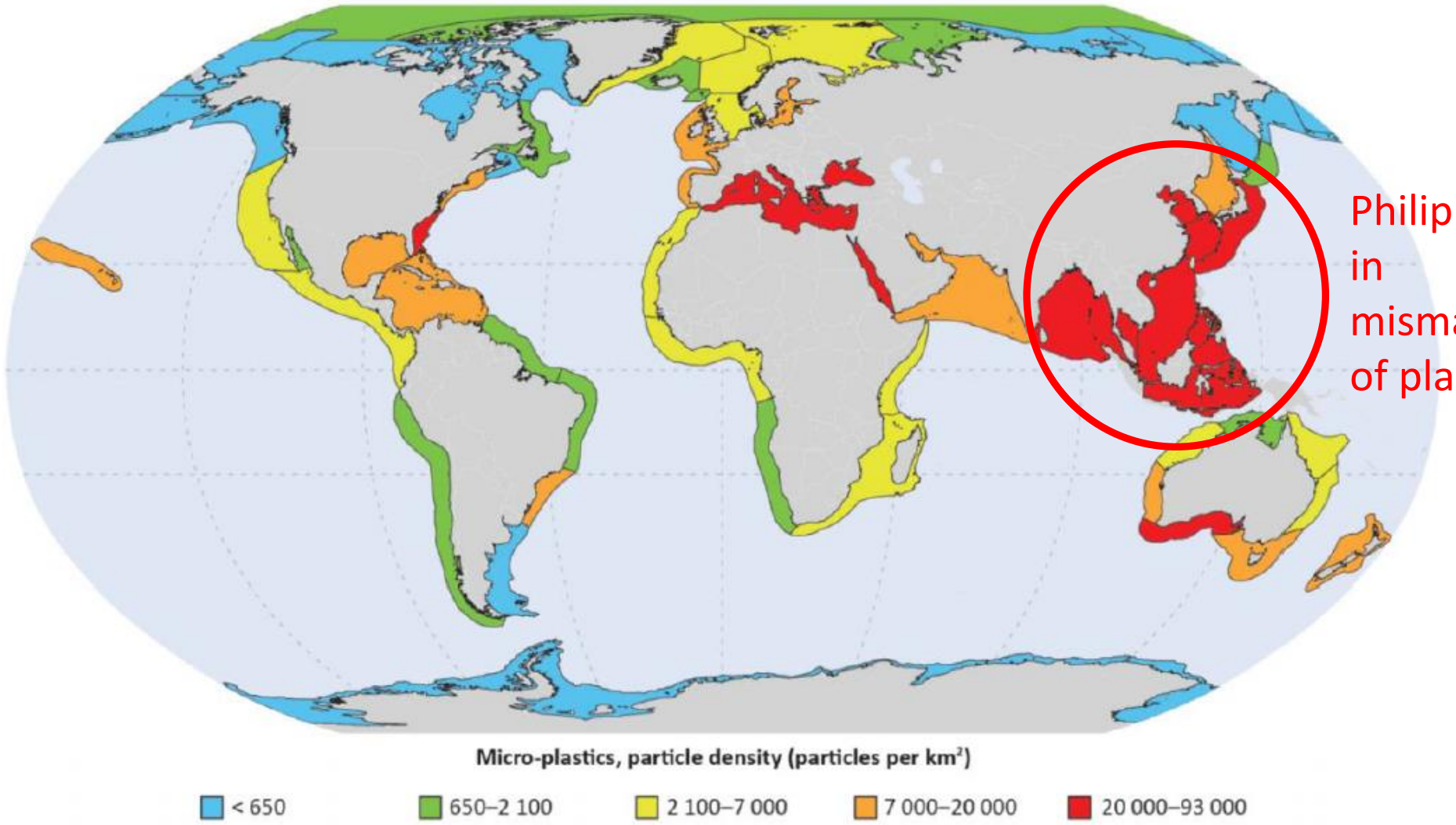
Managing Plastic Waste

How to Prevent Plastic Pollution

New Plastics in a Circular Economy

Plastic Pollution

Spatial distribution of micro- and macroplastics in large marine ecosystems



Philippines is #3 in mismanagement of plastic waste.

(Ref: Simon et al., 2018; Kershaw & Leberton, 2016)

Environmental and health impact of plastics

Philippine Journal of Science
145 (1): 17-23, March 2016
ISSN 0031 - 7683

Ingestion of Marine Plastic Debris by Green Turtle (*Chelonia mydas*) in Davao Gulf, Mindanao, Philippines

Figure 2. Carcass of the *Chelonia mydas* recovered in Davao City.

Figure 3. Stomach contents of the recovered *Chelonia mydas*.

NATIONAL GEOGRAPHIC

Researchers pulled nearly 90 pounds of plastic waste out of the stomach of a young cuvier beaked whale that died in the Davao Gulf of the Philippines on Saturday, March 16. The whale starved to death because of the plastic in its belly.

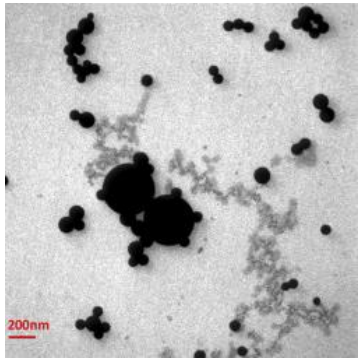
ENVIRONMENT | PLANET OR PLASTIC?

This young whale died with 88 pounds of plastic in its stomach

Environmental and health impact of plastics

Macroplastic ➔ **Microplastic** ➔ **Nanoplastic**

<5mm



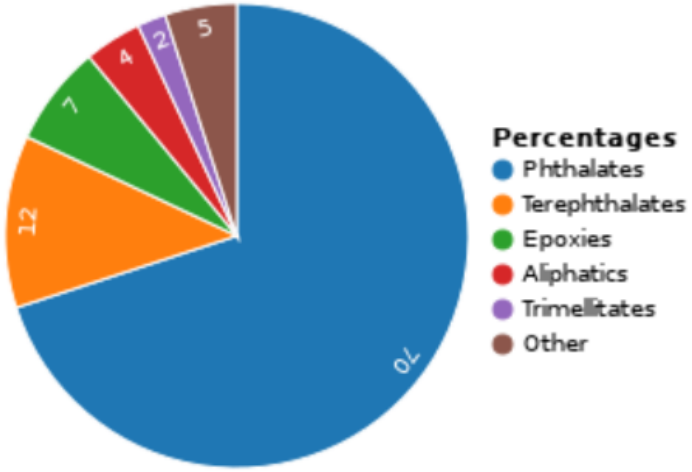
Nano-plastics are able to enter organs to affect cells directly. (Lehner, Nanoplastic Impact on Human Health, 2018)

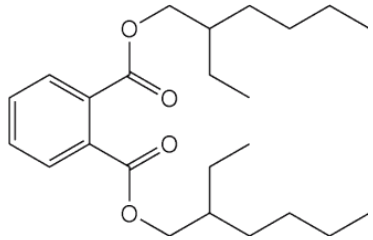
- **Micro- and Nano-fibers**
  - Polyester
  - Nylon

Dri-Fit, Spandex, Lycra…

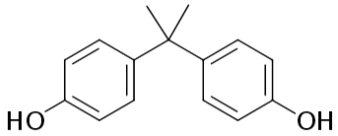
Environmental and health impact of plastics

- **Plasticizers**



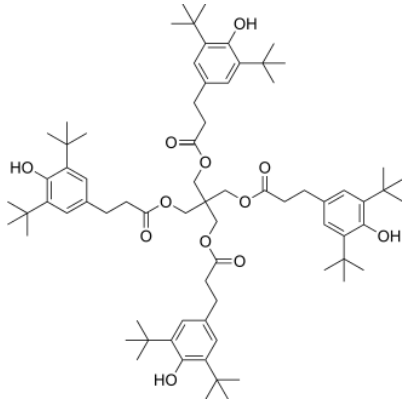


Bis(2-ethylhexyl) phthalate

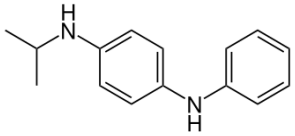


Bisphenol A
(polycarbonate, epoxies)

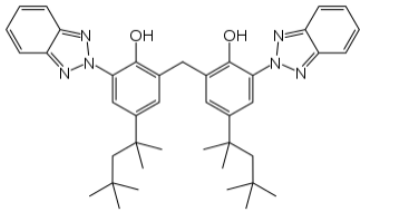
- **Antioxidants, free-radical and acid scavengers, anti-ozone, anti-UV**



A primary antioxidant

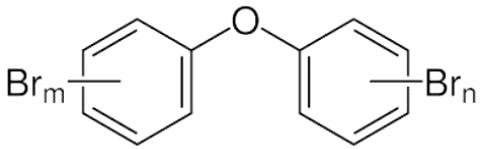


Anti-ozonant

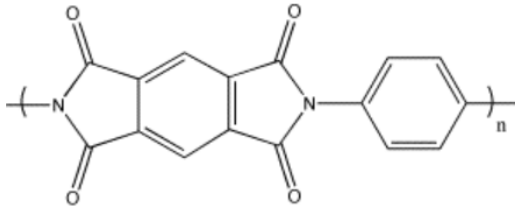


Anti-UV

- **Photochemical and fire**



Polybrominated diphenyl ether

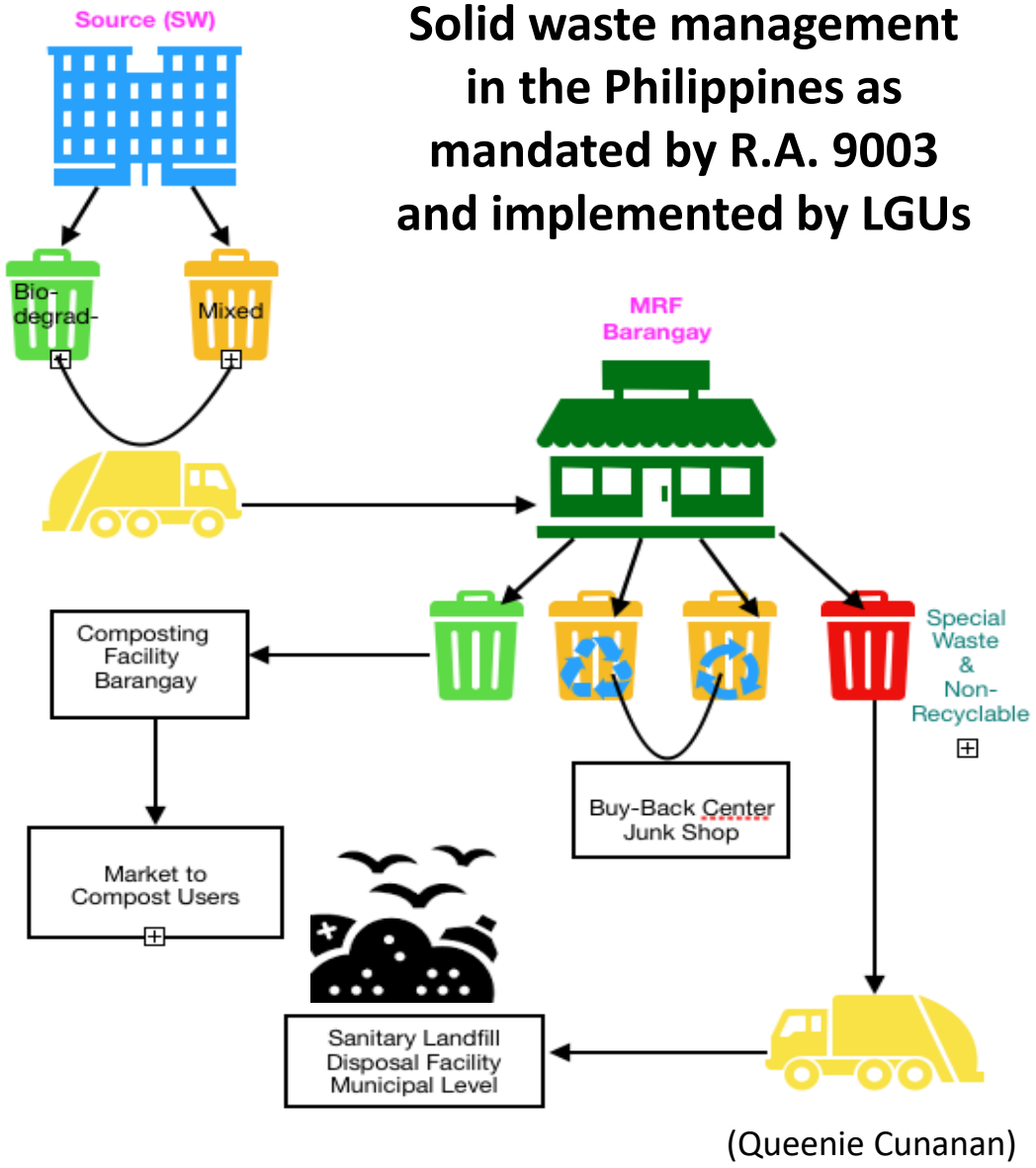


Polyimide

Ba	Cd	Pb	Zn
Barium	Cadmium	Lead	Zinc

Metal stabilizers

⇨ **Reuse** and **Recycling** requires adequate knowledge and technology.



Solid waste management in the Philippines as mandated by R.A. 9003 and implemented by LGUs

(Queenie Cunanan)

1. R.A. 9003 (2001) tackles solid waste as a whole and was crafted before the plastic crisis was recognized: **Plastic waste needs a different strategy**.
2. R.A. 9003 is based on "end of pipe" approach and ultimate dependence on landfills.
3. Burden of responsibility is on LGUs and DENR. Lack of attention to industry and research.

The Multiple Challenges of Plastic

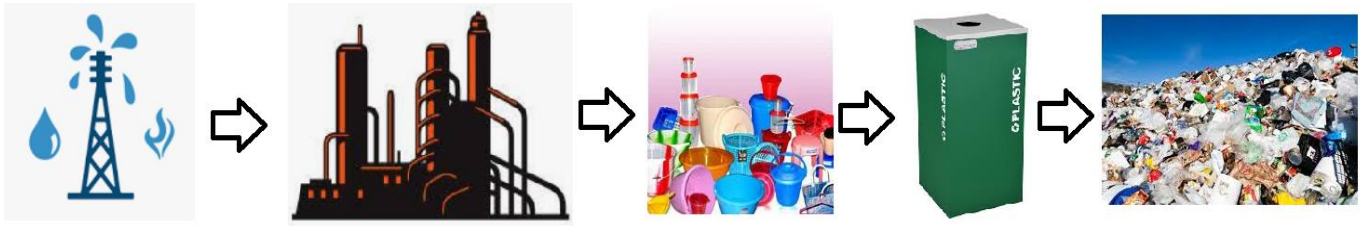
Understanding Plastic

Managing Plastic Waste

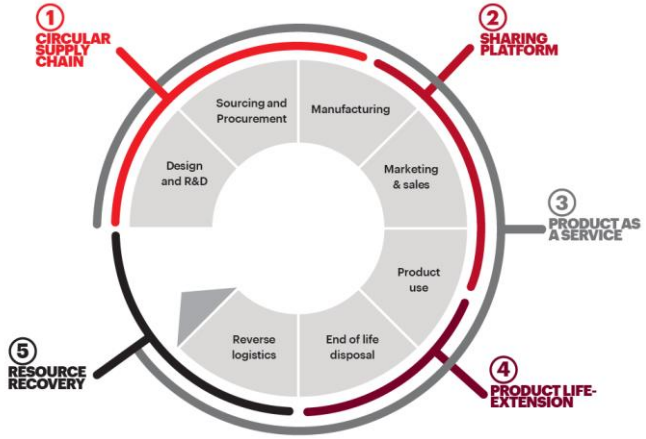
How to Prevent Plastic Pollution

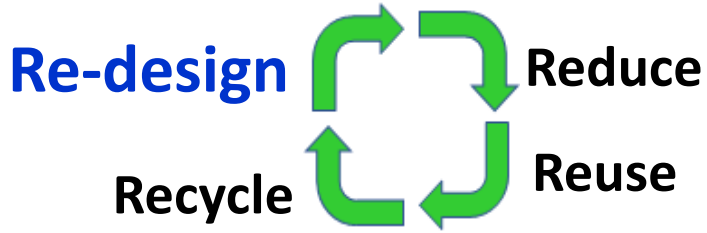
New Plastics in a Circular Economy

From the 3Rs: Cradle to Grave



To the 4Rs: The Circular Economy

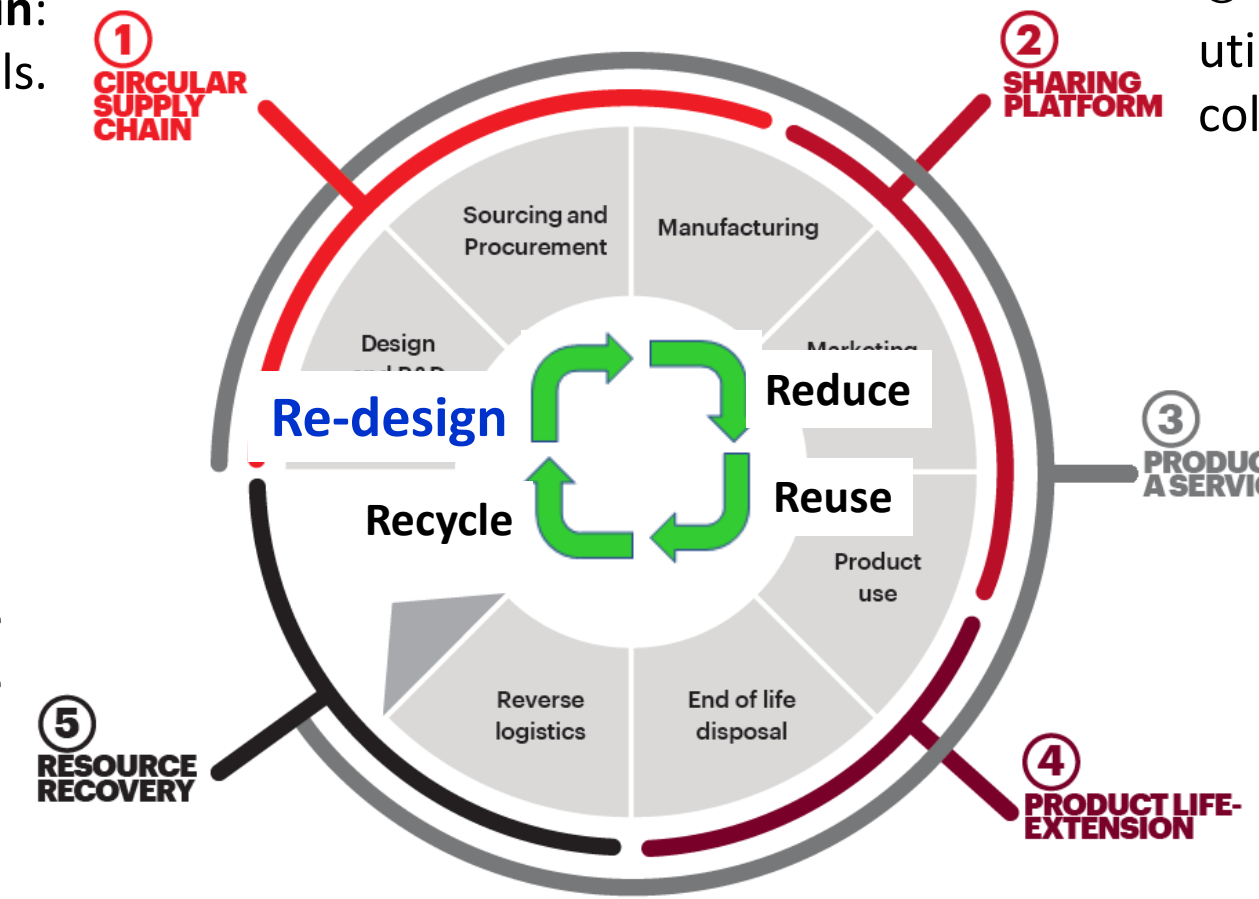




4Rs in a Circular Economy

① **Circular Supply Chain**: Use of circular materials.

② **Sharing Platform**. Increase utilization rates through collaborative usage or ownership.



③ **Product as a Service**. Producer retains product ownership: Extended Producer Responsibility.

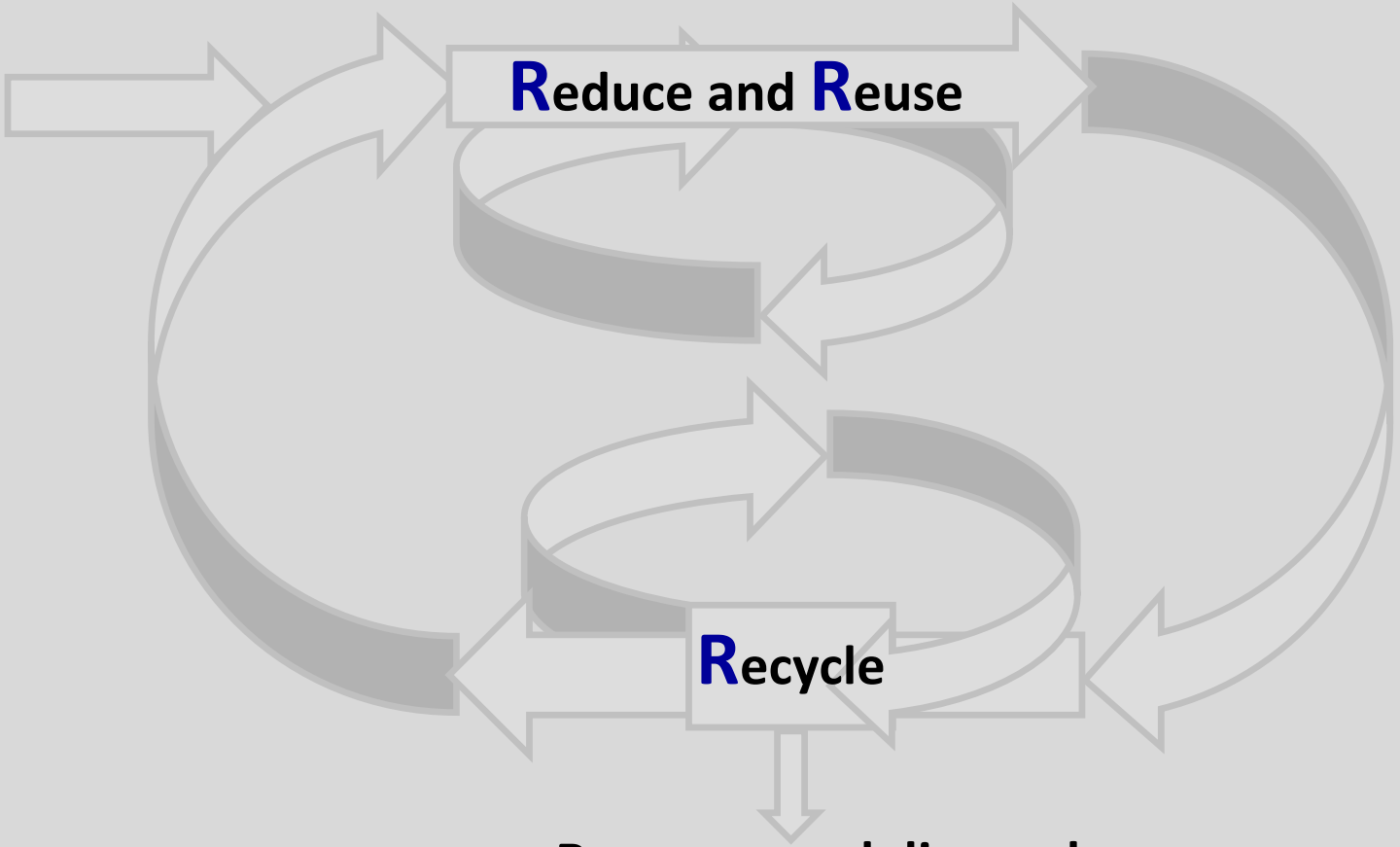
⑤ **Resource Recovery**: Recovery of usable resources from waste and by-products.

④ **Product Life-Extension**: Prolong lifecycle through repair, reprocessing, and resale.

(from: The Circular Advantage Handbook)

The Multiple Challenges of Plastic

Redesign plastics with circular raw materials and biomaterials



A holistic strategy for the management of plastic

1. Plastic is a multi-faceted problem: environmental, economic and life-style. It requires a multi-faceted approach.
2. Revise R.A. 9003 to craft a more **holistic approach to the management of plastic**.
3. Adopt a **Circular Economy**:
   - Move from 3R's to **4R**'s: prioritize R&D for the redesign of plastics
   - Strengthen the **recycling industry**.
4. Use **life cycle analysis** (LCA) to determine environmental sustainability.
5. Educate **consumers** for a **sustainable lifestyle** and **responsible consumption**. Eliminate non-essential plastic products, especially single-use plastics.


Reduce
Reuse
Recycle
Re-design
Thank you !