

The Challenges of Plastic Waste: Legislation, Regulation, R&D and Management Strategies

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Plastics are a multi-faceted issue



- Ocean pollution
- Protection of environment and biodiversity
- Tourism



- Reduce, Reuse, Recycle
- Waste management
- Waste to raw material



- Consumer demand
- Affordability
- Lifestyle



- Industry 4.0
- Nanotechnology
- R&D

Plastics are everyone's responsibility



- Consumerism
- Consumer responsibility



- Policy and legislation
- Implementation
- Incentives



- Extended product responsibility
- Circular economy



- Plastic waste to plastic raw materials
- New plastic materials

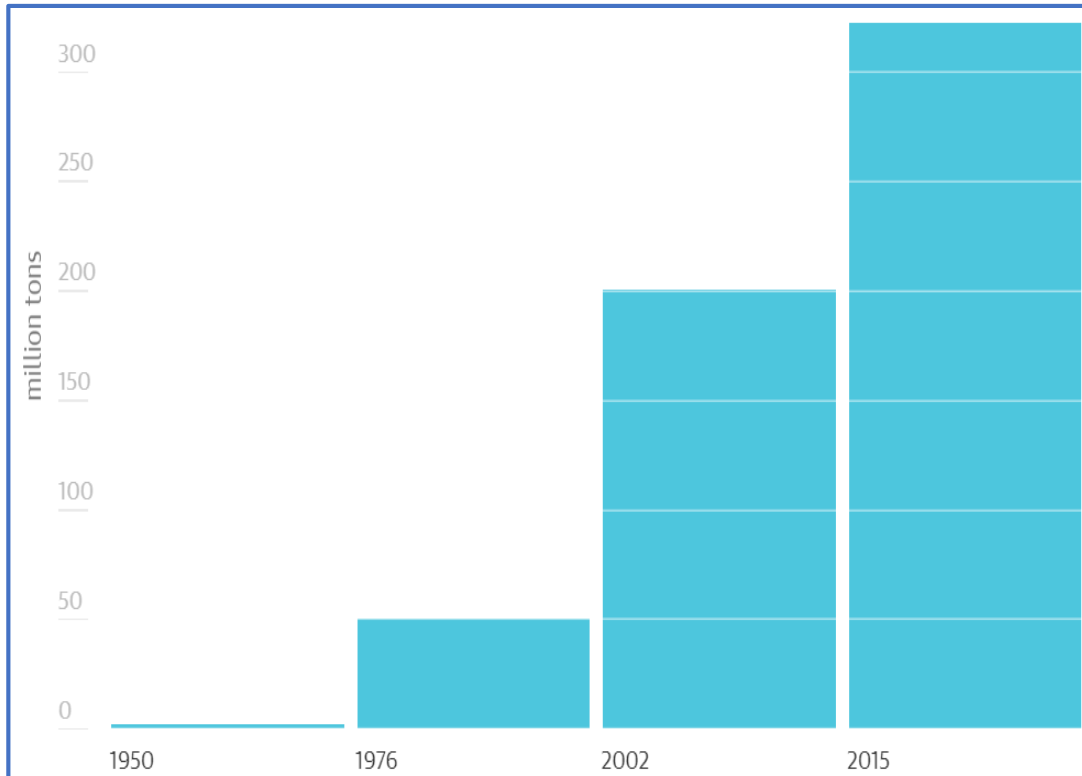
What are plastics?

- Plastics are synthetic polymer materials that can be formed into useful shapes with desirable characteristics and functions.
- Plastics contain additives to attain properties for specific applications, to prolong life, and to reduce cost.
- Plastics have become ubiquitous. They have replaced many natural materials and expanded into new uses.
- Current plastics are generally non-biodegradable.



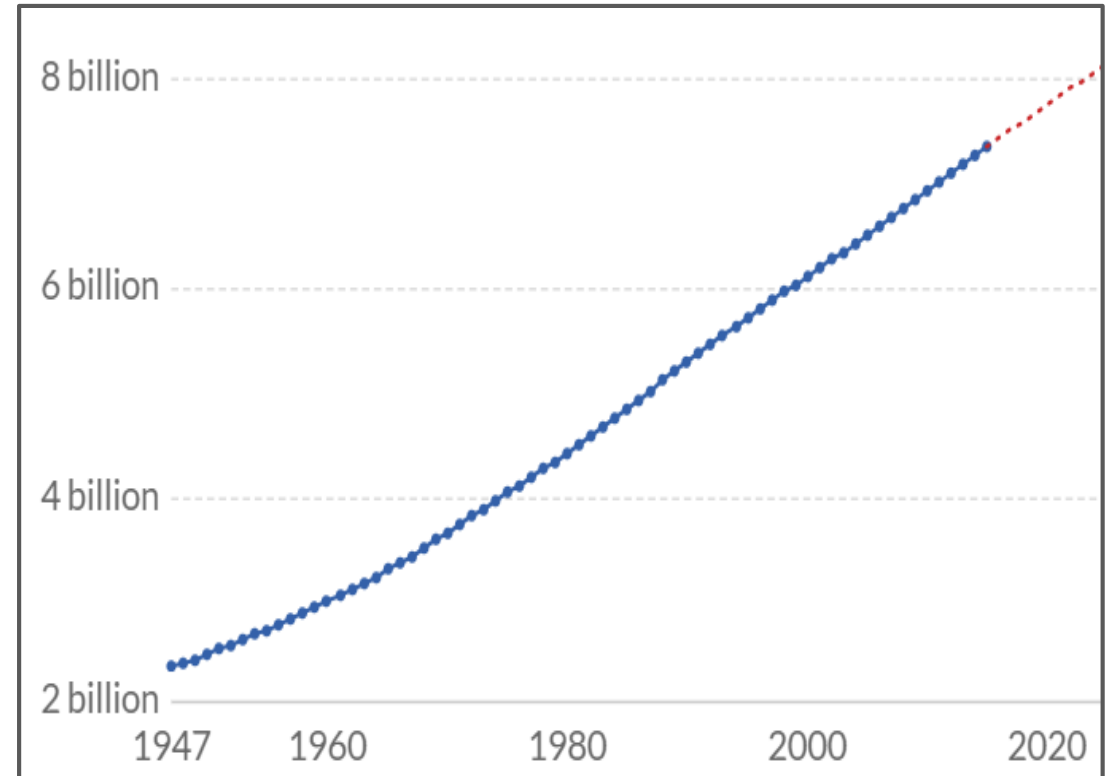
Growth of the plastics industry

Global plastic production



(Source: Statista, PlasticsEurope)

World Population



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

The total amount of plastic produced in a year is roughly the same as the entire weight of humanity.

(7.5 billion people x 40 kg/person = 300 million tons)

Types of plastics based on polymer composition



Acrylonitrile butadiene styrene (ABS)

Acrylic (AC)

Epoxy resin (thermoset) (EP)

Fiberglass (FG)

Perfluorinated polymers (PTFE)

Polyamide (PA, nylon)

Polycarbonate (PC)

Polycaprolactone (PCL)

Polyethylene

High density (HDPE)

Low density (LDPE)

Polyethylene terephthalate (PETE)

Polyglycolide (PGA)

Poly lactide (PLA)

Polypropylene (PP)

Polystyrene (PS)

Polyurethane (PU)

Polyvinyl alcohol (PVA)

Polyvinyl chloride (PVC)

Silicone polymers (Si)

Uses of plastics and their polymer composition



Single-use	: AC, HDPE , LDPE , PETE , PP , PU, Si
Durable goods	: ABS, AC, FG, PTFE, PA, PC, HDPE , LDPE , PETE , PP , PU, Si
Clothing	: PA (nylon), PETE , PTFE (Teflon), PETE-PU (Lycra)
Electrical	: PTFE, PP , PVC , Si
Home appliances	: ABS, FG, PP , PVC
Automotive	: ABS, AC, EP, FG, PTFE, PA, PC, PP , PU, PVC , Si
Construction	: ABS, AC, EP, FG, PTFE, PA, PC, PP , PU, PVC
Engineering	: ABS, AC, EP, FG, PTFE, PA, PC, PP , PU, PVC , Si
Optical fiber	: AC, PTFE

Recycling of plastic waste



ABS PCL
AC PGA
EP PLA
FG PU
PTFE PVA
PA Si
PC

There are many forms of plastic waste

- **Macro-plastics**



- **Micro- and Nano-plastics**

Macroplastic → Microplastic → Nanoplastic



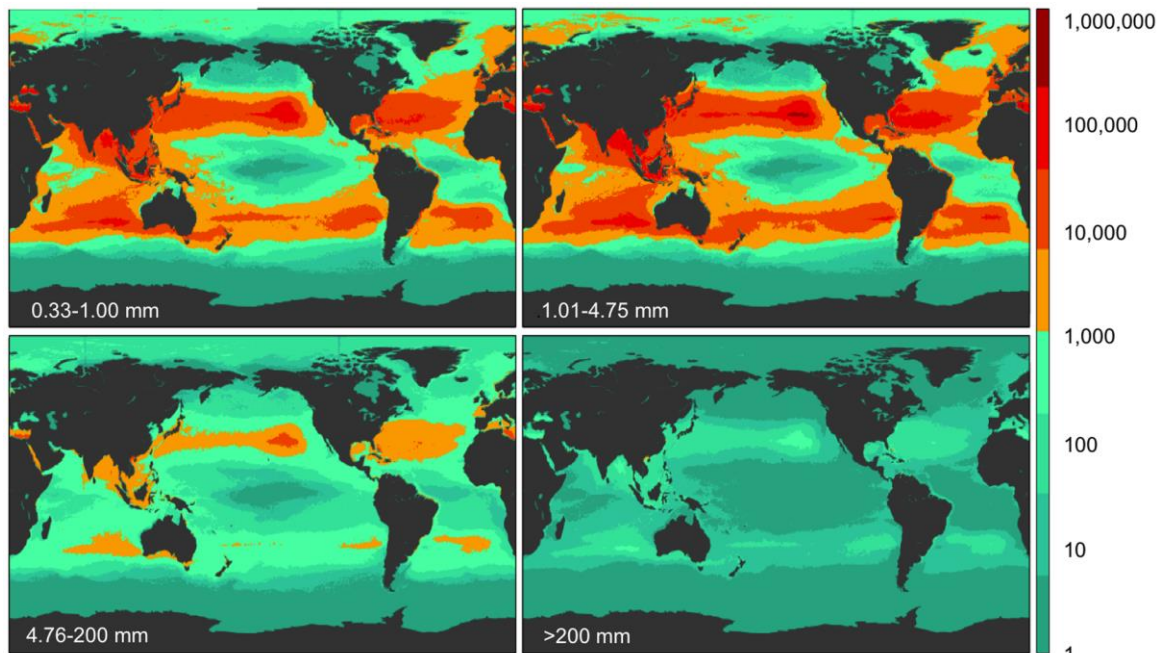
Nano-plastics are able to enter organs to affect cells directly. (Lehner, Nanoplastic Impact on Human Health, 2018)

- **Micro- and Nano-fibers**

- Polyester
- Nylon



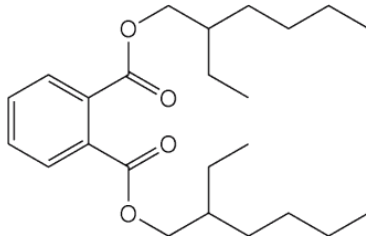
Dri-Fit, Spandex, Lycra...



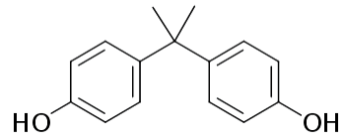
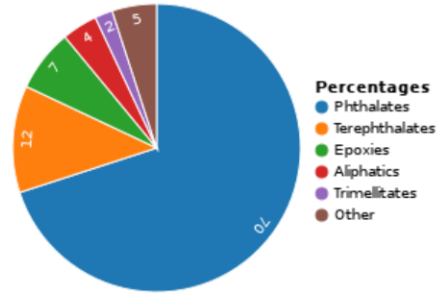
(Eriksen *et al.* "Plastic pollution in the world's oceans", PlosOne, 2014)

Chemical additives in plastics

- Plasticizers

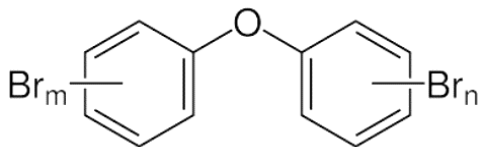


Bis(2-ethylhexyl) phthalate

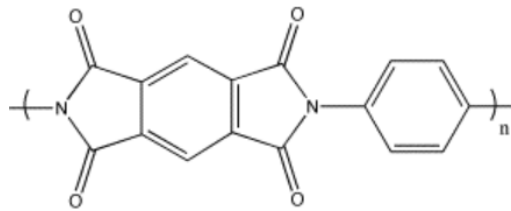


Bisphenol A
(polycarbonate, epoxies)

- Photochemical and fire retardants

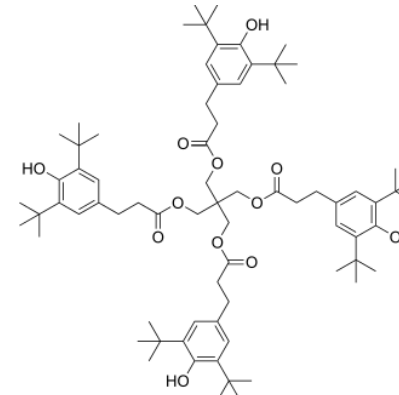


Polybrominated diphenyl ether

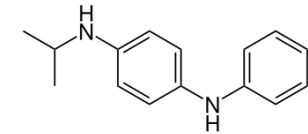


Polyimide

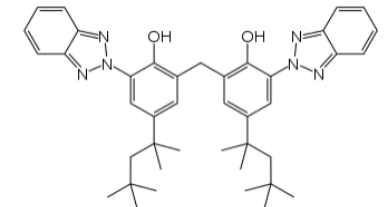
- Antioxidants, free-radical scavengers, acid scavengers, anti-ozone, anti-UV, stabilizers



A primary antioxidant



Anti-ozonant



Anti-UV

Ba	Cd	Pb	Zn
Barium	Cadmium	Lead	Zinc
Metal stabilizers			



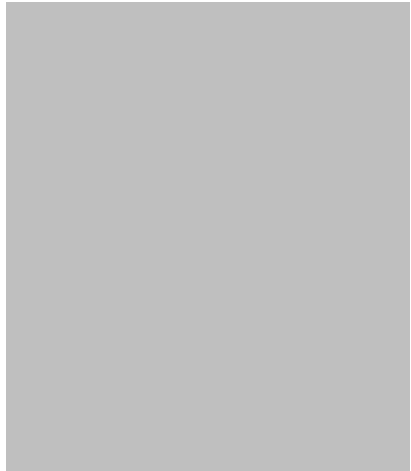
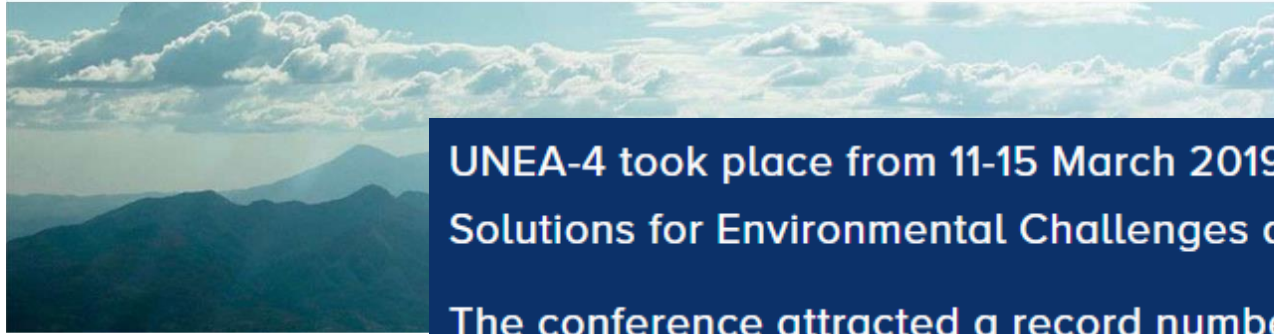
DELIA PAUL
Thematic Expert for
Poverty Reduction, Rights
and Governance
(Malaysia/Australia)

19 March 2019

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



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.

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.



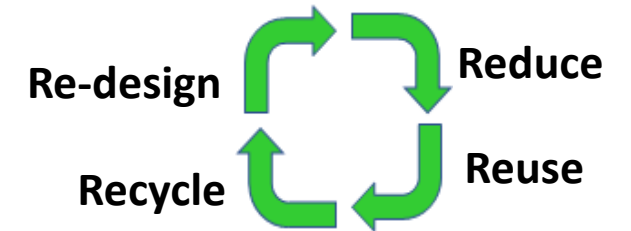
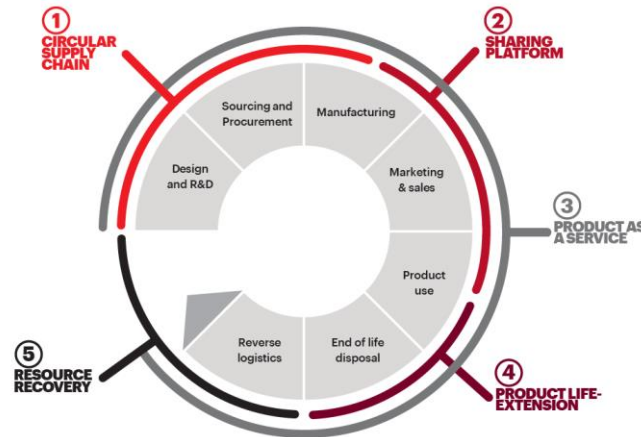


Are the 3Rs enough?

From: Cradle to Grave and the 3R's



To: Circular Economy and the 4R's



Philippine Legal Mandates Related to Plastic Waste

1. Local Government Code of 1991 (R.A. 7160)

Basic Services and Facilities at LGU levels: Barangay, Municipality, Province, City. (Sec. 17)

2. Ecological Solid Waste Management Act of 2000 (R.A. 9003)

Sec. 2. (c) Set guidelines and targets for solid waste avoidance and volume reduction through source reduction and waste minimization measures, including composing, recycling, re-use, recovery, green charcoal process, and others, before collection, treatment and disposal in appropriate and environmentally sound solid waste management facilities in accordance with ecologically sustainable development principles;

(d) Ensure the proper segregation, collection, transport, storage, treatment and disposal of solid waste through the formulation and adoption of the best environmental practices in ecological waste management excluding incineration;

Philippine Legal Mandates Related to Plastic Waste

2. Ecological Solid Waste Management Act of 2000 (R.A. 9003)

Sec. 2. (e) Promote national research and development programs for improved solid waste management and resource conservation techniques, more effective institutional arrangement and indigenous and improved methods of waste reduction, collection, separation and recovery;

(f) Encourage greater private sector participation in solid waste management;

(g) Retain primary enforcement and responsibility of solid waste management with local government units while establishing a cooperative effort among the national government, other local government units, non-government organizations, and the private sector;

Philippine Legal Mandates Related to Plastic Waste

2. Ecological Solid Waste Management Act of 2000 (R.A. 9003)

Sec. 2. (i) Institutionalize public participation in the development and implementation of national and local integrated, comprehensive and ecological waste management programs; and

(j) Strengthen the integration of ecological solid waste management and resource conservation and recovery topics into the academic curricula of formal and non-formal education in order to promote environmental awareness and action among the citizenry.

Philippine Legal Mandates Related to Plastic Waste

2. Ecological Solid Waste Management Act of 2000 (R.A. 9003)

Section 4. **National Solid Waste Management Commission.** There is hereby established a National Solid Waste Management Commission under the Office of the President. The Commission shall be composed of fourteen (14) members from the government sector and three (3) members from the private sector.

Section 5. Powers and Functions of the Commission.

- (a) Prepare the National Solid Waste Management Framework;
- (c) Review and monitor the implementation of local solid waste management plans;
- (d) Coordinate the operation of local solid waste management boards in the provincial and city/municipal levels

Philippine Legal Mandates Related to Plastic Waste

2. Ecological Solid Waste Management Act of 2000 (R.A. 9003)

Section 5. Powers and Functions of the Commission.

- (h) Develop and implement a program to assist local government units in the identification of markets for materials that are diverted from disposal facilities through re-use, recycling, and composting, and other environment-friendly methods
- (p) Formulate and update a list of non-environmentally acceptable materials in accordance with the provisions of this Act. For this purpose, it shall be necessary that proper consultation be conducted by the Commission with all concerned industries to ensure a list that is based on technological and economic viability
- (q) Encourage private sector initiatives, community participation and investments resource recovery-based livelihood programs for local communities

Philippine Legal Mandates Related to Plastic Waste

2. Ecological Solid Waste Management Act of 2000 (R.A. 9003)

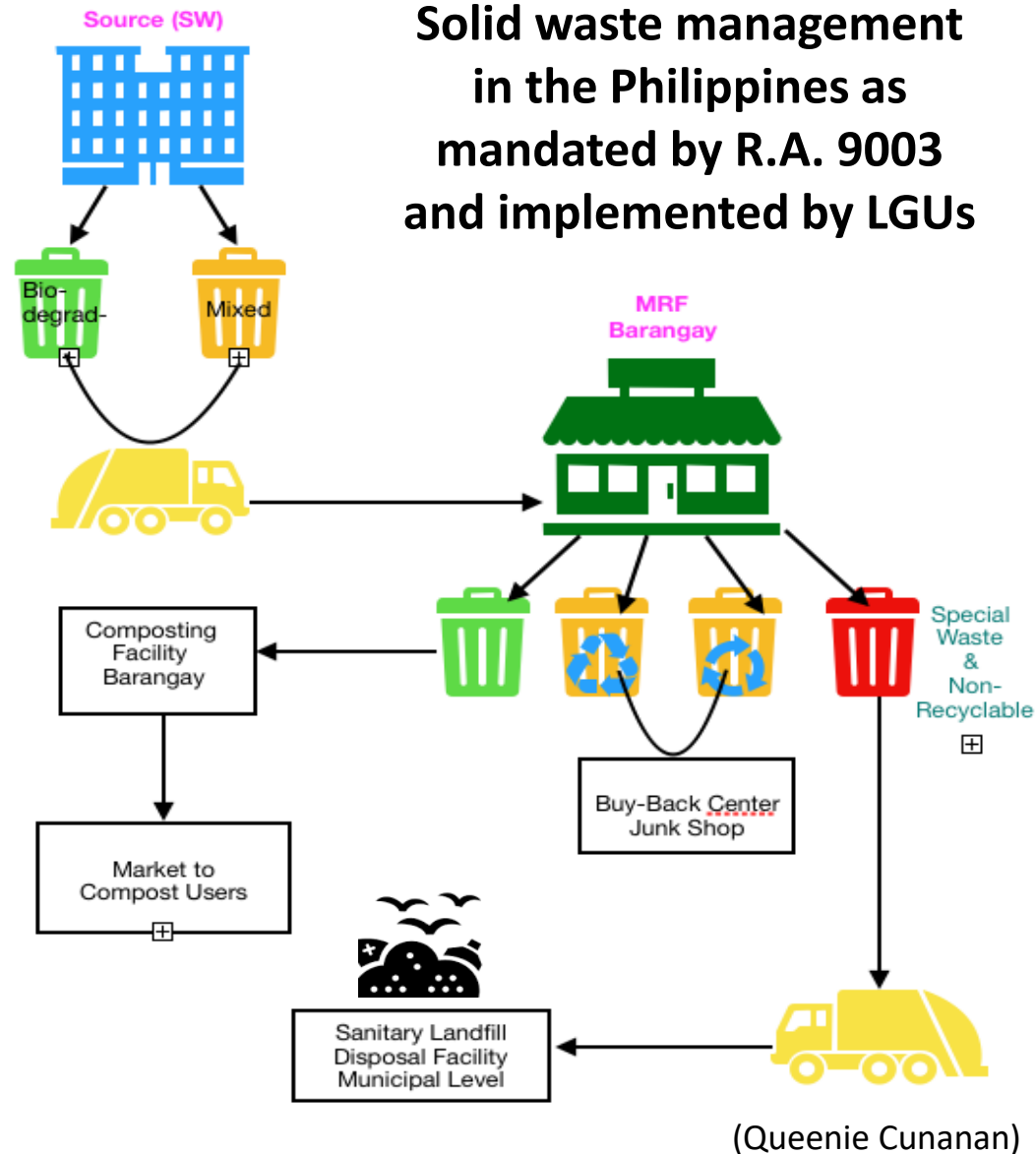
Section 7. The **National Ecology Center**.

- (a) Facilitate training and education in integrated ecological solid waste management;
- (b) Establish and manage a solid waste management information data base, in coordination with the DTI and other concerned agencies
- (c) Promote the development of a recycling market through the establishment of a national recycling network that will enhance the opportunity to recycle;
- (d) Provide or facilitate expert assistance in pilot modeling of solid waste management facilities;

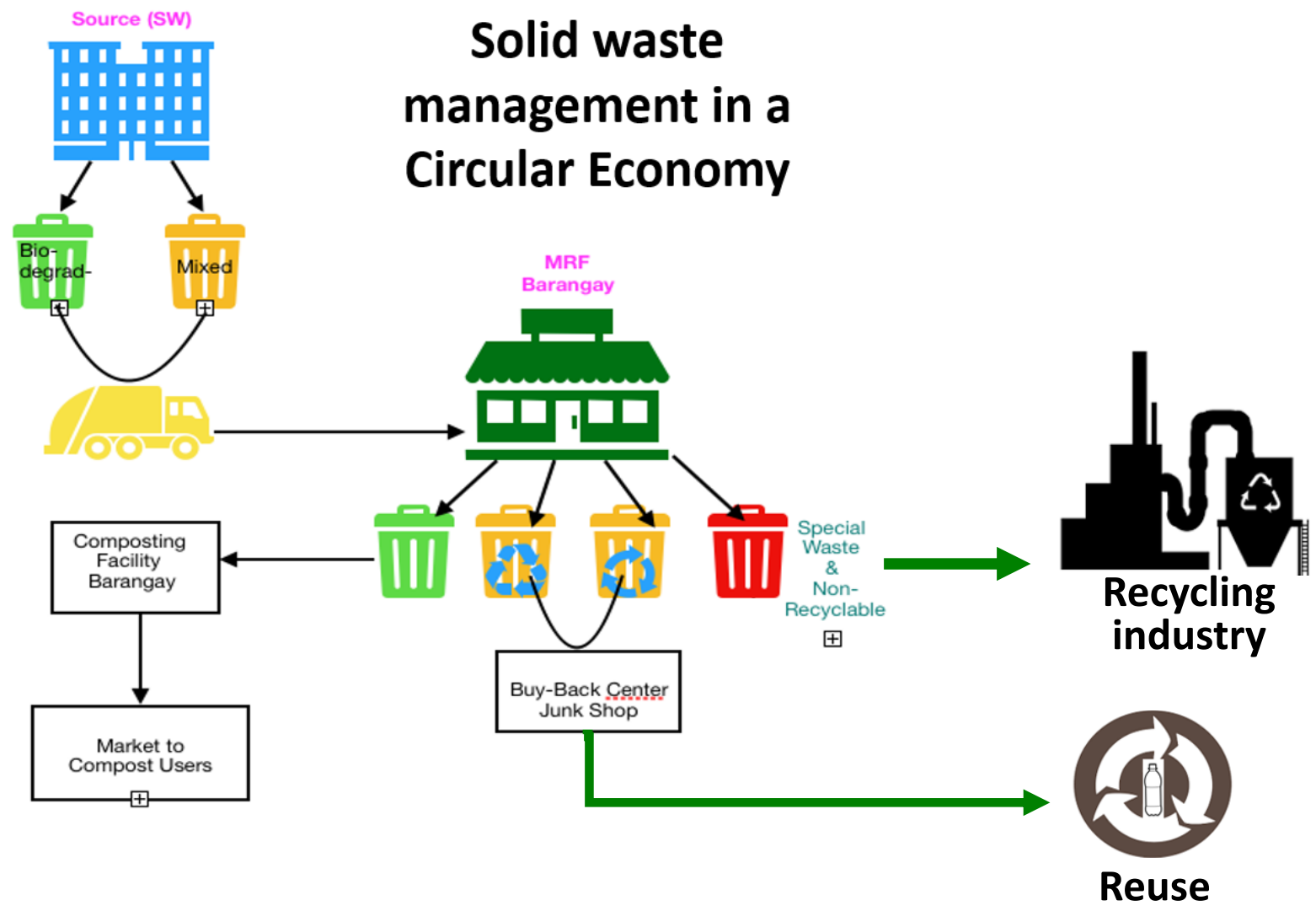
Some observations regarding RA 9003:

1. Tackles solid waste as a whole.
However, plastic wastes need a different strategy.
2. SWM strategy depends on landfills (“end of pipe”).
3. Lack of attention to S&T.
4. More support is needed for plastic waste recycling industry.

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



Solid waste management in a Circular Economy



Multi-sectoral approach to plastics



Chemical and plastics industries



Global



Law and policy makers



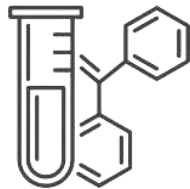
Regulators



Waste management and recycling industries



Local government units



R&D



Stakeholder governance



Public education



Consumers

Reduce
Reuse
Recycle
Re-design
Thank you!

the GREEN issue EARTH DAY
FAIR TRADE
Ride a Bike
RESPONSIBLE FISHING
SUSTAINABLE ECOLOGY
PROTECT & RAINFOREST
ORGANIC
CONSERVE
MINDFULLY
Solar Panels
RENEWABLES
ROOFTOP meadows
REDUCING
LOW IMPACT
CAR POOL
plant a tree
Wild Life
Environment
Water
BUS