BOSTON CONSULTING GROUP

Solving the circularity challenges in plastics value chain

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Plastics have powered human progress, but their disposal is becoming a complex challenge – especially in Southeast Asia

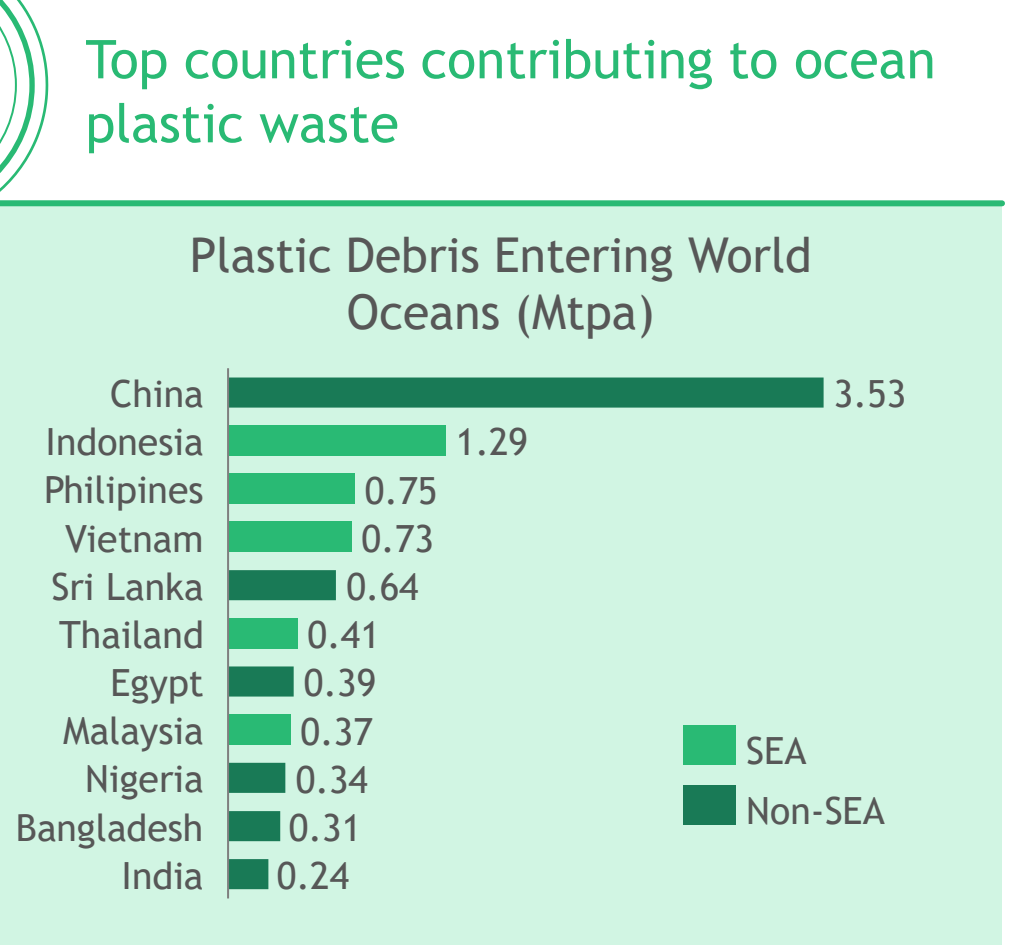
The problem with plastic

From the stomachs of baby seabirds to the depths of the oceans — plastic pollution is everywhere

A Patch of Plastic Garbage in the Pacific Ocean Amounts to Twice the Size of Texas, a New Study Says

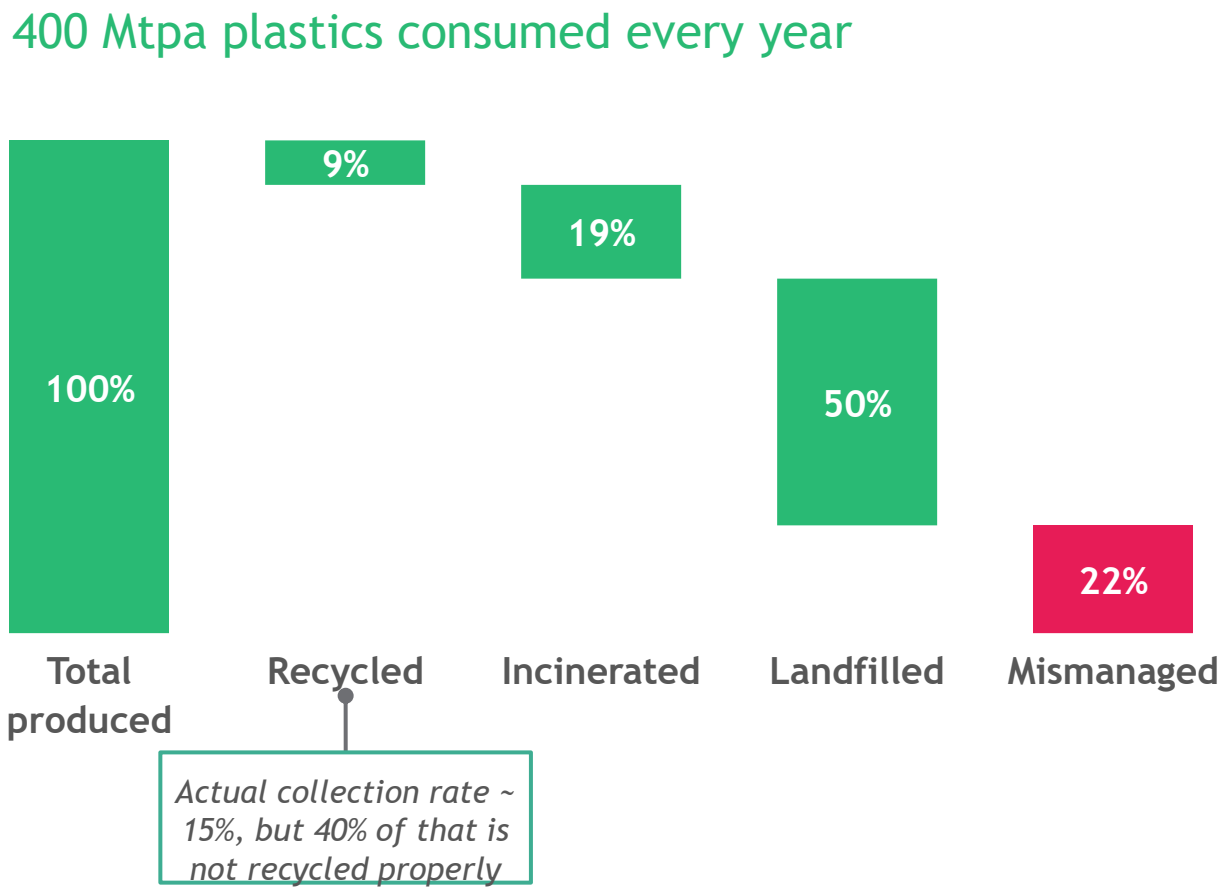
Ocean plastic waste set to triple within a decade, government scientists warn

Top countries contributing to ocean plastic waste



Source: American Chemistry Council, Helmholtz Centre for Environmental Research

Unfortunately, even today > 70% of plastic produced annually goes untreated

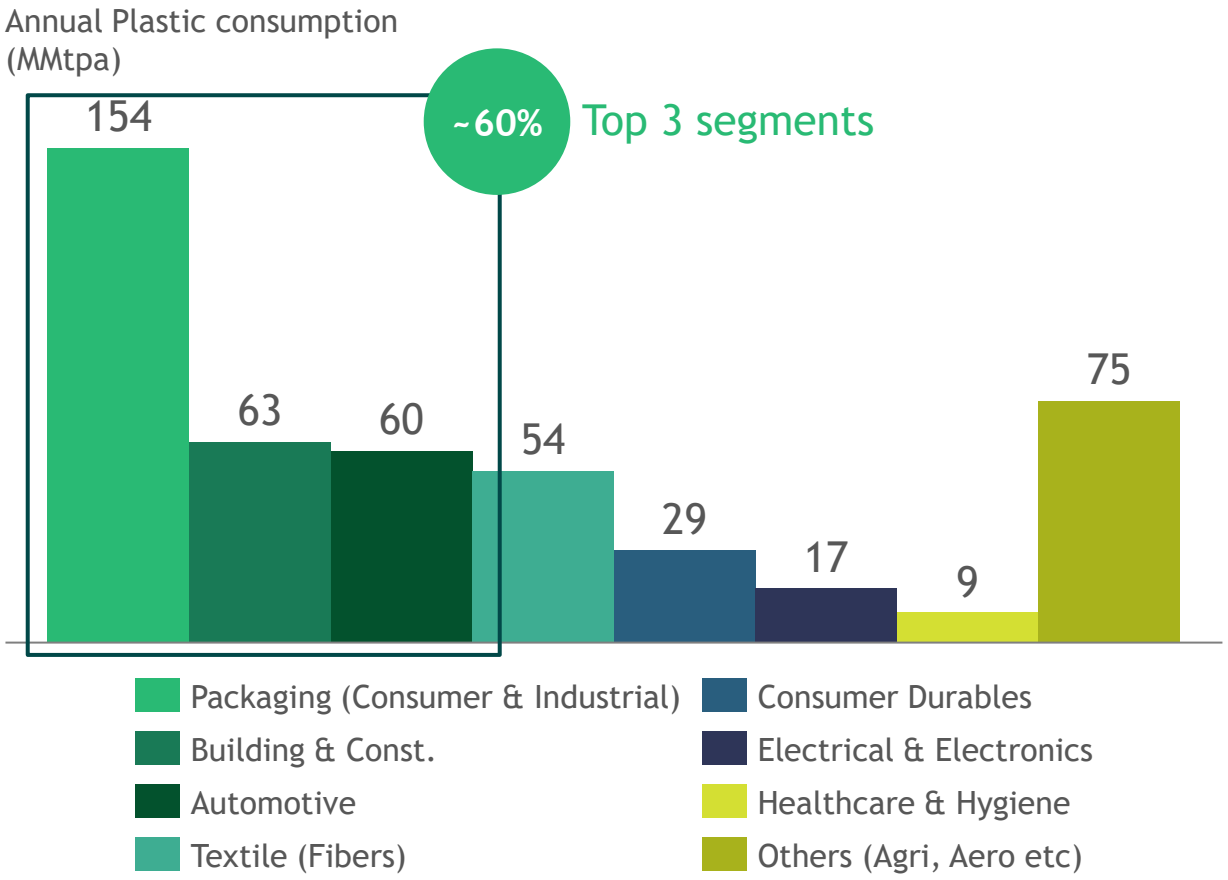


Source: OECD, BCG analysis

8B+ tons of plastics have been produced to date, and most of the scrapped volume of ~6B tons has been landfilled/incinerated

Packaging (consumer & industrial), Building & Construction and Automotive segments make up ~60% of plastic consumption

Key plastic segments by consumption volume (MMtpa)



Segment growths underpinned by strong demand

Packaging (Consumer & Industrial)
- Growth driven by demand for varied packaging sizes, refillable packs, durability and protection of products for long haul transportation

Building & Construction
- Infrastructure growth in railways, roads, water and sewage will continue to drive demand

Automotive
- Growing middle and affluent class drives increased car ownership

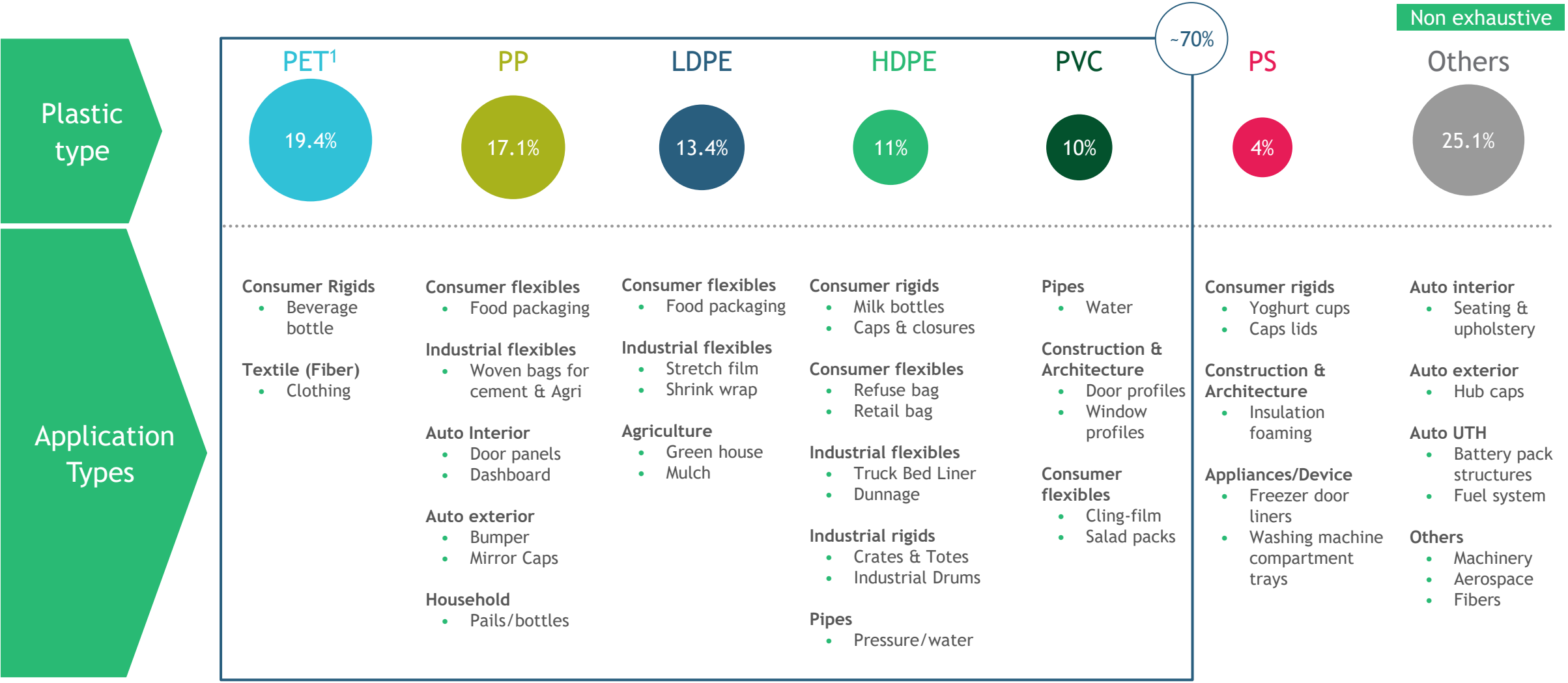
Consumer durables
- Growing middle and affluent class with aspiration to improve standard of living drives appliance growth

Electrical & Electronics
- Increasing demand for technological advancement with rising disposable income

Healthcare & Hygiene
- Growth driven by gov funding of COVID-19 prevention, treatment and expansion of public health insurance coverage

Source: OECD 2022 (global plastics outlook to 2060); IHS Markit; BCG Analysis

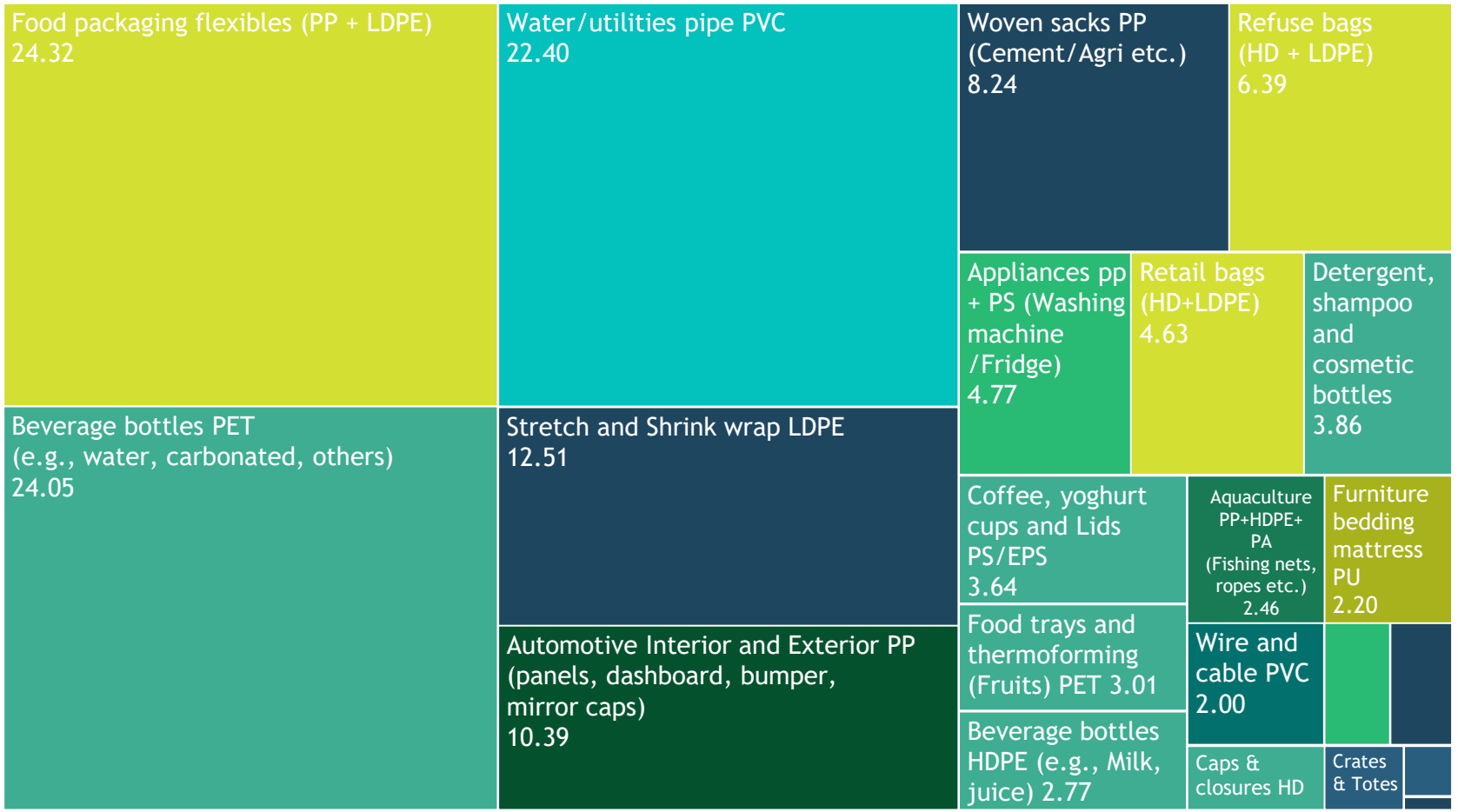
PET, PP, LDPE, HDPE & PVC accounts for roughly 70% of plastic demand



Note: LDPE represents LLDPE & LDPE;1. 55% of total PET volume is fibers for use in textile; 45% PET resin: 34% for use in PET Beverage
Source: OECD 2022 (global plastics outlook to 2060); IHS Markit; BCG Analysis

Top 20 sub-application x plastics | 5 largest sub-applications consumes about 20% of global plastics (~94 MMtpa)

Plastic consumption (MMtpa)



Sub-application

- Appliances PP + PS (Washing machine/A/Cs/Fridge)
- Aquaculture products PP + HDPE + PA (Fishing nets, ropes etc.)
- Automotive Interior and Exterior PP (panels, dashboard, bumper, mirror caps)
- Beverage bottles HDPE (e.g., Milk, juice)
- Beverage bottles PET (e.g., water, carbonated, others)
- Caps and closures HDPE
- Coffee. yoghurt cups and Lids PS/EPS
- Crates and Totes HDPE
- Detergent, shampoo & cosmetic bottles HDPE
- Devices (Phones, tablets etc.)
- Dunnage HDPE
- Food packaging flexibles (PP + LDPE)
- Food trays and thermoforming (Fruits) PET
- Furniture bedding/mattress PU
- Industrial drums and large containers HDPE
- Refuse bags (HD + LDPE)
- Retail bags (HD+LDPE)
- Stretch and Shrink wrap LDPE
- Truck bed liners HDPE
- Water/utilities pipe PVC
- Wire and cable PVC
- Woven sacks PP (Cement/Agri etc.)

Note: LDPE represents LDPE & LLDPE
Source: OECD 2022 (global plastics outlook to 2060); IHS Markit; Open-source publications; BCG analysis

The good news is that Southeast Asia govts are already pushing ahead with sensible plastics regulations

Country	Plastic-specific strategy	Ban of single-use plastics	Levy/charge on single-use plastics	Sorted collection	Import regulation
Indonesia	●	●	●	●	●
Malaysia	●	●	●	●	●
Philippines	●	●	●	●	●
Singapore	●	●	●	●	●
Thailand	●	●	●	●	●
Vietnam	●	●	●	●	●

Plastic-related policy/strategic: ● Exists ● Partial ● Does not exist

Recent press clippings:

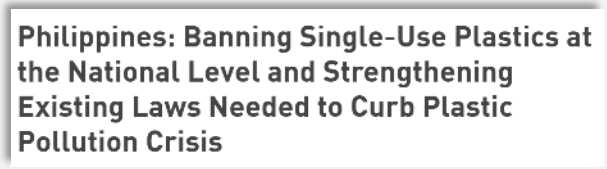

ENVIRONMENT

Viet Nam and the WEF Launch Partnership to Tackle Plastic Pollution


Ready to report: How Singapore firms are preparing for new packaging mandate

With Singapore set to introduce mandatory reporting requirements in 2020 in a bid to raise awareness of packaging waste, companies tell Eco-Business how they are preparing for the mandate, and what they are doing to limit their packaging waste.


Waste not want not: Malaysia moves to become a leader in tackling plastic waste


Philippines: Banning Single-Use Plastics at the National Level and Strengthening Existing Laws Needed to Curb Plastic Pollution Crisis


Indonesia to reduce marine plastic waste 70% by 2025

Tons of waste enters oceans every year, says Indonesian Institute of Sciences

Nicky Aulia Widadio | 13.12.2019


ENVIRONMENT AUGUST 16, 2018 / 8:58 PM / UPDATED 2 YEARS AGO

Thailand to ban imports of high-tech trash, plastic waste

1. Extended producer responsibility

Source: ASEAN Cooperation on Environment: Circular Economy and Plastics Report 2021; Press search

The Private sector has also responded strongly with major investments in plastics recycling space in the region in recent years

PTT Global Chemical and Alpla to build recycling plant in Thailand

08:07 AM | September 9, 2019 | Kartik Kohli

Siam Cement completes demonstration plant for chemical recycling

09:52 AM | February 2, 2021 | Kartik Kohli

PCG, Plastic Energy sign MoU on addressing plastic waste

POSTED ON JUNE 28, 2019, FRIDAY AT 12:11 AM

Dow, SCG and Unilever to develop Vietnamese plastics circular economy

By **Paul Sanderson** - March 2, 2020

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Plastic Energy to build chemical recycling plants in Indonesia

06:21 AM | April 8, 2019 | Kartik Kohli

Indorama secures $300 million from IFC to raise recycling capacity

06:37 AM | November 25, 2020 | Kartik Kohli

Indorama Ventures (Bangkok, Thailand) says that its affiliate Indorama Ventures Global Services has secured $300 million financing packag
International Finance Corporation (IFC), a member of the World Bank Group. The funding will help the company to increase its recycling cap
in Thailand, Indonesia, Philippines, India, and Brazil, and invest in renewable energy and resource efficiency projects, it says.

NEA And Shell To Jointly Explore New Chemical Recycling Value Chain To Turn Plastic Waste Into Chemicals

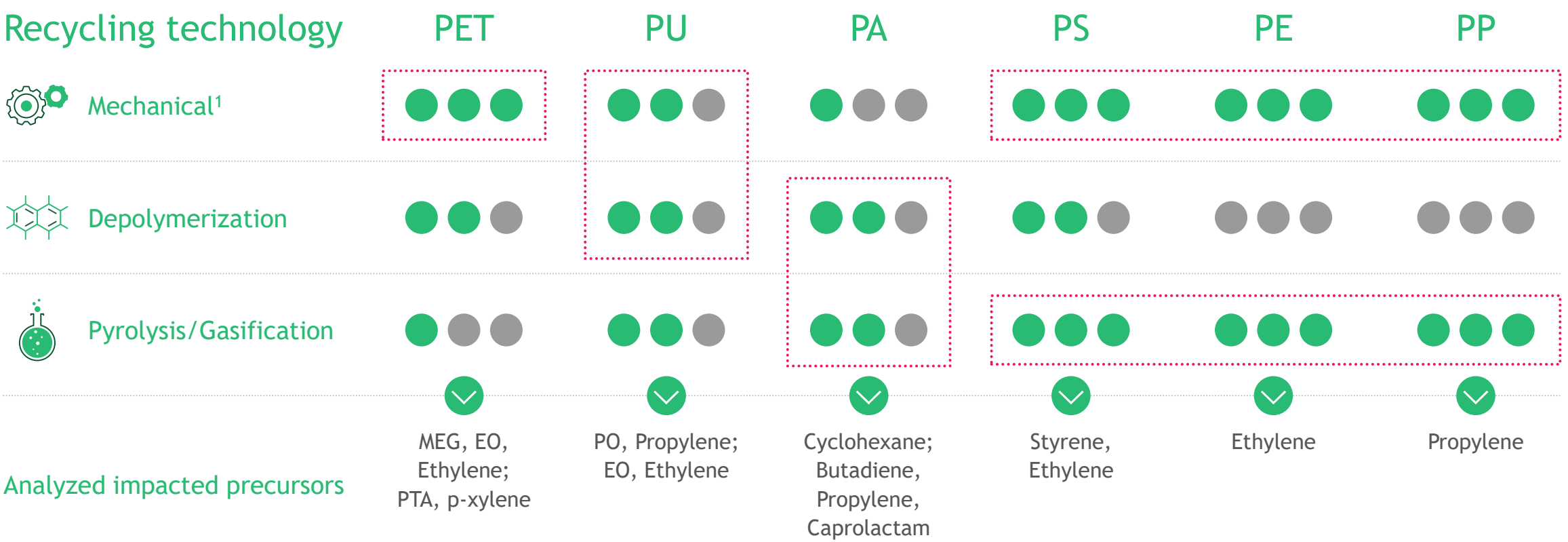
16 Oct 2020

Indorama Ventures and Coca-Cola forms Joint Venture to set up largest bottle-to-bottle recycling facility in the Philippines

MARCH 11, 2020 · SAKSHI

Source: ChemWeek, Plastics Insights, Press search

The type of recycling solution will however vary by polymer



1. Recycling ability dependent on product quality, i.e., generally limited amount of recycling loops as combined with reduction of material properties
2. BCG perspective on future application potential based on plastic type and polymerization process

Note: Not exhaustive, BCG research in progress

Source: Technoeconomics—Energy&Chemicals; TECH 2021S10; Web search; Expert Interviews; BCG analysis

But key challenges remain for the recycling business

Scalability

Current pyrolysis plants are limited in size (e.g., 30-50 ktpa plants)

Economics

Transporting waste is expensive; collection and sorting high quality waste not easy, making pyrolysis uneconomical at low oil prices

Quality

Recycled plastics often get downcycled or get converted to fuel or feedstock; difficult to have high quality recyclates (e.g., food grades)

Several opportunities to disrupt the recycling value chain – new value pools and opportunities will be created

1

Can we collect and sort plastic efficiently before it even goes to landfill?

(e.g., full ecosystem play relying on reverse logistics)

2

Can we use technology to disrupt plastic extraction from landfills?

(e.g., AI powered robots with cameras)

3

Can we develop IP for breakthrough technology?

(e.g., trash—monomer technology)

4

Can we prevent products from going to waste?

(e.g., value chain supports full re-use)

How else can we disrupt this space?

Beyond recycling, companies need to think of the overall ecosystem of plastics

1 BIO based feedstock usage (e.g., PLA, bio-PE)

3 DESIGN plastics that are recyclable (e.g., mono modal matl.)

4 MAKE plastics operations net-zero

5 SELL access (rather than ownership) – new business models

6 USE – design plastic products to long last

2,7 COLLECT AND RECYCLE plastics at the end of their current life to close the loop

Source: BCG

Example – Design for Recylcability

Non-colored & Label free bottles (rPET)

Source: Ellen Macarthur foundation Upstream Innovation; Danone; BCG research

Brands are embossed on water bottle replacing labels. The barcode that was previously on the label are also integrated into the cap improving recyclability of single-use PET bottles

Above change, can result in an extra ~18,000 tonnes of PET bottles collected every year in Southeast Asia even without any changes to collection infrastructure

Circular Economy of Plastics — key messages

1

Circular Economy of Plastics is no longer a “nice to have”, but a “must have” for chemical companies

Plastics waste pollution issue getting acute in SE Asia, and aggressive targets set by major consumers of plastics (e.g., Coco-cola requiring 50% recycling content in packaging by 2030)

2

Circular practices has a multiplier effect on the core business

Recycled polymers typically blended with virgin polymers to meet recycled content regulations; without recyclates, virgin polymer also at risk

4

Solutioning will need to be holistic and go beyond recycling

Requires options for every step of the circular economy (e.g., improved designs for recycling, bio-plastics); disruptive business models and technologies will create new value pools and opportunities for ChemCos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