



East Asia and Pacific Region: **MARINE PLASTICS SERIES**

# Appendices

MARKET STUDY FOR MALAYSIA:

Plastics Circularity Opportunities and Barriers





© 2021 The World Bank Group  
1818 H Street NW, Washington, DC 20433  
Telephone: 202-473-1000; Internet: [www.worldbank.org](http://www.worldbank.org)

This work is a product of the staff of The World Bank Group. “The World Bank Group” refers to the legally separate organizations of the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA).

While believed reliable, the World Bank Group does not guarantee the accuracy, reliability or completeness of the content included in this work, or for the conclusions or judgments described herein, and accepts no responsibility or liability for any omissions or errors (including, without limitation, typographical errors and technical errors) in the content whatsoever or for reliance thereon. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of the World Bank Group concerning the legal status of any territory or the endorsement or acceptance of such boundaries. The findings, interpretations, and conclusions expressed in this volume do not necessarily reflect the views of the Executive Directors of the World Bank Group or the governments they represent.

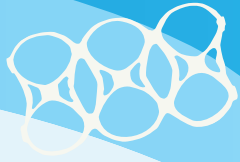
Nothing herein shall constitute or be construed or considered to be a limitation upon or waiver of the privileges and immunities of any of The World Bank Group organizations, all of which are specifically reserved.

#### **Citation**

World Bank Group 2021. *Market Study for Malaysia: Plastics Circularity Opportunities and Barriers*. Marine Plastics Series, East Asia and Pacific Region. Washington DC.

#### **Rights and Permissions**

The material in this work is subject to copyright. Because The World Bank Group encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given. All queries on rights and licenses should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; e-mail: [pubrights@worldbank.org](mailto:pubrights@worldbank.org).



# Appendices

## MARKET STUDY FOR MALAYSIA:

### Plastics Circularity Opportunities and Barriers



KEMENTERIAN  
ALAM SEKITAR DAN AIR  
Ministry of Environment and Water



**WORLD BANK GROUP**

THE WORLD BANK  
IBRD • IDA

**IFC**

International  
Finance Corporation

**PROBLUE**



Administered by  
**THE WORLD BANK**  
IBRD • IDA | WORLD BANK GROUP

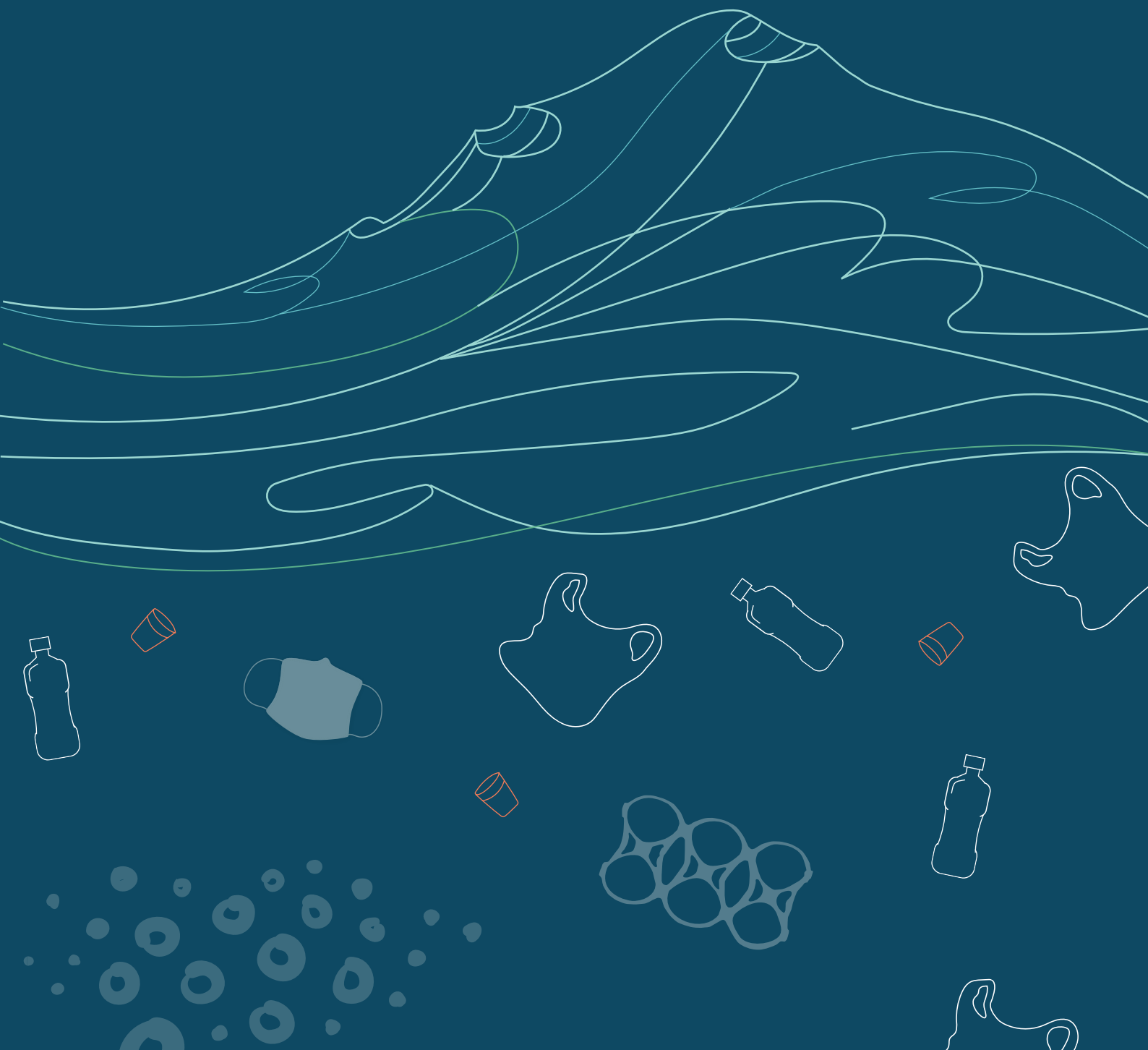


**GA  
CIRCULAR**

# CONTENTS

Appendix 1: Stakeholder Engagement List .....	6
Appendix 2: Further Definitions on Circularity and Other Related Concepts .....	10
Appendix 3: Comparing the Impact of PET and PVC Recycling on Primary Chemical Demand .....	12
Appendix 4: Data Points Used for Lifespan Calculations .....	13
Appendix 5: Methodology Differences Between Material Flow Analysis Conducted by WWF and Under this World Bank Study .....	15
Appendix 6: Data Sources and Key Assumptions for Material Value Loss Calculations .....	16
Appendix 7: Comparison of Import/Export Data from Various Sources .....	25
Appendix 8: Comparison of Virgin and Recycled Resins and Oil Prices.....	26
Appendix 9: Mandating Recycled Content Targets & Malaysia’s Ability to Fulfill these Targets.....	30
Appendix 10: Calculation for Estimated Installed Capacity vs. Missing Capacity .....	31
Appendix 11: Import Conditions for Plastic Waste HS Code 39.15 (Effective on 26 October 2018) .....	32
Appendix 12: Malaysia’s Scrap Plastic Imports and Exports .....	33
Appendix 13: MSW System in Malaysia (Act 672 and Non-ACT 672 States) .....	34
Appendix 14: The Enabling Policy Environment for Circularity and Interventions for Plastic Packaging .....	40
Appendix 15: Existing Industry-Led Efforts and Roadmap Towards Zero Single-Use Plastics 2018–2030 .....	44
Appendix 16: Checklist for Plastic Recycling Process Evaluations.....	46
Appendix 17: Tightening of Global Regulations on Scrap Plastic and Recycled Plastic Trading.....	47
Appendix 18: Bioplastic Alternatives .....	49
Appendix 19: Assumptions and Conditions Behind Calculation of the Impact of Interventions.....	51
Appendix 20: Summary of all Recommended Interventions and Actions .....	53

# APPENDICES



## APPENDIX 1:

# STAKEHOLDER ENGAGEMENT LIST

### APPENDIX 1A: ATTENDEE LIST OF STAKEHOLDER CONSULTATION WORKSHOP

Table A1.1

**ATTENDEE LIST OF STAKEHOLDER CONSULTATION WORKSHOP**

#	Company	Stakeholder Category	Full Name	Position
1	BP Plastics Sdn Bhd	Company (Processor)	CY Lim	Managing Director
2	Coca-Cola Bottlers (Malaysia) Sdn Bhd	Company (Consumer Goods)	Finaswani Zin	Head of Public Affairs, Communications & Sustainability
3	DCT Plastic Sdn Bhd	Company (Recycler)	Khoo Chun Lan	Director
4	Green Concept Technology Sdn Bhd	Company (Recycler)	Gilbert Tan Teng Liat	Managing Director
5	L'Oréal Malaysia	Company (Consumer Goods)	Jida Mohamed	Corporate Communications Director
6	Lotte Chemical Titan (M) Sdn Bhd	Company (Petrochemical)	Philip Kong	Executive Vice President, Corporate Planning
7	Lotte Chemical Titan (M) Sdn Bhd	Company (Petrochemical)	Jessica	No position available
8	Lotte Chemical Titan (M) Sdn Bhd	Company (Petrochemical)	Kelvin Choong You Jian	No position available
9	Lotte Chemical Titan (M) Sdn Bhd	Company (Petrochemical)	Mohd Raihan	No position available
10	Lotte Chemical Titan (M) Sdn Bhd	Company (Petrochemical)	Thomas Khoo	Manager, Corporate Planning & Investor Relations
11	Malaysian Petrochemicals Associations (MPA)	Industry Association	Nasruddin M Zain	General Secretary
12	Malaysian Plastics Manufacturers Association (MPMA)	Industry Association	CC Cheah	Vice- President/ Chairman, Recycling Sub-Committee
13	Malaysian Plastics Manufacturers Association (MPMA)	Industry Association	Crystal Cheah	Assistant Manager
14	Malaysian Plastics Manufacturers Association (MPMA)	Industry Association	SC Chan	Manager
15	Malaysian Plastics Manufacturers Association (MPMA)	Industry Association	Wee Ching Yun	Chairperson, Sustainability Subcommittee
16	Malaysian Plastics Recyclers Association (MPRA)	Industry Association	Daniel Loo	Secretariat
17	Ministry of Environment and Water (KASA)	Government (National)	Nor Haswani binti Kamis	Principal Assistant Secretary
18	Ministry of Environment and Water (KASA)	Government (National)	Nur Hidayah binti Hasnan	Environmental Management Department
19	Ministry of Housing and Local Government (KPKT)	Government (National)	Mohd Hafiz Bin Sulaiman	Department of Policy and Strategy
20	Ministry of International Trade and Industry (MITI)	Government (National)	Nur Afiqah Md Nasir	Department of Sectoral Policy
21	Nebula Waste Management (M) Sdn Bhd	Company (Recycler)	Sangeeta Mohan Das	Managing Director
22	Nestlé (Malaysia) Berhad	Company (Consumer Goods)	Immy Ooi Lay Imm	Manager, Corporate Communications

23	Nestlé (Malaysia) Berhad	Company (Consumer Goods)	Dato' Adnan Pawanteh	Executive Director, Group Corporate Affairs
24	Penang Green Council	Government (State Level)	Wong Fen Fen	Senior Officer
25	Penang Green Council	Government (State Level)	Josephine Tan Mei Ling	General Manager
26	Petronas	Company (Petrochemical)	Mohd Noor Fitri	Manager, Operational Excellence
27	Recron (Malaysia) Sdn Bhd	Company (Petrochemical)	Hemant Kedia	Head Sourcing, Strategy & Business Development
28	Reef Check Malaysia	NGO/Foundation	Theresa Ng	Programme Development Manager
29	Plastic Energy Malaysia	Company (Recycler)	Rudy Ahmad	No position available
30	Plastic Energy Malaysia	Company (Recycler)	Nadia Chang	No position available
31	World Wildlife Fund (WWF) Malaysia	NGO/Foundation	Tahirah Banu Mohamed Ariff	Interim Manager - Plastics Initiative
32	Deloitte Malaysia	Consultant for Circular Economy Roadmap Project	Lorraine Jiang	Senior Consultant - Sustainability
33	Deloitte Malaysia	Consultant for Circular Economy Roadmap Project	Roman Chen	Consultant, Deloitte United Nations and Sustainability Team APAC
34	Deloitte Malaysia	Consultant for Circular Economy Roadmap Project	Jonah	No position available
35	Deloitte Malaysia	Consultant for Circular Economy Roadmap Project	Amrita	Deloitte United Nations and Sustainability (DUNAS - Risk Advisory)
36	World Bank	International Organization	Navneet Chadha	Sustainability Professional
37	World Bank	International Organization	Dr. Anjali Acharya	Senior Environmental Specialist
38	World Bank	International Organization	Kate Almora Philip	Environmental Engineer
39	World Bank	International Organization	Mei Ling Tan	Country Operations Officer
40	World Bank	International Organization	Minisha Deepu	Program Assistant
41	World Bank	International Organization	Rattanyu Dechjejaruwat	Economist, Consultant
42	World Bank	International Organization	Yeoh Tze Ni	Private Sector Specialist, Markets and Technology
43	GA Circular	Consultant for Malaysia Plastics Circularity Project	Ashwin Subramaniam	Founder & CEO
44	GA Circular		Laura Allen	Co-founder & COO
45	GA Circular		Amirul Adli	Project Manager
46	GA Circular		Amita Baecker	Project Manager
47	GA Circular		Tam Nguyen	Head of Operations
48	GA Circular		Paolo Facco	Project Manager
49	GA Circular		Nurul Aisyah	Project Executive
50	GA Circular		Sinye Ong	Project Executive
51	GA Circular		Juline Lew	Project Executive

## APPENDIX 1B: LIST OF PRIVATE SECTOR STAKEHOLDERS ENGAGED FOR IN-DEPTH INTERVIEWS

Five of the key private sector stakeholders that are discussed in this study are:

1. **Resin Producers:** Resin producers produce virgin resin (e.g. PET, PP, PE) from crude oil that is needed as feedstock for production of plastic goods.
2. **Converters:** Converters use the resin produced by resin producers, and in some cases recycled resins produced by recyclers, to manufacture plastic products.
3. **Collectors:** Collectors are formal waste management companies and informal workers who collect the plastic products after consumption to re-sell for recycling.
4. **Aggregators:** Aggregators collect large quantities of post-consumer or post-industrial plastics from their supply chain (consisting of collectors and junk shops) to re-sell to recyclers.
5. **Processors & Recyclers:** Processors and recyclers convert the waste plastics collected by the collectors and aggregators and convert them into the recycled raw materials.

Table A1.2

### LIST OF PRIVATE SECTOR STAKEHOLDERS ENGAGED FOR IN-DEPTH INTERVIEWS

#	Stakeholder name	Stakeholder category	Name of contact person	Position
1	Chong Wah Plastics Sdn Bhd	Company (Processor)	CY Wee	Managing Director
2	Coca-Cola Bottlers (Malaysia) Sdn Bhd	Company (Consumer Goods)	Finaswani Zin	Head of Public Affairs, Communications & Sustainability
3	DCT Plastic Sdn Bhd	Company (Recycler)	Yang Pai Fei	Director
4	Etika Malaysia Sdn Bhd	Company (Consumer Goods)	Mohd Zurairi Mustafa	Senior Manager - Government Liaison
5	Fizlestari Plastic Sdn Bhd	Company (Recycler)	Daniel Loo	Manager
6	Green Concept Technology Sdn Bhd	Company (Recycler)	Gilbert Tan	Managing Director
7	Heng Hiap Industries Sdn Bhd	Company (Recycler)	Seah Kian Hoe	CEO
8	Ipoh S.Y. Recycle Sdn Bhd	Company (Recycler)	Ethan Chee	Manager
9	Malaysian Petrochemicals Associations (MPA)	Industry Association	Nasruddin M Zain	General Secretary
10	Malaysian Plastics Manufacturers Association (MPMA)	Industry Association	Crystal Cheah	Sustainability Subcommittee Chairperson
11	Malaysian Plastics Recyclers Association (MPRA)	Industry Association	Daniel Loo	Secretariat
12	Malaysian Green Technology & Climate Change Centre (MGTC)	Industry Association	Roslina Muhammad	Senior Analyst – Circular Economy ((MGTCCC)
13	Nebula Waste Management (M) Sdn Bhd	Company (Recycler)	Sangeeta Mohan Das	Managing Director
14	Nestlé Malaysia	Company (Consumer Goods)	Immy Ooi	Manager, Corp Comms
15	Pepsico (Malaysia) Sdn Bhd	Company (Consumer Goods)	Mohd Zurairi Mustafa	Senior Manager - Government Liaison
16	PETRONAS Chemicals Marketing (Labuan) Ltd	Company (Petrochemical)	Azilah M Said	Marketing and Sales, Polymer Department
17	Plastic Energy Malaysia	Company (Recycler)	Ying Staton	Business Director, Asia
18	Recron (Malaysia) Sdn Bhd	Company (Resin Producer)	Hemant Kedia	Head of Procurement & Strategy
19	See Hau Global Sdn Bhd	Company (Processor)	CC Cheah	Director

20	SWM Environment Sdn Bhd	Company (Waste Collector)	Dr Ho De Leong	Chairman
21	Unilever (Malaysia) Holdings Sdn Bhd	Company (Consumer Goods)	Lisa Tan	CEO
22	Waste Management Association of Malaysia (WMAM)	Industry Association	Dr Ho De Leong	Chairman
23	Xin Da Spinning Technology Sdn Bhd	Company (Recycler)	Allen Lui Ge	Operations Head

## APPENDIX 1C: LIST OF GOVERNMENT OR OTHER STAKEHOLDERS ENGAGED FOR IN-DEPTH INTERVIEWS

Table A1.3

### LIST OF GOVERNMENT OR OTHER STAKEHOLDERS ENGAGED FOR IN-DEPTH INTERVIEWS

#	Stakeholder name	Stakeholder category	Name of contact person	Position
1	Buddhist Tzu Chi Foundation Malaysia	NGO/Foundation	Goh Suz Suz	Environmental Protection Team Lead
2	Food Safety and Quality Division (FSQD), Ministry of Health (MOH)	Govt (National)	Norhidayah Othman	Senior Assistant Director
3	Malaysian Investment Development Authority (MIDA)	Govt (National)	Surayu Binti Susah	Chemical & Advanced Materials Division
4	Ministry of Environment and Water (KASA)	Govt (National)	Eddy Mazuaansyah Bin Mohd Ali Murad	Deputy Under Secretary Environmental Management and Climate Change Division
5	Ministry of Housing and Local Government (KPKT)	Govt (National)	Aswita Sazmin binti Ismail	Department of Policy and Strategy
6	Ministry of International Trade and Industry (MITI)	Govt (National)	Nur Afiqah Md Nasir	Department of Sectoral Policy
7	National Solid Waste Management Department (JPSPN)	Govt (National)	Aswita Sazmin binti Ismail	Department of Sectoral Policy
8	Pahang State Government	Govt (State Level)	Siti Aisyah Atiqah	Senior Assistant Director
9	Penang State Government	Govt (State Level)	Oon Lai Kuan	Head of Waste Management Unit
10	Sabah State Government	Govt (State Level)	Johnny Samson	Head of Waste Management Section
11	World Wildlife Fund (WWF) Malaysia	NGO/Foundation	Jazlyn Lee	Corporate Engagement Manager, Sustainable Markets Programme

## APPENDIX 2:

# FURTHER DEFINITIONS ON CIRCULARITY AND OTHER RELATED CONCEPTS

### 2.1 Further Definition of Circularity

To better understand and utilize this definition for this study on plastics circularity, it is important to dissect the definition. This can be done in three approaches:

#### 1. Plastics circularity for a strong, innovative and resilient plastics industry

This approach to plastics circularity is the focus of this study and it builds on the foundation of Malaysia's existing plastics industry. This approach to plastics circularity includes the following activities:

- > Reduction of plastics usage/single-use plastics usage
- > Increasing local plastics recycling capacity
- > Increasing production and use of recycled plastics content
- > Moving towards 100% reusable, recyclable, biodegradable or compostable plastics materials

#### 2. Plastics circularity as a means to address climate change

The world is increasingly becoming aware of the climate crisis. However, the efforts to tackle this crisis have mainly focused on a transition to renewable energy which only addresses 55% of global greenhouse gas emissions. The remaining 45% comes from making the products we use every day, according to a 2019 report by The Ellen MacArthur Foundation.<sup>1</sup> If countries are serious about achieving the climate goals, they need to address and tackle this remaining 45%. While meeting climate change and related emissions targets is increasingly a large driver for circular economy efforts in the private sector, plastic circularity as a means to address climate change will be built on the foundation of the first approach outlined above.

#### 3. Plastics circularity as a means to address resource inefficiency

According to a UN Environment report in 2019, each year, 90 billion tonnes of primary materials are extracted and used globally, with only 9% recycled.<sup>2</sup> This is commercially and environmentally unsustainable. In the last two decades, not only have resource inefficiencies and pollution challenges become more severe, but countries around the world are also seeing the limits of a linear economy which is built in the model of "take-make-dispose." The current linear economy system is no longer working for businesses, people or the environment. Addressing the question of resource efficiency through plastic circularity is out of scope of this study and this approach will not be covered in this study.

### 2.2 Other Definitions Used in the Study

In addition to circularity, other terms need to be explained to understand the details and contexts of how the Circular Economy works.

**Waste:** Waste is defined as "substances or objects which are disposed of or intend to be disposed of by provisions of National Law" by the Basel Convention.

**Municipal Waste/Post-Consumer Waste:** Municipal waste is waste that has been disposed of by households or commercial entities after consumption. It is collected through the public waste collection infrastructure of the city. Therefore, post-consumer waste is typically dirty as organic waste that is also produced by residential and commercial sources is mixed into the municipal waste collection system.

1 Ellen MacArthur Foundation, "Completing the Picture"

2 United Nations Environment Programme, "Global Resources Outlook"

**Industrial Waste/Post-Industrial Waste:** Industrial waste is waste that is generated from industrial activities. These include materials such as chemical containers, pallet film wraps and factory offcuts. These wastes are typically disposed of through privately contracted waste collection services. Hence, they are usually less contaminated than post-consumer waste as it is not typically mixed with other types of waste unless it has already been contaminated due to the industrial activity it is produced from. In fact, in some cases, factories might engage recyclable collectors to collect their recyclables as it is usually cheaper than simply disposing of the materials.

**Recycling:** Recycling processes may be categorized as two types—Mechanical Recycling and Chemical Recycling

- **Mechanical Recycling:** Defined as “the processing of plastic waste into secondary raw material or products without significantly changing the chemical structure of the material” by the Basel Convention. For example, the flaking and pelletization of post-consumer PET bottles into rPET pellets is an example of mechanical recycling.
- **Chemical Recycling:** The Basel Convention defines Chemical Recycling as “the depolymerization of long polymer chains into monomers through a chemical reaction by means of heat and/or chemical agents to produce monomers, chemical raw materials and/or fuels.” Technologies that convert plastics back into secondary raw materials or fuels can be considered to fall under two broad categories: (a) plastic-to-plastic (via naphtha or monomer recycling); (b) plastic-to-fuel (PTF).<sup>3</sup> For example, DEMETO, a European project which uses microwave-based processes to de-polymerize PET at an industrial scale by converting it back to its composing elements (Ethylene Glycol and Terephthalic Acid) is an example of monomer recycling. Pyrolysis of multilayer flexibles into refuse derived fuel is an example of PTF recycling. While harmonized definitions for chemical recycling are still to be developed, in the EU—which leads in the development of these technologies—plastic-to-fuel technologies are considered by the chemical recycling industry to be energy recovery, not recycling (as they are linear); only plastic-to-plastic technologies (such as those that produce naphtha or monomers directly) are considered to fall under existing EU definition of recycling in the EU Waste Framework Directive.<sup>4</sup>

With regards to circularity, mechanical recycling is usually preferred as it requires less energy and has a lower technological requirement. Furthermore, it is possible to obtain the original product back through mechanically recycling waste recyclables, hence achieving true circularity. On the other hand, chemical recycling is able to handle most types of material that are not yet recyclable through mechanical recycling methods (e.g. multi-layer flexibles).

For mechanical recycling, circular recycling—where the product of the recycling process is similar to input material (e.g. bottle-to-bottle recycling)—is preferred to downcycling, where the products are different than the original input (e.g. PET to rPET fiber). This is because downcycling degrades the integrity and quality of the material and hence, reduces the value. This means that the incentive to collect these materials will be lower compared to a truly circular recycling process.

*Note: The report mentions the term smaller recyclers and larger recyclers. In the context of this report, larger recyclers are defined as recyclers with a capacity of more than 3000 tonnes per year. While other recyclers will be defined as smaller recyclers.*

**Energy Recovery:** Energy recovery is defined as the generation of heat, steam or electricity through the process of utilizing waste (plastics) as substitutes of primary fossil fuel resources for the production of fuel, for energy recovery. This is the least preferred method for recycling as it is the least efficient. However, for governments it is a convenient method to tackle two issues, waste management and electricity generation, with one solution.

---

3 A Circular Solution to Plastic Waste by BCG

4 Chemical Recycling Europe

## APPENDIX 3:

# COMPARING THE IMPACT OF PET AND PVC RECYCLING ON PRIMARY CHEMICAL DEMAND

This study acknowledges the fact that not all plastics are equal in terms of their recycling potential or in terms of the impact their recycling has on primary chemical demand. Consider two contrasting examples, PET and PVC:<sup>5</sup>

- PET resin (excluding polyester fiber) is almost exclusively used for packaging, much of which is single-use and therefore short-lived. PET is made from purified terephthalic acid and monoethylene glycol. The terephthalic acid is derived from para-xylene (part of the BTX aromatics) and monoethylene glycol is derived from ethylene. One unit of PET requires approximately 0.6 units of BTX aromatics and 0.2 units of ethylene, in mass terms.
- One unit of PVC requires twice as much ethylene, but less than 0.1 units of BTX aromatics and a further 0.1 units of propylene. The largest use of PVC is in construction. PVC windows, pipes and doors tend to stay locked in the built environment for 20 years or more. Even when they become available, they are hard to extract from the other building materials that accompany them.
- Recycling 1 unit of PET results in 38% more primary chemical savings than for PVC. There are also more abundant stocks available to recycle as newer (and therefore larger) volumes of packaging material are readily available. The PVC incurs a substantial delay before it is available for recycling.

It is for this additional reason that PVC and PS are not included within the scope of the study.

---

5 The Future of Petrochemicals, International Energy Agency (2018)

## APPENDIX 4:

# DATA POINTS USED FOR LIFESPAN CALCULATIONS

Table A4.1

**DATA POINTS USED FOR LIFESPAN CALCULATIONS**

Industry Sector	Mean (Average Lifespan)	Standard Deviation (Spread of Disposal)	Material Breakdown									
			LLDPE/LDPE		HDPE		PP		PET Bottle + Film		PET Polyester	
			Tonnes (2019)	Proportion (2019)	Tonnes (2019)	Proportion (2019)	Tonnes (2019)	Proportion (2019)	Tonnes (2019)	Proportion (2019)	Tonnes (2019)	Proportion (2019)
Packaging	0	0.83	309,581	83%	257,734	60%	212,901	50%	140,706	95%	0	0%
Construction	20	0.83	3,742	1%	77,320	18%	17,032	4%	0	0%	9,215	30%
E&E	10	0.83	22,452	6%	17,182	4%	42,580	10%	2,962	2%	0	0%
Automotive	15	0.83	0	0%	4,296	1%	63,870	15%	0	0%	0	0%
Textile	5	0.83	0	0%	0	0%	0	0%	0	0%	21,501	70%
Recreation	10	0.83	0	0%	4,296	1%	21,290	5%	0	0%	0	0%
Footwear	2	0.83	16,686	4%	0	0%	0	0%	0	0%	0	0%
Filament non-textile	0	0.83	0	0%	34,365	8%	12,774	3%	0	0%	0	0%
Medical	0	0.83	1,517	0%	0	0%	4,258	1%	1,481	1%	0	0%
Lens	0	0.83	0	0%	0	0%	0	0%	0	0%	0	0%
Agriculture	5	0.83	13,451	4%	21,478	5%	4,258	1%	0	0%	0	0%
Houseware	5	0.83	3,034	1%	8,591	2%	42,580	10%	1,481	1%	0	0%
Safety	5	0.83	0	0%	0	0%	4,258	1%	1,481	1%	0	0%
Security	5	0.83	0	0%	0	0%	0	0%	0	0%	0	0%
Security	5	0.83	3,742	1%	4,296	1%	0	0%	0	0%	0	0%
<b>Total</b>			374,205	100%	429,557	100%	425,801	100%	148,111	100%	30,715	100%

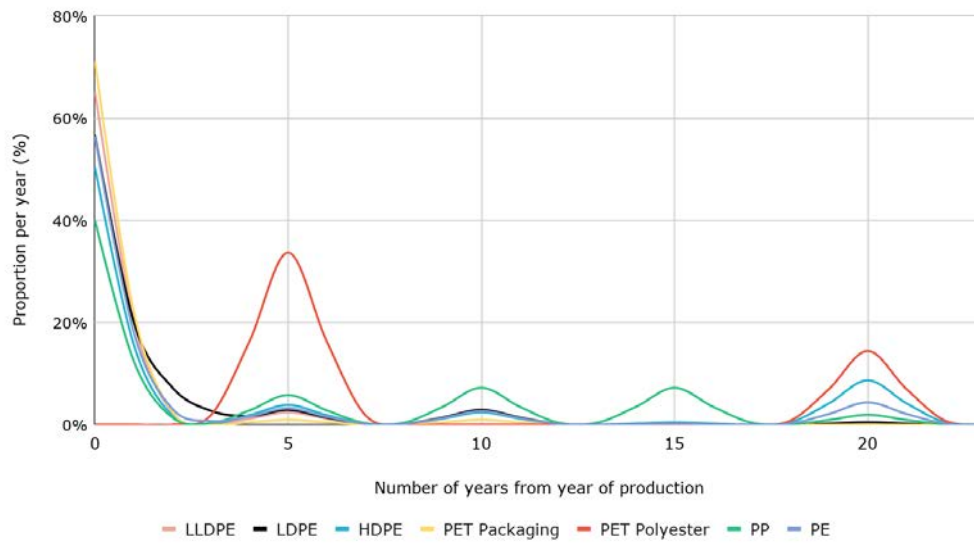
Source: Plastics Institute of Thailand (for percentage breakdown for end-use industry)

Table A4.1 Notes:

1. The breakdown above is used in order to determine 2019 disposal amounts, by determining the amounts consumed in 2019 and kept in use beyond 2019, and the amounts from past years that are being disposed of in 2019.
2. Data from the Plastics Institute of Thailand (PIT) has been used to calculate the material breakdown as Malaysia does not have such data available, and PIT data has been deemed the most representative.

Figure A4.1

**NORMAL DISTRIBUTION CURVES SHOWING AVERAGE LIFESPAN OF PLASTIC PRODUCTS FROM DIFFERENT RESINS**



Source: Plastics Institute of Thailand (as Malaysia specific data was not available), GA Circular modeling

## APPENDIX 5:

# METHODOLOGY DIFFERENCES BETWEEN MATERIAL FLOW ANALYSIS CONDUCTED BY WWF AND UNDER THIS WORLD BANK STUDY

Table A5.1

**SIMILARITY AND DIFFERENCE OF METHODOLOGY USED IN WWF MFA AND WORLD BANK MFA**

#	Methodology Areas	WWF EPR Study	MFA under Market Study by World Bank
1	Key Objective	To assess the status quo of the waste management system and plastic packaging material flows and recommend a relevant Extended Producer Responsibility (EPR) scheme for Malaysia.	To define the addressable market size in terms of tonnes and market value in plastics circularity in Malaysia. To identify the barriers and opportunities for plastics recycling.
2	Materials Studied	MFA covers the post-consumption phase of plastics under 3 key resins (PET, PP, HDPE). For PET it covers PET packaging only.	MFA covers plastics from production until post-consumption for all products under the 4 key resins (PET, PP, HDPE, LDPE/LLDPE). For PET it covers both PET packaging and PET polyester.
4	Type of Plastic Product	Mainly consumer products as a focus	Covers all plastic products produced from the 4 key resins studied
3	Data Collection	The methodology uses extrapolation from 2012 figures from the Survey on Solid Waste Composition, Characteristics & Existing Practices of Solid Waste in Malaysia commissioned by JPSPN based on estimated household incomes and district populations. Stakeholder interviews were also conducted with the formal sector, informal sector, government entities and NGOs.	The methodology uses in-depth stakeholder interviews with 34 public and private sector stakeholders from resin producers, converters and recyclers and additional consultation with more stakeholders.
		Both MFAs rely on interviews with recyclers to estimate the CFR rate.	

## APPENDIX 6:

# DATA SOURCES AND KEY ASSUMPTIONS FOR MATERIAL VALUE LOSS CALCULATIONS

The material value loss calculations are made based on low and high range estimations of the CFR rate. These ranges are used to account for two factors:

1. The fluctuation in CFR throughout the year based on seasonality and other variations (e.g. due to fluctuations in virgin price which affects recycled plastic demand and thus CFR rates). CFR rates also shift against each other— for example, when rPP is more attractive, recyclers will process more PP. That recycling capacity is essentially the same, which results in lower recycling for HDPE and/or LDPE (as polyolefin recyclers can generally recycle any three of these resins, and the proportion between the three will change depending on market conditions).
2. The variance of CFR estimates provided by different stakeholders.

CFR rates are informed by past studies by GA Circular focused on volumes of different plastics collected by the informal sector (e.g. higher amounts of PET/HDPE/PP, almost no LDPE) and what recyclers recycle (e.g. LDPE recyclers process 99% post-industrial LDPE and less than 1% post-consumer LDPE, which triangulates with informal sector data collection; whereas PP and HDPE recyclers process greater proportions of post-consumer HDPE and PP, which support the higher overall recycling rates for HDPE and PP). All CFR rate ranges have been triangulated against estimated recycling capacity (factoring in utilization and scrap plastic imports).

The term Most Valuable Recycled Product (MVRP) for each resin refers to the best circular scenario of the proportion of recycled products that can be produced. The calculation of the price of MVRP uses an average of the prices of various possible recycled products weighted according to the proportions of each type of recycled product under a best-case scenario of maximum value unlocked for the resin. This method takes into consideration that it is not realistic to expect 100% of resins to be recycled into the recycled product which has the most value.

Table A6.1

### PET PACKAGING

Price (USD/tonne)	
Food grade rPET	\$1,051
rPOY	\$960
Non-food grade rPET	\$720
Flakes	\$624
Best Circular Scenario (BCS) %	
Food grade rPET	55%
rPSF	40%
Non-food grade rPET	20%
Flakes	5%
BCS Weighted Average (USD/Tonne)	\$947.92
Current Recycled Product Breakdown (%)	
Food grade rPET	0.00%
rPOY	40.00%
Non-food grade rPET	50.00%
Flakes	10.00%

PET Starting Data Points		
Data Points	Value	Units
PET Bottle/Sheet Consumption	148,111	TPY
CFR rate (PET Packaging) (Low Range)	28%	%
CFR rate (PET Packaging) (High Range)	45%	%
CFR Tonnes (PET Packaging) (Low Range)	41,471	TPY
CFR Tonnes (PET Packaging) (High Range)	66,650	TPY
Price of MVRP under weighted average best circular scenario	\$947.92	USD/Tonne

PET Packaging						
Post-Consumer Destination		Tonnage	Price (USD/Tonne)	Price Difference from MVRP	Total Value Lost (Millions USD)	Total Lost (Millions USD)
Low Range Estimate of Recycling Rate	Food grade	0	\$1,051	-\$104	\$0	\$107
	PSF/POY	16,588	\$960	-\$12	\$0	
	Non-food grade	20,736	\$720	\$228	\$5	
	Flakes	4,147	\$624	\$324	\$1	
	Not recycled	106,640	\$0	\$948	\$101	
High Range Estimate of Recycling Rate	Food grade	0	\$1,051	-\$104	\$0	\$87
	PSF/POY	26,660	\$960	-\$12	\$0	
	Non-food grade	33,325	\$720	\$228	\$8	
	Flakes	6,665	\$624	\$324	\$2	
	Not recycled	81,461	\$0	\$948	\$77	

PET Packaging							
Post-Consumer Destination	Post-Consumer Destination (as a % of market inputs)	Weighted average price difference from MVRP	Price yield (a)	Volume yield (b)	Value yield (a x b) [Y-AXIS]	Collected for recycling rate [X-AXIS]	Economic value unlocked [X-AXIS x Y-AXIS]
Low Range Estimate of Recycling Rate	0.00%	\$142	85.07%	92.50%	78.69%	28.00%	22.03%
	40.00%						
	50.00%						
	10.00%						
High Range Estimate of Recycling Rate	0.00%	\$142	85.07%	92.50%	78.69%	45.00%	35.41%
	40.00%						
	50.00%						
	10.00%						

PET Packaging				
Post-Consumer Destination		Theoretical max of economic value unlocked Total Lost (Millions USD)	Value unlocked (after factoring in process loss) Total Lost (Millions USD)	Value lost Total Lost (Millions USD)
Low Range Estimate of Recycling Rate	Food grade	\$140	\$31	\$109
	PSF/POY			
	Non-food grade			
	Flakes			
	Not recycled			
High Range Estimate of Recycling Rate	Food grade	\$140	\$50	\$91
	PSF/POY			
	Non-food grade			
	Flakes			
	Not recycled			

Table A6.2  
PET POLYESTER

Price (USD/tonne)	
Food grade rPET	\$1,051
rPOY	\$960
Non-food grade rPET	\$720
Flakes	\$624
Best Circular Scenario (BCS) %	
rPSF	70%
Flakes	30%
BCS Weighted Average (USD/Tonne)	\$859.20
Current Recycled Product Breakdown (%)	
rPSF	70%
Flakes	30%

Polyester Starting Data Points		
Data Points	Value	Units
PET Polyester Consumption	30,715	TPY
Polyester CFR rate (Low Range)	0%	%
Polyester CFR rate (High Range)	5%	%
Price of MVRP under weighted average best circular scenario	\$859.20	USD/Tonne

PET Polyester						
Post-Consumer Destination		Tonnage	Price (USD/Tonne)	Price Difference from MVRP	Total Value Lost (Millions USD)	Total Lost (Millions USD)
Low Range Estimate of Recycling Rate	Recycled	0	\$624	\$235	\$0	\$26
	Not recycled	30,715	\$0	\$859	\$26	
High Range Estimate of Recycling Rate	Recycled	1,536	\$624	\$235	\$0	\$25
	Not recycled	29,180	\$0	\$859	\$25	

PET Polyester							
Post-Consumer Destination	Post-Consumer Destination (as a % of market inputs)	Weighted average price difference from MVRP	Price yield (a)	Volume yield (b)	Value yield (a x b) [Y-AXIS]	Collected for recycling rate [X-AXIS]	Economic value unlocked [X-AXIS x Y-AXIS]
Low Range Estimate of Recycling Rate	100.00%	\$235	72.63%	92.50%	67.18%	0.00%	0.00%
High Range Estimate of Recycling Rate	100.00%	\$235	72.63%	92.50%	67.18%	5.00%	3.36%

PET Polyester				
Post-Consumer Destination		Theoretical max of economic value unlocked (Millions USD)	Value unlocked (after factoring in process loss) (Millions USD)	Total Value lost (Millions USD)
Low Range Estimate of Recycling Rate	Recycled	\$26	\$0	\$26
	Not recycled			
High Range Estimate of Recycling Rate	Recycled	\$26	\$1	\$26
	Not recycled			

Table A6.3

PP

Price (USD/tonne)	
Food grade rPP	\$1,041
Natural rPP	\$876
Black rPP	\$588
Best Circular Scenario (BCS) %	
Food grade rPP	20%
Natural rPP	50%
Black rPP	30%
BCS Weighted Average (USD/Tonne)	\$822.56
Current Recycled Product Breakdown (%)	
Food grade rPP	0.00%
Natural rPP	20.00%
Black rPP	80.00%

PP Starting Data Points		
Data Points	Value	Units
PP Consumption	425,801	TPY
CFR rate (Low Range)	25%	%
CFR rate (High Range)	35%	%
Price of MVRP under weighted average best circular scenario	\$822.56	USD/Tonne

PP						
Post-Consumer Destination		Tonnage	Price (USD/Tonne)	Price Difference from MVRP	Total Value Lost (Millions USD)	Total Lost (Millions USD)
Low Range Estimate of Recycling Rate	Natural	21,290	\$876	-\$53	-\$1	\$282
	Black	85,160	\$588	\$235	\$20	
	Not recycled	319,351	\$0	\$823	\$263	
High Range Estimate of Recycling Rate	Natural	29,806	\$876	-\$53	-\$2	\$254
	Black	119,224	\$588	\$235	\$28	
	Not recycled	276,771	\$0	\$823	\$228	

PP							
Post-Consumer Destination	Post-Consumer Destination (as a % of market inputs)	Weighted average price difference from MVRP	Price yield (a)	Volume yield (b)	Value yield (a x b) [Y-AXIS]	Collected for recycling rate [X-AXIS]	Economic value unlocked [X-AXIS x Y-AXIS]
Low Range Estimate of Recycling Rate	20.00%	\$177	78.49%	95.00%	74.56%	25.00%	18.64%
	80.00%						
High Range Estimate of Recycling Rate	20.00%	\$177	78.49%	95.00%	74.56%	35.00%	26.10%
	80.00%						

PP				
Post-Consumer Destination		Theoretical max of economic value unlocked (Millions USD)	Value unlocked (after factoring in process loss) (Millions USD)	Total Value lost (Millions USD)
Low Range Estimate of Recycling Rate	Black	\$350	\$65	\$285
	Natural			
	Not recycled			
High Range Estimate of Recycling Rate	Black	\$350	\$91	\$259
	Natural			
	Not recycled			

Table A6.4

**HDPE**

Price (USD/tonne)	
Food grade rHDPE	\$1,456
Natural rHDPE	\$956
Pipe Grade Black rHDPE	\$730
GP Black rHDPE	\$671
Mixed Coloured Black rHDPE	\$684
Best Circular Scenario (BCS) %	
Food grade rHDPE	30.00%
Natural rHDPE	40.00%
Pipe Grade Black rHDPE	10.00%
GP Black rHDPE	10.00%
Mixed Coloured Black rHDPE	10.00%
<b>BCS Weighted Average (USD/Tonne)</b>	<b>\$1,027.66</b>
Current Recycled Product Breakdown (%)	
Food grade rHDPE	0.00%
Natural rHDPE	40.00%
Pipe Grade Black rHDPE	20.00%
GP Black rHDPE	20.00%
Mixed Coloured Black rHDPE	20.00%

HDPE Starting Data Points		
Data Points	Value	Units
HDPE Consumption	429,557	TPY
CFR rate (Low Range)	20%	%
CFR rate (High Range)	35%	%
Price of MVRP under weighted average best circular scenario	\$1,027.66	USD/Tonne

HDPE						
Post-Consumer Destination		Tonnage	Price (USD/Tonne)	Price Difference from MVRP	Total Value Lost (Millions USD)	Total Lost (Millions USD)
Low Range Estimate of Recycling Rate	Natural	34,365	\$956	\$72	\$2	\$373
	GP Black	17,182	\$730	\$297	\$5	
	Pipe Grade Black	17,182	\$671	\$357	\$6	
	Mixed Color	17,182	\$684	\$344	\$6	
	Not Recycled	343,646	\$0	\$1,028	\$353	
High Range Estimate of Recycling Rate	Natural	60,138	\$956	\$72	\$4	\$321
	GP Black	30,069	\$730	\$297	\$9	
	Pipe Grade Black	30,069	\$671	\$357	\$11	
	Mixed Color	30,069	\$684	\$344	\$10	
	Not Recycled	279,212	\$0	\$1,028	\$287	

HDPE							
Post-Consumer Destination	Post-Consumer Destination (as a % of market inputs)	Weighted average price difference from MVRP	Price yield (a)	Volume yield (b)	Value yield (a x b) [Y-AXIS]	Collected for recycling rate [X-AXIS]	Economic value unlocked [X-AXIS x Y-AXIS]
Low Range Estimate of Recycling Rate	40.00%	\$228	77.79%	95.00%	73.90%	20.00%	14.78%
	20.00%						
	20.00%						
	20.00%						
High Range Estimate of Recycling Rate	40.00%	\$228	77.79%	95.00%	73.90%	35.00%	25.87%
	20.00%						
	20.00%						
	20.00%						

HDPE				
Post-Consumer Destination		Theoretical max of economic value unlocked (Millions USD)	Value unlocked (after factoring in process loss) (Millions USD)	Total Value lost (Millions USD)
Low Range Estimate of Recycling Rate	Natural	\$ 441	\$65	\$376
	GP Black			
	Pipe Grade Black			
	Mixed Color			
	Not Recycled			
High Range Estimate of Recycling Rate	Natural	\$ 441	\$114	#327
	GP Black			
	Pipe Grade Black			
	Mixed Color			
	Not Recycled			

Table A6.5

**LDPE**

Price (USD/tonne)	
rLDPE Natural pellets	\$848
rLDPE black pellets	\$576
rLDPE mixed color pellets	\$528
Best Circular Scenario (BCS) %	
rLDPE Natural pellets	80.00%
rLDPE black pellets	10.00%
rLDPE mixed color pellets	10.00%
<b>BCS Weighted Average (USD/Tonne)</b>	<b>\$788.80</b>
Current Recycled Product Breakdown (%)	
rLDPE Natural pellets	50.00%
rLDPE black pellets	20.00%
rLDPE mixed color pellets	30.00%

LDPE Starting Data Points		
Data Points	Value	Units
PP Consumption	374,205	TPY
CFR rate (Low Range)	5%	%
CFR rate (High Range)	15%	%
Price of MVRP under weighted average best circular scenario	\$788.80	USD/Tonne

LDPE						
Post-Consumer Destination		Tonnage	Price (USD/Tonne)	Price Difference from MVRP	Total Value Lost (Millions USD)	Total Lost (Millions USD)
Low Range Estimate of Recycling Rate	Natural	9,355	\$848	-\$59	-\$1	\$282
	Black	3,742	\$576	\$213	\$1	
	Mixed Color	5,613	\$528	\$261	\$1	
	Not recycled	355,495	\$0	\$789	\$280	
High Range Estimate of Recycling Rate	Natural	28,065	\$848	-\$59	-\$2	\$256
	Black	11,226	\$576	\$213	\$2	
	Mixed Color	16,839	\$528	\$261	\$4	
	Not recycled	318,074	\$0	\$789	\$251	

LDPE							
Post-Consumer Destination	Post-Consumer Destination (as a % of market inputs)	Weighted average price difference from MVRP	Price yield (a)	Volume yield (b)	Value yield (a x b) [Y-AXIS]	Collected for recycling rate [X-AXIS]	Economic value unlocked [X-AXIS x Y-AXIS]
Low Range Estimate of Recycling Rate	50.00%	\$91	88.44%	95.00%	84.02%	5.00%	4.20%
	20.00%						
	30.00%						
High Range Estimate of Recycling Rate	50.00%	\$91	88.44%	95.00%	84.02%	15.00%	12.60%
	20.00%						
	30.00%						

LDPE				
Post-Consumer Destination		Theoretical max of economic value unlocked (Millions USD)	Value unlocked (after factoring in process loss) (Millions USD)	Total Value lost (Millions USD)
Low Range Estimate of Recycling Rate	Natural	\$ 295	\$12	\$238
	Black			
	Mixed Color			
	Not recycled			
High Range Estimate of Recycling Rate	Natural	\$ 295	\$37	\$258
	Black			
	Mixed Color			
	Not recycled			

## APPENDIX 7:

# COMPARISON OF IMPORT/EXPORT DATA FROM VARIOUS SOURCES

The import and export data used in this study is mainly sourced from MITI, MPA and UN Comtrade. The differences of resin and product import-export amounts between MPA data, MITI data, and UN Comtrade data are summarized in Table A7.1.

Table A7.1

**COMPARISON OF IMPORT/ EXPORT DATA FROM VARIOUS SOURCES**

	MPA			MITI			UN Comtrade (Destination country as reporting country for exports)		
	Import	Export	Net	Import	Export	Net	Import	Export	Net
PET	NA	NA	NA	112,093	224,089	-111,996	112,093	71,254	40,839
PET Polyester	NA	NA	NA	22,780	200,354	-177,573	22,780	119,279	-96,499
PP	420,000	480,000	-60,000	771,662	832,985	-61,322	771,778	276,568	495,210
HDPE	560,000	310,000	250,000	778,590	699,706	78,884	778,082	144,432	633,649
LDPE	140,000	350,000	-210,000	769,446	1,081,301	-311,855	769,388	330,290	439,097
LLDPE	560,000	130,000	430,000	671,395	495,197	176,198	671,498	18,741	652,758

## APPENDIX 8:

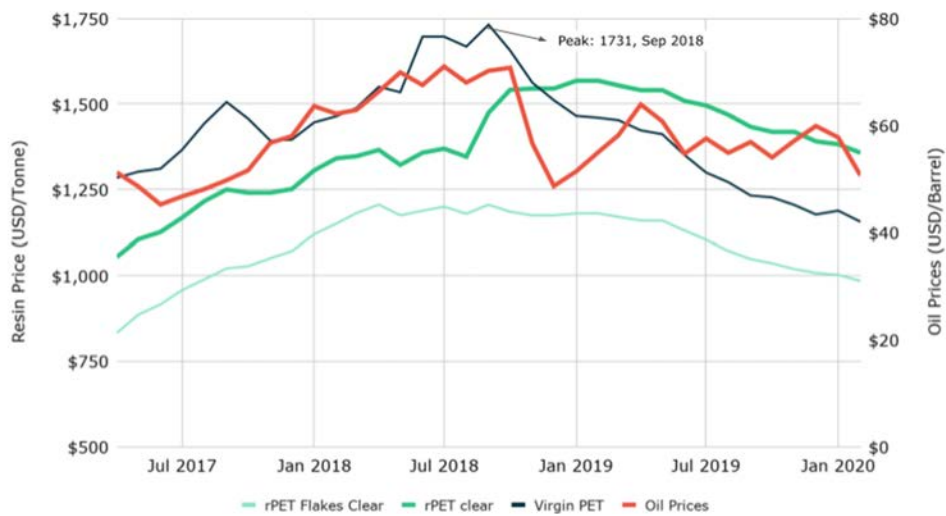
# COMPARISON OF VIRGIN AND RECYCLED RESINS AND OIL PRICES

The following charts show the EU price comparison of virgin and recycled resins. Please note that EU prices for virgin plastics and recycled plastics have been used as a proxy for global prices because the EU has the greatest price transparency/data availability for virgin prices and recycled prices

### PET

Figure A8.1.

**EU PRICE COMPARISON OF VIRGIN PET AND RECYCLED PET**



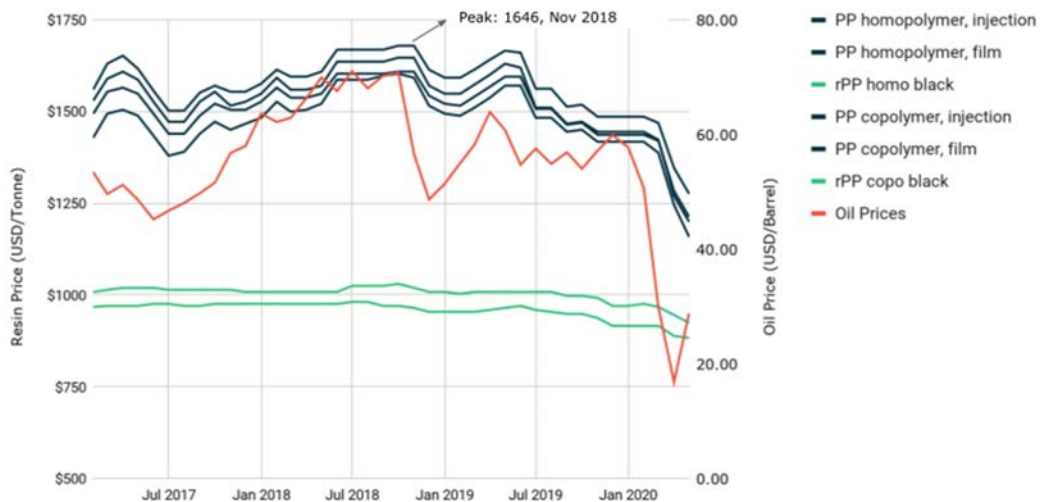
Source: Industry data

The chart with the comparison of virgin PET and recycled PET prices in Malaysia is not available as virgin PET prices in 2019 could not be obtained.

### PP

Figure A8.2.

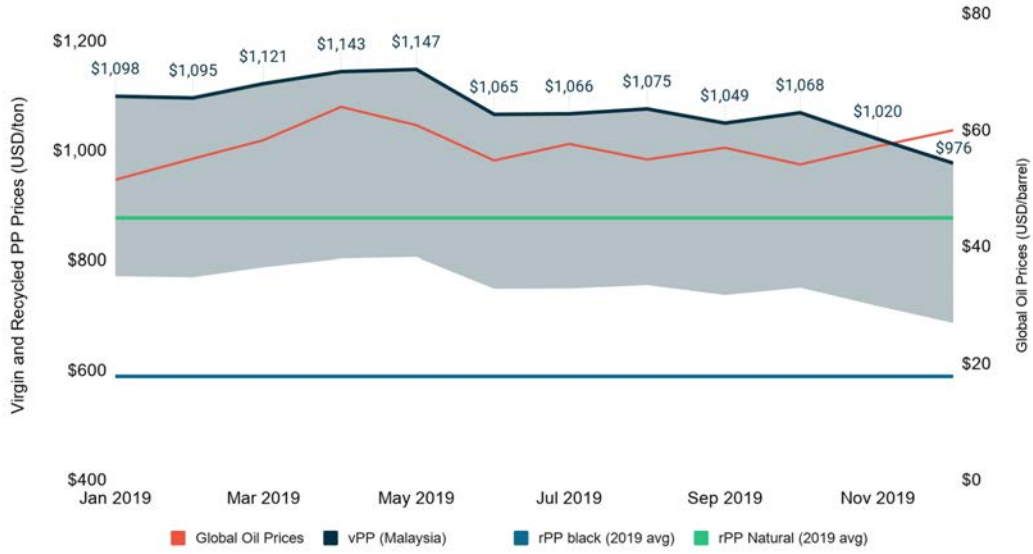
**EU PRICE COMPARISON OF VIRGIN PP AND RECYCLED PP**



Source: Industry data

Figure A8.3.

**COMPARISON OF VIRGIN PP AND RECYCLED PP PRICES IN MALAYSIA AND GLOBAL OIL PRICES**

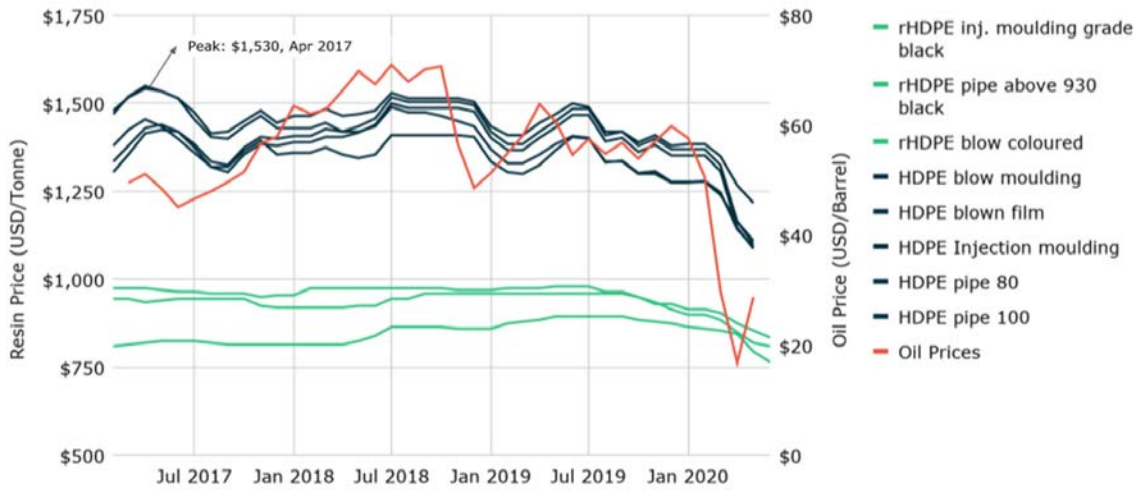


Source: S&P Platts for Virgin Resin Prices (via MPA) and Recyclers for Recycled Resin prices

**HDPE**

Figure A8.4.

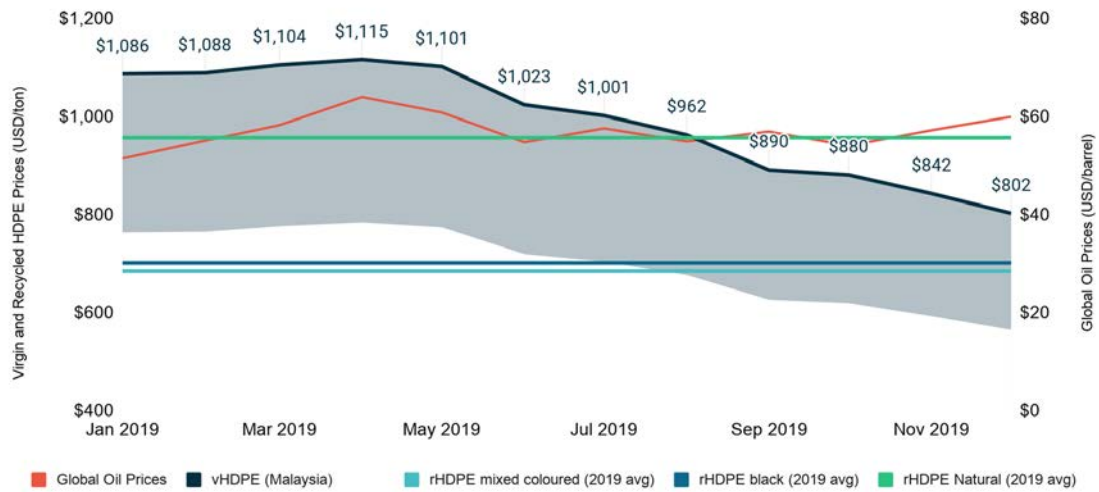
**EU PRICE COMPARISON OF VIRGIN HDPE AND RECYCLED HDPE**



Source: Industry data

Figure A8.5.

**COMPARISON OF VIRGIN HDPE AND RECYCLED HDPE PRICES IN MALAYSIA AND GLOBAL OIL PRICES**

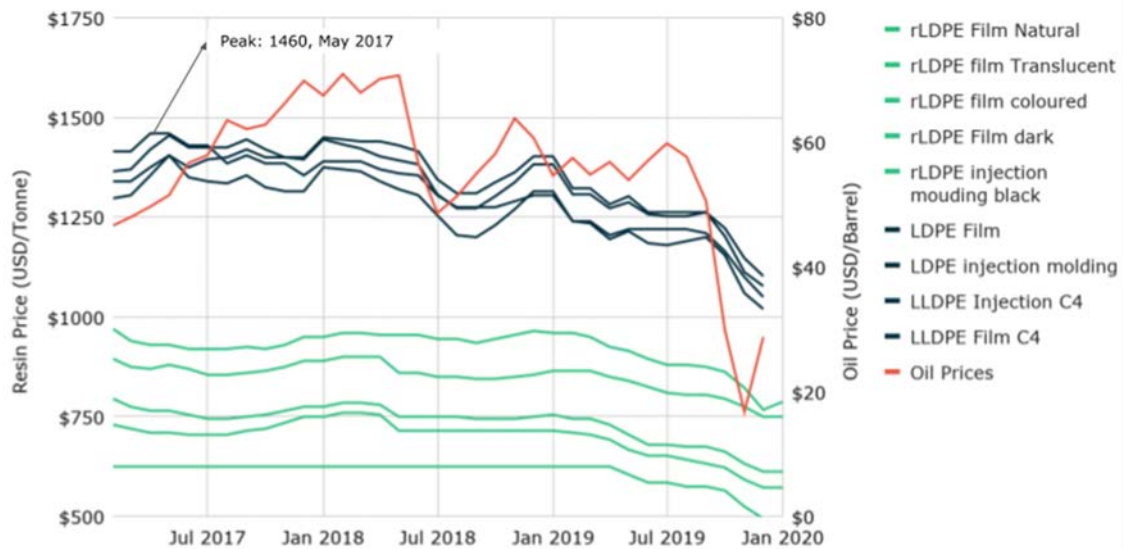


Source: S&P Platts for Virgin Resin Prices (via MPA) and Recyclers for Recycled Resin prices

**LDPE**

Figure A8.6.

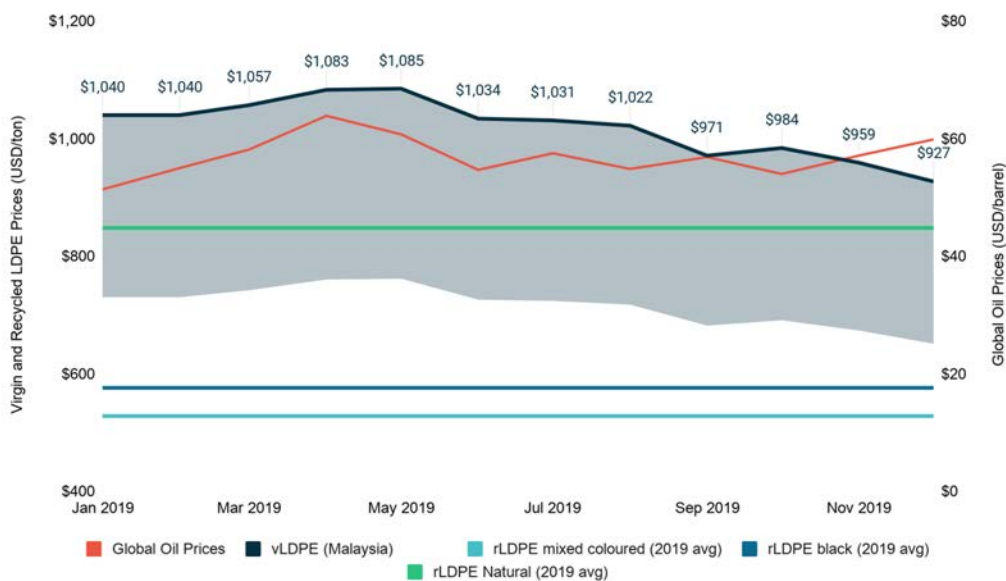
**EU PRICE COMPARISON OF VIRGIN LDPE AND RECYCLED LDPE**



Source: Industry data

Figure A8.7.

**COMPARISON OF VIRGIN LDPE AND RECYCLED LDPE PRICES IN MALAYSIA AND GLOBAL OIL PRICES**



Source: S&P Platts for Virgin Resin Prices (via MPA) and Recyclers for Recycled Resin prices

Table A8.1 shows the comparison of virgin prices in Malaysia in the period of April/May for both the years 2019 and 2020. The price drops are a direct result of Covid-19 impacts.

Table A8.1.

**MALAYSIA VIRGIN PRICE COMPARISON YoY**

MALAYSIA VIRGIN PRICE COMPARISON YoY			
	April/May 2019 (USD/Ton)	April/May 2020 (USD/ton)	% Price reduction (YoY)
PET	N/A	\$661	N/A
HDPE	\$1,108	\$701	37%
LDPE	\$1,084	\$706	35%
PP	\$1,145	\$776	32%
Average Polyolefins	\$1,112	\$728	35%

Source: Malaysian Petrochemicals Association (Virgin resin prices).

## APPENDIX 9:

# MANDATING RECYCLED CONTENT TARGETS & MALAYSIA'S ABILITY TO FULFILL THESE TARGETS

### 9.1 CHALLENGES THAT PREVENTING RECYCLED CONTENT TARGET EFFECTIVENESS

It must be noted that while switching to using recycled content that substitute virgin plastics may be technically feasible for specific applications, specific challenges need to be overcome, as outlined below:

- Usage of recycled plastics require sizable investments in upgrading/changing production and packaging lines, expensive re-testing to ensure compliance with safety regulations and quality/durability requirements.
- At least for the initial few years, until demand picks up further, recycled plastics are likely to come from several different suppliers, which are smaller in size than typical suppliers of virgin plastics. Hence, they are less able to meet fluctuations in demand volume as they cannot control the rate of source materials arising without holding expensive feedstock or finished material buffer volumes.
- Consumer acceptance of recycled plastics also needs to be addressed. Cosmetic blemishes from recycled content may not affect technical performance of a product but can still influence aesthetic factors. It is difficult to expect the wide use of recycled plastics for the products whose design and look can play a critical role in consumer purchase decisions.
- A well-managed formal source segregation and separate collection infrastructure needs to be established in order to meet increases in demand which will result from the implementation of mandatory recycled content targets. This is required as the current reliance on the supply from the informal sector does not always have the required quality of post-consumer material to address the demand that will result from an industry-wide recycled content target.

### 9.2 RECYCLED CONTENT VOLUMES TO MEET RECYCLED CONTENT TARGETS

With regards to the ability for stakeholders in Malaysia to fulfill recycled content targets, there is already sufficient recycling capacity in Malaysia to enable implementation of recycled content targets of at least 15-30%, as can be seen in Table A9.1.

Table A9.1

**RECYCLED CONTENT VOLUMES (TPY) WHICH WOULD BE REQUIRED BASED ON RECYCLED CONTENT TARGETS OF 15% AND 30%. 2030 ESTIMATED CONSUMPTION IS BASED ON 2.5% COMPOUND ANNUAL GROWTH RATE (CAGR).**

Resin	2030 Estimated Plastic Consumption (TPY)	Recycled Content Volumes (TPY) Based on 2030 Recycled Content Targets		Estimated 2019 Local Recycling Capacity (TPY)
		15%	30%	
PET Packaging	194,335	29,150	58,300	259,368
PET Polyester	40,301	6,045	12,090	NA
PP	558,688	83,803	167,607	283,114
HDPE	563,616	84,542	169,085	125,364
LDPE/LLDPE	490,990	73,648	147,297	155,170
<b>Total</b>	<b>1,847,930</b>	<b>277,190</b>	<b>554,379</b>	<b>823,016</b>

## APPENDIX 10:

# CALCULATION FOR ESTIMATED INSTALLED CAPACITY VS. MISSING CAPACITY

Table A10.1 shows the calculations used to derive the estimated installed capacity and missing capacity for each of the key resins. The recycling capacity figures are based on questionnaire responses/interviews for this study or other studies by GA Circular, or based on publicly available information or past conversations, which could not be validated as some of these recyclers have not been available for questionnaire responses/interviews for this study.

Table A10.1

### CALCULATIONS USED TO DERIVE THE ESTIMATED INSTALLED CAPACITY VS MISSING CAPACITY FOR RECYCLING OF MAJOR RESINS IN MALAYSIA

Capacity Estimates						
Data points	PP	LDPE/LLDPE	HDPE	PET Polyester	PET Packaging	Total
Total resin consumed in Malaysia (TPY)	425,801	374,205	429,557	30,715	148,111	1,408,390
CFR (TPY)	127,740	37,421	113,833	768	54,061	333,822
Estimated Installed capacity (TPY)	317,311	162,545	149,423	1,536	251,347*	882,161**
Missing Capacity (TPY)	108,491	211,660	280,134	29,180	0	629,465
Unused Recycling Capacity (TPY)	189,570	125,124	35,590	768	197,286	548,339
Missing Capacity as % of resins consumed	25%	57%	65%	95%	0%	45%
New capacity announced across all resins (TPY)	1,000	62,020	12,000	0	94,000	169,020
New capacity announced across all resins (as % of missing capacity)	1%	29%	4%	0%	NA	27%

Table A20.1 notes:

- \*Total estimated PET packaging recycling capacity is 251,347 TPY (it is more than PET packaging consumption in Malaysia).
- \*\*The Total estimated installed capacity figure of 882,161 TPY includes the total PET packaging installed capacity of 251,300 TPY.

Based on the table above, the gap in recycling capacity for PET polyester is the biggest in terms of percentage. Currently, only a minimal amount of PET polyester used in textiles and fiber applications is recycled in Malaysia. Technologies, such as Teijin Group's chemical recycling method<sup>6</sup> and H&M's in-store recycling system, "Loop",<sup>7</sup> to recycle polyester products are still in early stages of development globally and are not present in Malaysia. Therefore, while PET polyester recycling is still not viable in Malaysia at this stage, there is still an opportunity for polyester textiles to be more circular through incorporating recycled content in the polyester resin and yarns which Malaysia is a significant producer and exporter of and ensuring recycled content in the polyester garments which Malaysia consumes.

<sup>6</sup> [Japan Today: Teijin develops recycled polyester clothing](#)

<sup>7</sup> [H&M: From Old to New with Loop](#)

## APPENDIX 11:

# IMPORT CONDITIONS FOR PLASTIC WASTE HS CODE 39.15 (EFFECTIVE ON 26 OCTOBER 2018)

Below are the import conditions that need to be met by plastic aggregators/recyclers before importing plastic waste (HS 3915):

1. Submit a clear, actual pictures and plastic waste category
2. Obtain premises compliance information from Department of Environment (DOE) through National Solid Waste Management Department
3. Submit an exporter authorization letter with ISO 14000 certificate
4. Submit a confirmation letter from any related authority, accredited body or organization from exporting countries to carry out export activities of plastic
5. Submit a valid business license from respective Local Authority
6. Submit a stamped and signed invoice
7. Practice a good housekeeping in the factory
8. Having proper storage with roofing and concrete flooring at the factory
9. Submit an approval letter to install and operate machinery from Department of Occupational Safety and Health (DOSH)
10. Verify actual processing capacity of every machine by SIRIM
11. Specify location of waste disposal generated from factory
12. Submit list of buyers for final product
13. Submit list of factory and subsidiaries
14. Ratio for plastic waste import restrict to 70% of imported sources
15. Restricts importation only for plastic waste from industrial source and segregated post-consumer waste
16. Restrict importation of plastic waste from developing countries
17. Setting appropriate location (zoning) for waste processing factory
18. Submit a levy
19. Submit a Bank Guarantee (BG) of waste import

*\*Note: Fee of RM 50.00 will be charged for every tonne of plastic waste imported.*

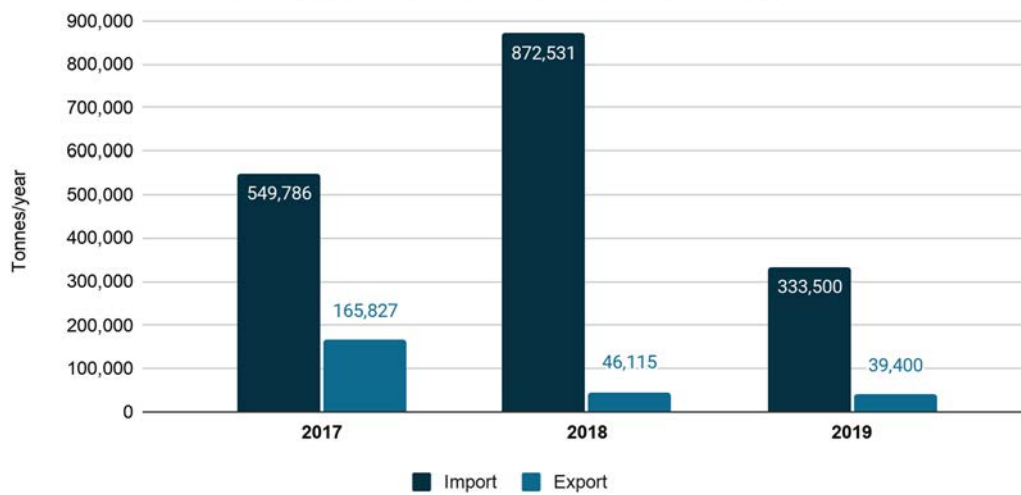
## APPENDIX 12:

# MALAYSIA'S SCRAP PLASTIC IMPORTS AND EXPORTS

Figure A12.1 illustrates that Malaysia has been a net importer of plastic scraps in 2017, 2018 and 2019. Meanwhile, the volumes have decreased from 2019 due to restrictions on impacts as discussed in this report.

Figure A12.1

### COMPARISON OF MALAYSIA'S SCRAP PLASTIC IMPORTS AND EXPORTS BETWEEN 2017, 2018 AND 2019



Source: UN Comtrade Malaysia imports and exports of plastic waste under HS Code 3915

## APPENDIX 13:

# MSW SYSTEM IN MALAYSIA (ACT 672 AND NON-ACT 672 STATES)

### 13.1 COVERAGE OF ACT 672 FOR EACH STATE OR TERRITORY IN MALAYSIA

Table A13.1 highlights the states which are managed by the waste collection concessionaires under Act 672.

Table A13.1

#### POPULATION UNDER ACT 672 VS. POPULATION NOT UNDER ACT 672

State	Population (2020)	Act 672 Coverage	Waste Collection
KL Federal Territory	1,910,700	Yes	Alam Flora
Putrajaya Federal Territory	94,600	Yes	Alam Flora
Pahang	1,750,100	Yes	Alam Flora
Johor	3,926,500	Yes	SWM Environment
Melaka	960,500	Yes	SWM Environment
N. Sembilan	1,162,600	Yes	SWM Environment
Kedah	2,267,500	Yes	E-Idaman
Perlis	264,700	Yes	E-Idaman
<b>SUB TOTAL</b>	<b>12,337,200</b>	<b>YES</b>	<b>39%</b>
Selangor (ex KL, Putrajaya)	6,715,600	No	Town Councils / KDEB
Penang	1,806,500	No	City Councils / Private contractors
Terengganu	1,294,100	No	Local Authorities
Kelantan	1,959,700	No	Local Authorities
Perak	2,611,600	No	Local Authorities
Sarawak	2,907,500	No	Local authorities/ Trienekens (Sarawak) Sdn Bhd
Sabah	4,047,000	No	Local authorities
<b>SUB TOTAL</b>	<b>19,066,000</b>	<b>NO</b>	<b>61%</b>

### The MSW Systems of Non-Act 672 States

The non-Act 672 states, which are not required to implement separation at source, have different waste management systems. The state of Penang for example implements the Waste Segregation at Source policy, a mandatory policy where households are required to segregate their waste into two streams: general waste and mixed recyclables. The volume of plastic recyclables collected through this mandatory policy amounted to 21,226 tonnes in 2019, which gives an estimated plastic CFR rate of 13.5% (out of the total plastics estimated to be consumed via Penang's MSW stream). This CFR rate is much higher than the plastic recyclables collected across the Act 672 states which amounted to 644 tonnes in 2019 (which gives a plastic CFR rate of 0.1%). The calculation of these estimated CFR rates is explained in the table in Appendix 13.3. The effective implementation of the Waste Segregation at Source policy was coupled with the positive response of the public with 67.77% participation rate of the households in both Penang Island and Seberang Perai.

Sabah, on the other hand, has a less advanced waste management system where financial and resource constraints of the Sabah state government limit the efficacies of their waste management system. Open dumpsites are still the common method of disposal. With regards to source segregation, only organic waste segregation is mandated, which is still in its initial stages of implementation. More details on these non-Act 672 states are listed in Appendix 13.4.

Based on interviews with some of the non-Act 672 states, these states have chosen not to be part of the federal Act 672 separation at source policy due to some of the following reasons:

- Good financial status of the district councils (majlis daerah) does not warrant a need for the state to be part of Act 672. When a state becomes part of Act 672, the federal government would take over the budgets of all city councils, town councils and district councils, which would benefit district councils which are struggling financially. For Penang, the strong financial positions of the district councils mean they do not stand to benefit from becoming part of the Act 672.
- Some states consider that waste management should be the responsibility of the town council. By engaging a third-party waste collection concessionaire to manage the state's waste, the local authorities risk backlash from their residents if the waste collection concessionaires do not maintain standards of waste management. This concern was shared by both Sabah's and Penang's waste management departments.

## 13.2 WASTE STATISTICS AND NATIONAL RECYCLING RATE

Based on the latest statistics, SWCorp estimates that:

- MSW generation nationally was 13.8 million tonnes in 2018.
- Recycling rate for all materials in 2018 was 24% (3.36 million tonnes of recyclables) and in 2019 it was 28% (3.88 million tonnes of recyclables).
- Plastic recycling contributes to 46% (1.56 million tonnes) of the recyclables volume reported in 2018 and 40% (1.57 million tonnes) of the recycling volume reported in 2019.

**Notes regarding the calculation of the recycling rates:**

- The national recycling rate estimates calculated by SWCorp are based on an annual survey by SWCorp of the recycling industry, including plastic, paper, metal and glass recyclers.
- The figures for volume of plastics collected and recyclables collected are based on previous year's figures which SWCorp uses to determine recycling rates of the following year.

### Material Limitations

Various material limitations have been identified, including:

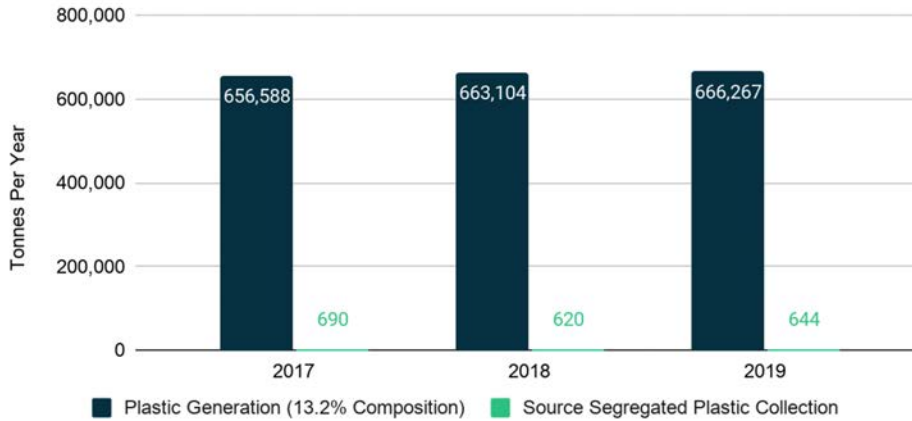
1. The volumes of plastic recycling reported include both post-consumer and post-industrial plastics (i.e. from both MSW and non-MSW sources) where the numerator is all plastic recycling (i.e. MSW and non MSW) and the denominator is MSW. When determining a plastic recycling rate for MSW, the numerator should be plastic collected-for-recycling from MSW sources only.
2. The plastic recycling volume and rate is significantly impacted by the number of responses to the SWCorp survey each year. SWCorp has advised that the plastic recycling tonnage has increased from 1.57 million tonnes of plastic reported in 2019 to 2.76 million tonnes reported in 2020. As a comparison, MPMA estimates in its 2019 [White Paper on An Advanced Plastics Recycling Industry for Malaysia](#) that the total plastic recycling capacity within Malaysia is about 1.5 million tonnes, which is based on revenue estimate by MPMA of RM4.5 billion per year. MPMA additionally acknowledges that a significant amount of this recycling capacity is used for imported plastic scrap, meaning that local plastic collected-for-recycling would be much lesser than 1.5 million tonnes.

### 13.3 PLASTIC COLLECTED-FOR-RECYCLING (CFR) RATE CALCULATIONS

Among the Act 672 states where separation at source is mandatory for all households, in 2019, only 2,012 tonnes of recyclables (all recyclables including plastics), or 0.04% of 5.04 million tonnes of municipal solid waste, were collected. With regards to plastics within MSW, only 644 tonnes of plastic recyclables, or 0.10% of 666,267 tonnes of estimated plastic generation within MSW, were collected in 2019 in Act 672 states.

Figure A13.1

#### PLASTIC GENERATION VS. SEGREGATED PLASTIC COLLECTION IN ACT 672 STATES



Source: SWCorp

Notes: Plastic Generation is based on 13.2% plastic composition within MSW (2012 SWCorp study widely used by stakeholders in Malaysia as of the time of this study). Note that diapers are separately accounted for (at 12.1%) and not included within the plastic data point of 13.2% even though diapers are mostly plastic.

The data used in plastic CFR rate calculation for both Act 672 states and non-Act 672 states (e.g.: Penang and Sabah) are summarized Table A13.2.

Table A13.2

#### COMPARISON OF PLASTIC CFR RATE

States	Non Act-672 States		Act 672 States	Notes
	Penang	Sabah		
Population (2019)	1,770,000	3,756,800	11,819,400	
MSW Generation in 2019 (TPY)	1,204,349	1,604,341	5,047,475	Based on the responses to questionnaire
Plastic in MSW (TPY) - Low Range	158,974	211,773	666,267	Using 13.2% of plastic in MSW data point - based on SWCorp National Recycling Rate Research (2019)
Plastic in MSW (TPY) - High Range	203,655	271,294	853,528	Using 16.9% of plastic in MSW data point—based on SWCorp National Recycling Rate Research (2019)

Recyclables Collected in 2019 (TPY)	707,549	NA	2,146	Based on the responses to questionnaire
Plastic in Recyclables (TPY)	21,226	NA	644	Based on the responses to questionnaire
Plastic CFR Rate (%) - High Range	13.35%	NA	0.10%	Using 13.2% of plastic in MSW data point—based on SWCorp National Recycling Rate Research (2019)
Plastic CFR Rate (%) - Low Range	10.42%	NA	0.08%	Using 16.9% of plastic in MSW data point—based on SWCorp National Recycling Rate Research (2019)

Source: GA interviews with JPSPN, SWCorp, Penang and Sabah waste management departments

## 13.4 DETAILS OF WASTE MANAGEMENT SYSTEMS IN TWO NON-ACT 672 STATES (PENANG & SABAH)

Table A13.3

### COMPARISONS BETWEEN PENANG AND SABAH'S WASTE MANAGEMENT SYSTEMS

	PENANG	SABAH
Description of waste management system		
<b>Collection</b>	<p>Waste collection differs according to the local authority (Penang Island City Council (MBPP) and Seberang Perai City Council (MBSP)) governing the jurisdiction in Penang.</p> <ul style="list-style-type: none"> <li>In MBPP, waste collection is carried out in 9 zones. Of these nine zones, seven are outsourced to private waste collectors while the remainder is managed by MBPP.</li> <li>In MBSP, waste collection is carried out through the use of private waste collectors.</li> </ul> <p>Collection coverage in Penang Island is about 90% of households and 70% of households in Seberang Perai mainland.<sup>8</sup></p>	<p>Under Local Ordinance 1961, waste collection is under the responsibility of the 26 local authorities in Sabah which means for the majority of the local authorities, waste collection is carried out by the local authority. The only exceptions are for Kota Kinabalu City Hall, Sandakan Local Municipality which have privatized their waste collection to private waste collectors.</p> <p>The solid waste collection coverage in Sabah is not available but is estimated to be low given the financial and resource constraints of the Sabah state government with regards to waste management.</p>
<b>Disposal</b>	<p>Waste collected from Penang is disposed of in Pulau Burung Sanitary Landfill.</p>	<p>Waste collected in Sabah is disposed of in three sanitary landfills and 22 open-dumpsites. Open dumping of waste is a common method of disposal due to the lack of funds for waste management.</p>

8 UNDP, "Malaysia Developing A Solid Waste Management Model for Penang"

<b>Challenges</b>	<p>There is only one landfill in Penang.</p> <p>Sourcing a location for a new landfill will be difficult and expensive as there is limited land available for such use, which will drive up the overall cost.</p>	<p>Firstly, a major challenge facing Sabah waste management is the lack of funding with less than 5% of the state budget being allocated to waste management. Hence, this leads to a scenario where open dumping of MSW is common as there is an insufficient amount of funds to maintain sanitary landfills with sufficient capacity.</p> <p>Secondly, the waste management unit lacks the authority needed to enforce the relevant bylaws on anti-litter and source segregation of organic waste.</p> <p>Next, landfill tipping fees are difficult to enforce as waste collectors will dispose of them at another open dumpsite where there are no tipping fees.</p> <p>Lastly, it is difficult to collect data on waste management due to the pervasiveness of open dumping in Sabah.</p>
<b>Formal public source segregation</b>		
<b>Description</b>	<p>Source segregation is implemented via the Waste Segregation at Source policy. This is a mandatory policy where households are mandated to segregate their waste into two streams: general waste and mixed recyclables. If more than 5 recyclable items are found in the general waste disposal of a household, a RM125 fine is then meted out to the household.</p>	<p>Organic waste segregation from MSW is mandated under the Uniform (Segregation and Disposal of Organic Waste) By-Laws 2016. However, this is still in the initial stages of implementation as local authorities are testing food waste digesters on a small scale.</p>
<b>Challenges</b>	<p>Some of the challenges cited are:</p> <ul style="list-style-type: none"> <li>• A lack of recycling bins to capture recyclables which are consumed on-the-go.</li> <li>• Data collection with regards to amounts of recyclables collected by the informal sector.</li> <li>• A lack of awareness and participation from the public regarding source segregation. This is especially true for residents in high-rise buildings.</li> <li>• Selective purchase of collected recyclables by recyclers (i.e. purchase of higher value plastic recyclables but not lower value).</li> </ul>	<p>No developed source segregation exists at scale due to a lack of financial resources and infrastructure.</p>
<b>Current Recycling Rate (All Recyclables)</b>	46.61%	NA
<b>Recycling targets</b>	50% by 2030	NA
<b>Plastic CFR rate from formal source segregation (estimated)</b>	<p>13.35%</p> <p><i>Note: This is a much higher rate than the plastic CFR rate reported for Act 672 states (less than 1%).</i></p>	NA

Other forms of collection for recycling		
<b>Informal recycling</b>	Tailgate recycling (where waste collectors segregate recyclables from MSW stream at the back of the waste collection trucks) occur. The informal sector has also been reported to pick out recyclables from recycling bins in Penang.	Informal recyclables collection occurs at dumpsites and landfills where recyclables are picked out from the MSW disposed of at these areas.
<b>NGOs</b>	Charities such as Buddhist Tzu-Chi Foundation Malaysia are active throughout Malaysia encouraging recycling through public awareness and education programs.	
Relevant local regulations		
<b>Local regulations</b>	<ul style="list-style-type: none"> <li>• Local Government Act 1976</li> <li>• Separation of Waste and Licensing of Recyclable Waste Collection Services By-Laws 2016</li> </ul>	<ul style="list-style-type: none"> <li>• Local Ordinance 1961</li> <li>• Uniform (Segregation and Disposal of Organic Waste) By-Laws 2016</li> <li>• Waste Management and Public Cleansing Enactment 2020</li> </ul>

Source: GA interviews with Penang and Sabah waste management departments

## APPENDIX 14:

# THE ENABLING POLICY ENVIRONMENT FOR CIRCULARITY AND INTERVENTIONS FOR PLASTIC PACKAGING

Creating an enabling policy environment for circularity of plastic packaging through a range of policy instruments plays a defining role in the success towards achieving circularity. In this section, the study will analyze the existing national-level regulations, roadmaps and timelines and identify any gaps that are limiting the scale-up of the domestic plastic recycling industry and compare these against a benchmark of best practices from other jurisdictions.

### 14.1 LIFE CYCLE APPROACH TO PLASTICS CIRCULARITY POLICIES

Assessment of the enabling policy environment for plastics circularity in Malaysia can be approached using a life cycle approach for each of the major end-use industries consuming plastics. Over their lifetime, plastic products can contribute to various environmental impacts. Taking a life cycle approach considers the range of impacts throughout the life of a product and quantifies this by assessing the emissions, resources consumed and pressures on health and the environment that can be attributed to a product. It takes the entire life cycle into account—from the extraction of natural resources through to material processing, manufacturing, distribution and use, as well as the re-use, recycling, energy recovery and the disposal of remaining waste.<sup>9</sup> Thus a life cycle approach provides a holistic framework for assessment of policies and their impacts (Figure A14.1).

Figure A14.1

#### HOW A LIFECYCLE APPROACH CAN ADDRESS ISSUES IN PLASTIC WASTE MANAGEMENT

For example, taking a life cycle approach can quantitatively address a frequent issue in plastic waste management: whether to recycle or incinerate used plastic products such as plastic bottles. The production of plastic bottles from raw materials requires about 80 MJ/kg (energy per kilogram). Incineration can generate about 3 MJ/kg of electricity and about 10 MJ of process steam from the recovered energy. However, despite this small energy gain, new bottles would have to be produced, requiring high amounts of energy. In contrast, recycling and selective collection consumes 9 MJ/kg while also avoiding the much higher energy consumption used in the production of new plastic from raw materials. Recycling therefore normally results in lower energy consumption than incinerating bottles and producing new ones from raw material.

This example assumes, however, that the plastic is not heavily soiled and is not degraded in the recycling process. If the plastic recycling process produces plastic products of lower value end use applications or under different conditions then it could result in different conclusions.

For the plastic packaging industry, policies impacting plastics circularity can be divided into the following life cycle stages:

1. **General Legislative Framework:** The overarching legislation which guides policies for the industry.
2. **Production:** Policies which affect the ways and rules under which plastic products are manufactured.
3. **Consumption:** Policies which affect consumption behavior.
4. **Disposal:** Policies which relate to what occurs when a product is sent to a landfill, incinerator, or is leaked into the environment.
5. **Recycling:** Policies which affect the recovery of plastics after consumption and the actual recycling process.

<sup>9</sup> [Life Cycle Thinking and Assessment for Waste Management](#)

## 14.2 PACKAGING: ENABLING POLICY ENVIRONMENT

### Packaging: Global Policy Examples Across Life Cycle

Table A14.1

**GLOBAL POLICY EXAMPLES ACROSS LIFE CYCLE**

Life Cycle Stages	General Policy Framework	Production	Consumption	Disposal	Recycling
Policies	MSW Legislation National Targets Export Import Trade Policy	Design Standards Recycled Content Policy Alternative Materials Packaging Taxes	Source Reduction Policies (e.g. plastic bag bans) Green procurement	Landfill bans Diversion from landfill targets Anti-Litter legislation	Source segregation/ deposit refund schemes Food-grade standards Extended Producer Responsibility

Between the packaging and non-packaging industries analyzed in this report, packaging has by far the most developed policies due to its heavy use of plastics and the attention that the leakage of plastics has garnered over the last five years. Hence, as described in the table above, the best policies that deal with plastic packaging are those which engage stakeholders across the value chain, plug leakages along the product life cycle and have clear targets which enables each stakeholder to understand what is required of them and hence enables effective implementation.

### Packaging: Current Policies Across Life Cycle In Malaysia and in Benchmark Jurisdictions

Table A14.1

**CURRENT POLICIES ACROSS PACKAGING LIFE CYCLE**

Light blue = Best case practice

Life Cycle Stages	Malaysia	Benchmarks from other jurisdictions		
		European Union	Japan	India
General Legislative Framework	Act 672 outlines the roles of waste collection concessionaires in the mandatory separation at source policy.	The Packaging and Packaging Waste Directive sets targets for the recovery of packaging waste and covers strategies to be implemented by member states to collect packaging waste.	The Basic Act for Establishing a Sound Material-Cycle Society clarifies the responsibilities of all key stakeholders and articulates fundamental matters for making policies for the formation of a Sound Material-Cycle society.	Plastic Waste Management (PWM) Rules, 2016. Collection targets exist and minimum requirements for EPR schemes do not exist in these rules.
Production	The Roadmap Towards Zero Single-Use Plastics sets a target to shift away from single-use plastics to biodegradable alternatives by 2030.	The "essential requirements of packaging" requires the minimization of packaging volume and weight, design of packaging for reuse or recovery and the encouragement of recycled materials usage in packaging.  The EU Commission is also initiating work on new harmonized rules to ensure that by 2030 all plastics packaging placed on the EU market can be reused or recycled in a cost-effective manner.	Requires payment of a recycling fee by manufacturers to the designated organization for recycling.	Plastics producers need to work out modalities for waste collection systems for collecting back the plastic waste within a period of six months. No targets set.  <span style="background-color: #e6f2ff; border: 1px solid #0070c0; padding: 2px;">Maharashtra state requires industrial packaging produced to include at least 20% recycled material.</span>

Consumption	The Roadmap Towards Zero Single-Use Plastics aims to eliminate all single-use plastics by 2030.	The Single Use Plastics directive bans selected single-use products made of plastic for which alternatives exist by 2021 and implements EPR systems for others.	The Japanese government has plans to make plastic shopping bag charges mandatory.	Waste generators including institutional generators, are required to segregate plastic waste.
Disposal	The Eleventh Malaysia Plan 2016-2020, aims to achieve a rate of 40% waste diversion from landfill.	The EU Landfill Directive aims to phase out landfilling for recyclable material by 2025.	There are no targets for diversion from landfill or landfill bans currently in Japan.	Local bodies are responsible for segregation, collection, storage and disposal. No targets set.  Local bodies are required to encourage use of plastic waste for road construction or energy recovery or waste to oil or co-processing in cement kilns under Plastic Waste Management Rules 2016.
Recycling	Separation at source is mandated under Act 672 (Solid Waste and Public Cleansing Management Act 2007).	The Single-Use Plastics Directive establishes EPR systems, by 2025, which covers the costs of collection, transport, treatment, cleanup of litter and awareness-raising measures for all packaging.  The directive mandates: (a) new recycling target for plastic packaging, set at 55% in 2030; (b) Specifically for plastic PET bottles a 25% recycled content target by 2025 and 30% recycled content target by 2030; (c) Collection target of 77% of single-use plastic drink bottles by 2025 and 90% by 2029 through EPR or through deposit refund schemes	Act on the Promotion of Effective Utilization of Resources fosters the recycling of reusable resources.	The draft 2019 National Resource Efficiency Policy sets targets for packaging recycling including 100% recycling rate for PET by 2025 and 75% recycling and reuse rate for other plastics by 2030.

There are three key lessons to be gained from the above assessment on circularity for the packaging industry:

1. The EU has the best policies for packaging circularity except for the general legislative framework where Japan has the advantage. This reflects the EU's expertise and experience in the Circular Economy. For example, the "essential requirements of packaging" by the EU establishes rules on packaging design to minimize its impact on the environment and to improve recyclability of packaging. By 2025 at least 55% of all plastics packaging in the EU are required to be recycled. As of 2017, this rate is at 42%. The clear requirements and targets mean that there is less confusion and better enforcement. This also reflects the strong governance that the EU and its member states have that enables them to enforce these rules across all the stakeholders in the EU. Therefore, should the Malaysian government want to set its ambitions high, it should look to the targets of the EU as a reference point.
2. Japan has a better general legislative framework than the EU as the Basic Act for Establishing a Sound Material-Cycle Society is an enforceable law with details on how stakeholders should act to increase collection of recyclables. On the other hand, while the Packaging and Packaging Waste Directive of the EU is mandatory (i.e. the targets and actions listed within it must be complied by member states),

the directive must be interpreted by member states and then laws in each member state must be enacted to comply with the directive. It is not, by itself, a legislation hence is not applicable to the Malaysian context. Hence, Japan's Basic Act for Establishing a Sound Material-Cycle Society can be used as a solid reference point to draft an overarching Circular Economy legislation for Malaysia.

3. While Malaysia has some policies that are positive in terms of encouraging circularity (e.g. bans on imports of plastic scraps with HS Code 3915, and single use plastic bags), interviews with stakeholders as part of this study reveal that confusion on the use of recycled content for food packaging hinders the brand owners or manufacturers in using the recycled content. This is counter productive as it eliminates local demand for recycled materials resulting in any food grade recycled products to be exported. This eliminates local demand for high value products, while also making the prices of food grade recycled materials vulnerable to global fluctuations.

## APPENDIX 15:

# EXISTING INDUSTRY-LED EFFORTS AND ROADMAP TOWARDS ZERO SINGLE-USE PLASTICS 2018–2030

This section reviews two of the leading existing industry-led efforts within Malaysia to collect and recycle plastics and provides an overview of the Roadmap Towards Zero Single-use Plastics 2018–2030.

### 15.1 INDUSTRY-LED EFFORTS

In Malaysia, MaSPA and MAREA are the industry-led efforts which drive the development of the EPR framework. Table A15.1 shows the summary of the details of both organizations.

Table A15.1

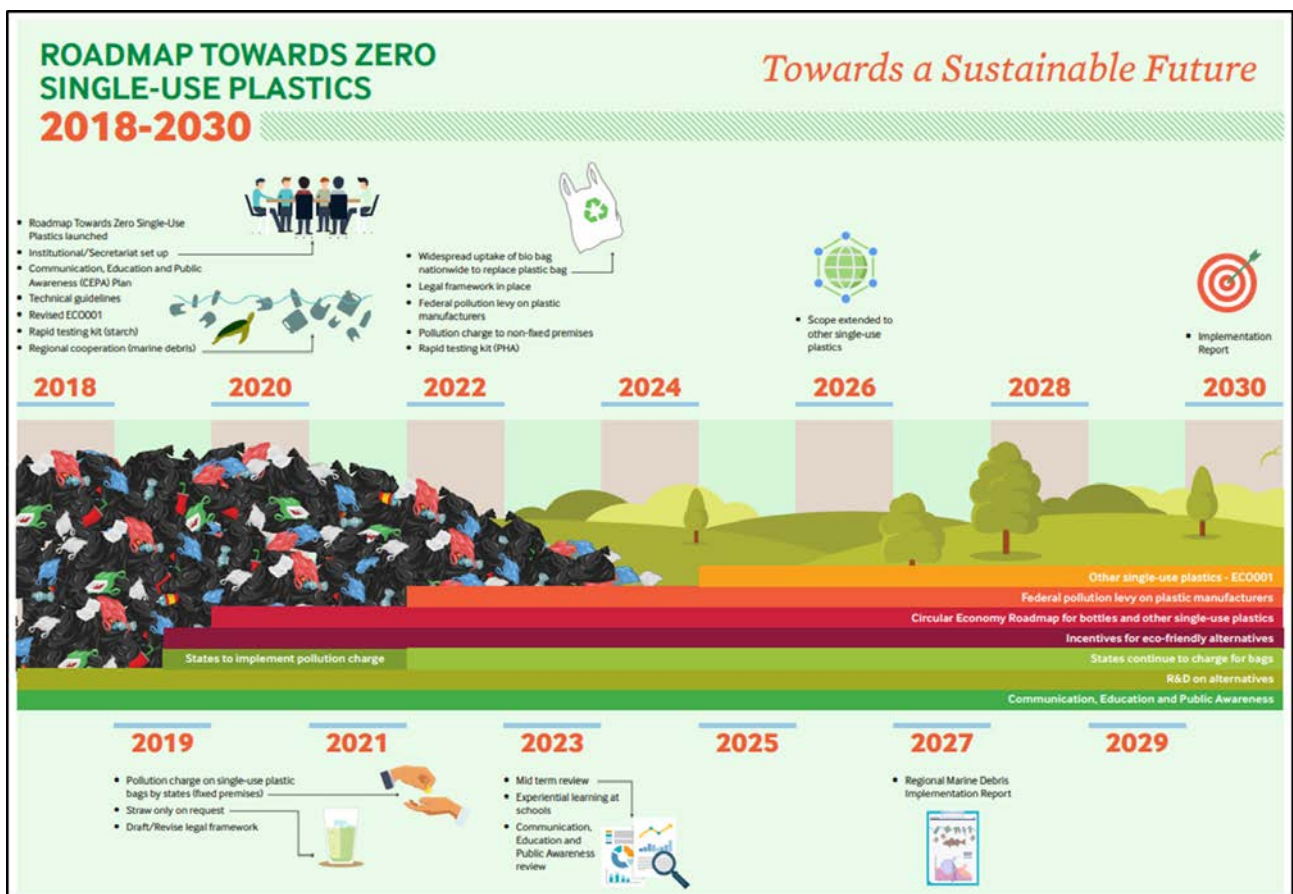
**COMPARISON BETWEEN MASPA AND MAREA**

	Malaysian Sustainable Plastics Alliance (MaSPA)	Malaysia Recycling Alliance (MAREA)
<b>Description</b>	<p>Formerly known as the Malaysian Plastics Pact (MPP), MaSPA is an industry-driven multi-stakeholder initiative brought about by the former ministry—MESTECC as a platform for members to commit to actions and goals with regards to four sectors:</p> <ol style="list-style-type: none"> <li>1. Improvement of product design</li> <li>2. Adoption of effective plastic waste management</li> <li>3. Implementation of the EPR schemes</li> <li>4. Building R&amp;D agenda for plastics circularity</li> </ol> <p>Objectives of MaSPA are as follows:</p> <ol style="list-style-type: none"> <li>1. Identify and eliminate five problematic or unnecessary single-use plastic items through redesign, innovation or alternative (reuse) delivery models by 2025.</li> <li>2. 100% of plastic packaging to be recyclable/ reusable/ compostable in Malaysia by 2030.</li> <li>3. 25% of post-consumer plastic packaging effectively recycled or composted by 2025.</li> <li>4. 15% average recycled content across all plastic packaging by 2030.</li> </ol>	<p>MAREA is a voluntary and industry-led based PRO that will be formally incorporated by the end of 2020. The function of MAREA is to consolidate and facilitate efforts and resources by the member companies to increase the collection for recycling rate of the focus materials (i.e. PET, Used Beverage Cartons, and Flexible Packaging).</p>
<b>Stakeholders</b>	<p>Public and private stakeholders in the plastic value chain. There are a total of 17 founding members which are representatives from public sector (ministries, governmental agencies, etc.) and private sector (private companies, NGOs, etc.). About 80 additional stakeholders, from diverse backgrounds such as companies, consultancies, academia, have indicated an interest in joining MaSPA after the official launch.</p>	<p>It is currently made up of 10 founding members from the Fast Moving Consumer Goods Industry (FMCG) industry.</p>

<b>Working groups/ Subcommittees</b>	<p>There are six working groups:</p> <ol style="list-style-type: none"> <li>1. Business advice and engagement</li> <li>2. International collaboration</li> <li>3. Technical projects, research and tools</li> <li>4. Circular Economy Initiatives</li> <li>5. EPR scheme</li> <li>6. Communication, Education &amp; Public Awareness (CEPA)</li> </ol>	<p>Three subcommittees focusing on:</p> <ol style="list-style-type: none"> <li>1. PET</li> <li>2. Used Beverage Cartons</li> <li>3. Flexible Packaging.</li> </ol>
<b>Actions</b>	<p>The primary role of MaSPA is to act as an umbrella group for all sustainability initiatives related to plastics circularity. This means that MaSPA will act as a platform for collaboration between different stakeholders, help increase cooperation between industry and government, and support plastic sustainability through funding from sponsors.</p>	<p>Once active, the activities of the MAREA can be categorized into two areas.</p> <ol style="list-style-type: none"> <li>1. Category A: Activities which directly increase CFR rates. For example: <ul style="list-style-type: none"> <li>• Price incentive mechanism</li> <li>• Offtake agreement</li> </ul> </li> <li>2. Category B: Activities which help to increase visibility of the efforts of the PRO and support category A activities. For example: <ul style="list-style-type: none"> <li>• Communication, Education &amp; Public Awareness (CEPA)</li> <li>• Government Advocacy</li> </ul> </li> </ol>

Source: MGTC, brand owners, NGOs and publicly available information<sup>10</sup>

Figure A15.1  
**ROADMAP TOWARDS ZERO SINGLE-USE PLASTICS 2018–2030**



<sup>10</sup> APEC, "Circular Economy Roadmap - Malaysia's Practice"

## APPENDIX 16:

# CHECKLIST FOR PLASTIC RECYCLING PROCESS EVALUATIONS

The FSQD under MOH has created a checklist based on European Food Safety Authority (EFSA) to help guide industry players in terms of selecting safe recycling technologies. Please note that this checklist is a guiding document only and not an approval or license for product sales.

Figure A16.1

### CHECKLIST FOR PLASTIC RECYCLING PROCESS EVALUATIONS

No	Contents
1	Company Details
2	Name of recycling process: <ul style="list-style-type: none"><li>• Status of recycling process in other countries</li><li>• Mechanical recycling or physical recycling</li></ul>
3	Recycling process description: <ul style="list-style-type: none"><li>• Flow chart of the process</li><li>• Detailed description</li><li>• Critical parameters</li></ul>
4	Characteristic of plastic input (not more than 5% input from non-food used): <ul style="list-style-type: none"><li>• Used or unused plastic</li><li>• Possible contaminations</li><li>• Plan of evaluation and qualification of the supplier</li></ul>
5	Decontamination efficiency: <ul style="list-style-type: none"><li>• Result of challenge test (demonstration of the effectiveness of a recycling process to remove chemical contamination)</li><li>• Experimental or theoretical consideration on the possible migration</li></ul>
6	Characteristic of the recycled plastic: <ul style="list-style-type: none"><li>• Specification (melt flow index, glass transition temperature)</li><li>• Recycled plastic is used behind the plastic functional barrier or direct contact with food</li></ul>
7	Intended use: <ul style="list-style-type: none"><li>• % of recycled plastic in the final articles</li><li>• Single use or repeated use applications</li><li>• Type of food</li><li>• Condition of contact to enable of the possible migration</li></ul>
8	Declaration of compliance with the Reg. 27 under FR 1985 or other countries legislation: <ul style="list-style-type: none"><li>• Self-evaluation/warranty must be provided</li><li>• Conclusion of safety evaluation</li><li>• Possible recommendation on restriction of use and/or special application</li></ul>

## APPENDIX 17:

# TIGHTENING OF GLOBAL REGULATIONS ON SCRAP PLASTIC AND RECYCLED PLASTIC TRADING

### 17.1 BASEL CONVENTION PLASTIC WASTE AMENDMENTS

Basel convention, a near-universal treaty which regulates the transboundary movements of hazardous wastes and other wastes and of which Malaysia is a signatory, has adopted amendments to Annexes II, VIII and IX to the Convention which deal with the transboundary movement of plastic waste that will come into force on the 1st of January 2021.<sup>11</sup>

The following are the amendments made to the Annexes II, VIII and IX:

- **Annex II**
  - Insertion of a new entry Y48 (covers non-hazardous plastic waste which is not covered by Basel Listing B3011, including mixtures of such wastes unless they are hazardous.)
  - Prior notice and consent are required.
- **Annex VIII**
  - New entry A3210 which clarifies the scope of plastic wastes presumed to be hazardous.
  - Prior notice and consent are required.
- **Annex IX**
  - Entry B3010 is replaced with a new entry B3011 which clarifies the types of plastic wastes that are presumed to not be hazardous.
  - Prior notice and consent are not required.

Through three amendments to the annexes to the Convention, this decision specifies the new categories of plastic waste that will be subject to the Convention's:

- Control procedure for transboundary movements (Prior informed Consent (PIC) procedure) and the conditions under which this procedure applies or not
- Provisions pertaining to waste minimization
- Provisions pertaining to the environmentally sound management of wastes

Based on these amendments, the types of plastic scrap/waste that will or will not be controlled are as follows:

- All plastic waste and mixtures of plastic wastes with the exception of waste covered by entry B3011 will require the importing country's prior informed consent before it can be exported. Types of plastic scrap/waste that will be controlled<sup>12</sup>:
  - Plastic scrap and waste that is contaminated (e.g., with food residue and/or other non-hazardous waste)
  - Plastic scrap and waste mixed with other types of scrap and waste
  - Plastic scrap and waste containing halogenated polymers (e.g., PVC)
  - Mixed plastic scrap and waste, with the exception of shipments consisting of polyethylene (PE), polypropylene (PP), and polyethylene terephthalate (PET) that meet the criteria described in Basel listing B3011
- Only batches of individual non-halogenated polymers (for a very narrow mix of polyethylene, PP and PET), that are sorted, clean and uncontaminated and effectively destined for recycling can be freely traded

11 [Secretariat of the Basel Convention, "Basel Convention Plastic Waste Amendments"](#)

12 [EPA, "New international requirements for the export and import of plastic recyclables and waste"](#)

globally. Types of plastic scrap/waste that will not be controlled/subjected to PIC procedure (criteria in Basel Listing B3011)<sup>13</sup>:

- Plastic scrap must be pre-sorted, clean, destined for “recycling in an environmentally sound manner” and be classified in one of the following groups:
  1. Plastic scrap “almost exclusively” consisting of one non-halogenated polymer (e.g. PE, PP, PET, PS, ABS)
  2. Plastic scrap “almost exclusively” consisting of one cured resin or condensation product (e.g. epoxy resins)
  3. Plastic scrap “almost exclusively” consisting of one of a limited number of fluorinated polymers (e.g. polyvinyl fluoride)
  4. Mixed plastic scrap consisting of PE, PP, and PET, provided it is destined for “separate recycling” of each material, in an environmentally sound manner and almost free from contamination and other types of wastes.

## 17.2 HONG KONG, CHINA'S UPDATED GUIDELINES IN COMPLIANCE WITH THE AMENDMENTS

Thus far, only Hong Kong, China has updated its guidelines to comply with the Basel Convention Plastic Waste Amendments. The following are the new controls in Hong Kong, China:

- Unrestricted plastic waste: Non-regulated plastic waste items within the Sixth Schedule of WDO (Waste Disposal Ordinance of Hong Kong, China)<sup>14</sup> or entry B3011 of Annex IX of Basel Convention which are almost free from contamination and other types of wastes (with contaminants of not more than 0.5%), can still be imported without the requirement of import permit if it is destined for recycling in an environmentally sound manner.<sup>15</sup>
- Restricted plastic waste: On the other hand, the import of plastic waste items not within the Sixth Schedule of WDO or non B3011 of Annex IX such as Y48 and A3210 will be subject to the control of permit/consent while transshipment will require a notification.
- Export permits or approval issued by the exporting countries must be available in case of import to Hong Kong, China or transshipment via Hong Kong, China.

---

13 [EPA, “New international requirements for the export and import of plastic recyclables and waste”](#)

14 [The Waste Disposal Ordinance \(WDO\), Cap. 354, provides legislative control on pollution caused by all forms of wastes including activities which involve the import or export of waste. It provides the statutory framework for the planning, management and control of wastes in Hong Kong, China.](#)

15 “Environmentally sound recycling” is defined in the technical guidelines on the identification and environmentally sound management of plastic wastes and for their disposal.

## APPENDIX 18:

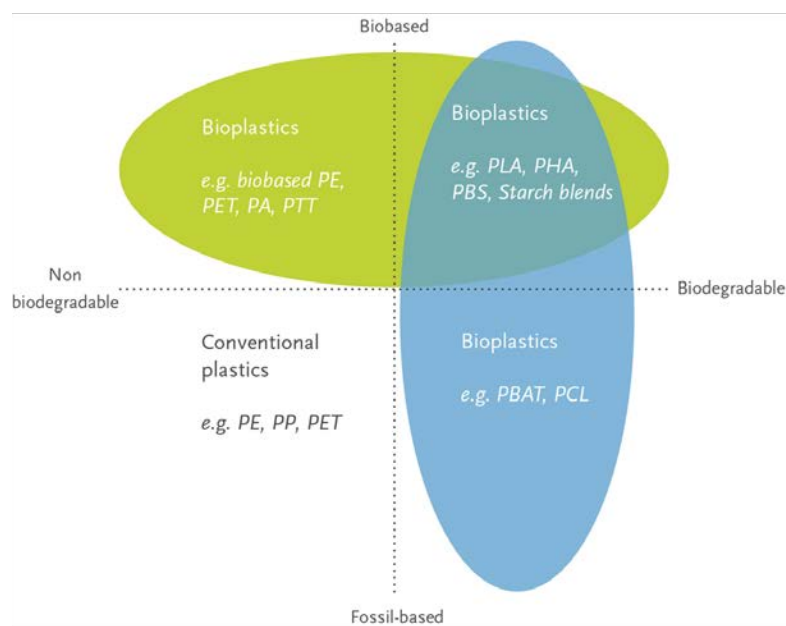
# BIOPLASTIC ALTERNATIVES

Until 2015, bioplastics remained a very niche subcategory of the global plastics industry. However recent attempts by governments around the world to curb the use of single-use plastics and fossil-fuel derived plastics, has given an opportunity for the emergence of bioplastics. Globally, approximately 2 million TPY of different types of bioplastics is produced. In comparison to fossil-fuel derived plastics, this is only 1-2%.

To understand bioplastics in the context of plastics recycling, it is important to understand their sources and biodegradability together with plastics based on conventional, fossil resources.

Figure A18.1

### OVERVIEW OF TYPES OF PLASTIC<sup>16</sup>



All plastics can be categorized into four main groups:

1. Biobased or partially biobased non-biodegradable plastics such as biobased PE, PP, PET (so-called drop-ins) and biobased technical performance polymers such as PTT, TPC-ET
2. Plastics that are both biobased and biodegradable, such as PLA, PHA, PBS
3. Plastics that are based on fossil resources and are biodegradable, such as PBAT
4. Plastics that are based on fossil resources and are non-biodegradable, such as conventional PET, PP, HDPE, LDPE

Biobased plastics can contribute to lowering greenhouse gas emissions and demand for fossil resources, when substituting the fossil counterparts. Together with a high recycling rate of biobased plastics and the substitution of the fossil fuel inputs by sustainable biobased resources, this would provide an attractive vision for a circular economy.<sup>17</sup>

<sup>16</sup> [European Bioplastics](#)

<sup>17</sup> [Biobased plastics in a circular economy, CE Delft \(2017\)](#)

In general, there are two main criteria that need to be fulfilled for bioplastics to be a viable and sustainable alternative to plastics derived from fossil resources:

1. **Supporting policies and standards.** This includes:
  - > Policies which prohibit the use of plastics from fossil resources
  - > Policies that encourage the widespread adoption of bioplastics in single use applications
  - > Standards that govern the manufacturing and distribution of bioplastics and which also prevent non-bio-degradable such as oxo-degradable plastics from flooding the market
2. **Post-consumer stage infrastructure.** This includes separation, collection and recycling infrastructure in the post-consumer stage of bioplastics.

In Malaysia, only the first criteria of supporting policies and standards have received some attention from government agencies, however the criteria has not been optimally addressed thus far in the government policies such as the 12th Malaysia Plan 2021-2025 and the Roadmap Towards Zero Single-Use Plastic 2018-2030.

Although Kuala Lumpur implemented the use of biodegradable plastic bags almost two years ago, the number of people switching from regular petroleum-based plastic bags was far from encouraging. Based on the report from the Kuala Lumpur City Hall (DBKL) Health and Environment Department, since the implementation of biodegradable plastic bags in the Federal Territories in 2017, only around 60% of restaurants and 80% of shopping complexes have complied with this ruling.<sup>18</sup> In addition, some traders have also opted for cheaper photo-degradable or oxo-biodegradable plastic bags.

On the other hand, according to the Malaysian Bioeconomy Development Corporation Sdn Bhd (Bioeconomy Corporation), there is potential for Malaysia to be a global bioplastics hub. According to their chief executive officer, Dr Mohd Shuhaizam Mohd Zain, Indonesia, the Philippines and Thailand are major producers of starch, sugar and biopolymers respectively, they could also capitalise on the bioresin conversion technologies available in Malaysia to produce bioplastic materials.<sup>19</sup> The abundance of non-food crops and agricultural by-products such as palm oil wastes can also be utilized as the feedstock for the production of bioplastic.

In order to encourage the SMEs in Malaysia to adopt bioplastics in their business, a seminar named 'Developing the Bioplastics Industry SMEs in Malaysia' was organized in 2019. Dr Mohd Shuhaizam looked forward to the development of local SMEs in the bioplastics industry who can penetrate the globally emerging green markets and also boost the acceptance of bioplastic products among consumers.

While bioplastics currently remain a very small portion of the plastic resins consumed in Malaysia, given that the government's focus on addressing marine plastics and the efforts of the Bioeconomy Corporation, bioplastics share of the total resins consumed in Malaysia is expected to grow in the future.

---

18 Bioplastics News, "Biodegradable Plastics Uptake Still Discouraging in Malaysia"

19 MIDA, "Money in bioplastics in SME"

## APPENDIX 19:

# ASSUMPTIONS AND CONDITIONS BEHIND CALCULATION OF THE IMPACT OF INTERVENTIONS

Table A19.1

**ASSUMPTIONS AND CONDITIONS BEHIND CALCULATION OF THE IMPACT OF INTERVENTIONS**

Recommendations	Modeling Assumptions	Value Yield Increase	CFR Rate Increase
<b>1</b>	<b>INTERVENTIONS THAT INCREASE VALUE YIELD AND CFR RATE</b>		
<b>A</b>	<p><b>Increase sorting efficiency of post-consumer collection of plastics</b></p> <p>CFR rate: Implementing this intervention will increase MSW sorting to 50% of all collected MSW, so the current volume of non-recycled plastics reduces by 50%. Assume there will be a 100% collection of MSW. This leads to an increase in CFR rate of 38%.</p> <p>Value Yield: Implementing this intervention will increase demand for all products by approximately 10% of existing value (77%) due to better sorting. Note: Currently, 1.07 million tonnes of plastics go to landfills. So value generated from landfills is currently very minimal or non-existent.</p>	8%	38%
<b>B</b>	<p><b>Set recycled content targets across all major end-use applications</b></p> <p>CFR rate: Assuming 30% recycled content all comes from local sources and 10% process losses occur, a minimum CFR rate of 33% is required in order to achieve 30% recycled content target. Also, currently it is assumed 50% of all recycled plastics is exported. When recycled content targets are set, it is assumed only 25% of all recycled plastics will be exported i.e. local demand for recycled plastics will increase to 75% of all recycled plastics. Thus 44% CFR rate is needed such that 75% of that becomes 33% CFR rate. Thus the increase in CFR rate needed is 44%-24%=20%.</p> <p>Value Yield: Implementing this intervention will increase demand for all products by approximately 15% of existing value (77%*15% = 12%)</p>	12%	20%
<b>C</b>	<p><b>Mandate "design for recycling" standards for all plastics, especially for packaging</b></p> <p>CFR rate: Based on Ellen MacArthur Foundation's New Plastics Economy Catalyzing Action report, without fundamental redesign and innovation about 30% of plastic packaging will never be reused or recycled. Assuming this 30% can be applied across all applications of plastics, then plastic CFR can move to the right by 30%.</p> <p>Value Yield: Based on the above-mentioned report, implementing four areas of packaging design changes could have a positive impact on recycling economics amounting to USD 90-140 per tonne collected. Based on a current average sales price per tonne of 700 USD with an average value yield increase of 115 USD (average of 90-140 USD), the increase is 16%.</p>	16%	30%

2 INTERVENTIONS THAT INCREASE CFR RATE				
D	Encourage increase in recycling capacities (mechanical and chemical)	CFR rate: 100% recycling capacity is needed to achieve very high recycling rates for plastics. Assuming the current value yield stays the same as recycling capacity increases to 100%. Increasing recycling capacity to 100% can enable an additional 76% of plastics to be recycled. It must be noted that this increase in CFR cannot be achieved without the implementation of policies which create a demand pull for recycled plastics and implementation of actions which enable plastics to be available for recycling (e.g. source segregation, design-for-recycling). Value Yield: No change	0%	76%
E	Create industry-specific requirements to collect post-use products	CFR Rate: Assuming a 90% CFR rate target for packaging and 50% CFR rate target for all non-packaging applications. 42% of all plastics is consumed by packaging and the rest by non-packaging so this provides a weighted average CFR rate of 67% to be reached. After factoring in the existing CFR rate of 24%, the increase in CFR rate is 43%. Value Yield: No change	0%	43%
F	Restrict disposal of plastics into landfills and dumpsites	CFR Rate: Implementing this intervention will reduce all non-recycled plastics from entering landfills by 50%. This leads to an increase in CFR rate of 38%. Value Yield: No change	0%	38%

## APPENDIX 20:

# SUMMARY OF ALL RECOMMENDED INTERVENTIONS AND ACTIONS

Figure A20.1

### SUMMARY OF ALL RECOMMENDED INTERVENTIONS AND ACTIONS UNDER THIS STUDY

Recommended Interventions	#	Actions
A. Increase sorting efficiency of post-consumer collection of plastics	1	Harmonize and enforce source-segregation and separate collection standards and targets
	2	Establish dedicated materials recovery facilities (MRF) as part of the waste collection system
	3	Develop awareness and behavior change campaigns
	4	Provide opportunities for informal sector inclusion
	5	Invest in treatment of organic waste
	6	Digitalize recyclables collection
	7	Implement Pay-as-you-throw (PAYT) waste collection model
B. Set recycled content targets across all major end-use applications	8	Communicate the approved usage of recycled content for food-contact applications and finalize decision on Halal labeling/certification
	9	Set recycled content targets and standards for major plastic use industries (i.e. packaging, construction, electronics, filament sectors)
	10	Develop and launch incentives for using recycled content (e.g. reducing Sales and Services Tax (SST))
	11	Implement green public procurement of recycled plastic products
	12	Tax plastic applications without minimum recycled content
C. Mandate "design for recycling" standards for plastics, especially for packaging	13	Align industries on "design for recycling" standards
	14	Voluntarily adopt "design for recycling" standards for all plastic products
	15	Mandate national "design for recycling" standards for packaging plastics
D. Encourage increase in recycling capacities (mechanical and chemical)	16	Incentivize increase in recycling capacities for polyolefins (PP, PE)
	17	Incentivize PET recycling to higher-end recycled products
	18	Provide market pricing and volume data for virgin & recycled plastics
	19	Invest in chemical recycling capacity for low value plastics
E. Create industry-specific requirements to collect post-use products	20	Setup voluntary extended producer responsibility system for all major end-use application industries for plastics (e.g. PRO for not only packaging but also for electronics)
	21	Mandate collection targets specifically for packaging and electronics industries
	22	Mandate reporting framework for plastic products
	23	Mandate a compliance scheme to meet obligations
F. Restrict disposal of plastics into landfills and dumpsites	24	Improve reporting and tracking of plastics (against HS codes reporting for import/export of plastic resins, semi-finished products and scrap plastics)
	25	Assess feasibility of regional scrap plastics trade
	26	Mandate targets to lower landfill disposal rates for plastics
	27	Increase landfill tipping fees
	28	Reduce unfair competition from illegal recyclers



**WORLD BANK GROUP**

**THE WORLD BANK**  
IBRD • IDA

**IFC**

International  
Finance Corporation

**PROBLUE**



Administered by  
**THE WORLD BANK**  
IBRD • IDA | WORLD BANK GROUP

MARCH 2021