

Environmentally responsible trade in waste plastics
Report 2: Capacity gaps and needs for managing plastic waste in Asia Pacific

Prepared for the Department of Agriculture, Water and the Environment by Asia Pacific Waste Consultants

Report 2 of 3

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Report 2 of 3 of the *Environmentally responsible trade in waste plastics* project undertaken by UTS Institute for Sustainable Futures, Asia Pacific Waste Consultants and the Centre for International Economics.

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Asia Pacific Waste Consultants (APWC) is a leading international environmental management consultancy specialising in the solid waste and recycling sector. APWC's dedicated team of experts is passionate about improving environmental outcomes in developed and developing economies.

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Glossary

APWC	Asia Pacific Waste Consultants		
CDS	Container deposit schemes		
CIE	The Centre for International Economics		
DAWE	The Australian Government Department of the Agriculture, Water and Environment		
ERT	Environmentally Responsible Trade		
EU	European Union		
HDPE	high-density polyethylene		
ISF	Institute for Sustainable Futures		
MEA	Multilateral Environmental Agreement		
MLP	Multi-layer plastics		
MRF	Material Recycling Facilities		
OECD	Organisation for Economic Co-operation and Development		
PET	Polyethylene terephthalate		
PICs	Pacific Island Countries		
POPs	Persistent organic pollutants		
PP	Polypropylene		
PS	Polystyrene		
PVC	Poly vinyl chloride		
UK	United Kingdom		
USA	United States of America		
USD	United States Dollar		

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1. The rationale for plastics recycling

A well-organised and efficient plastics recycling ecosystem allows the local resource-recovery sector to emerge while simultaneously strengthening trade ties for materials exchanged on the international commodity market. It creates significantly more local jobs than those generated by sending equivalent amounts of waste to landfill or for incineration, or by synthesising an equivalent quantity of virgin resins within the petrochemical industry¹.

The plastics recycling industry is going through an unprecedented period of change due to policy shifts around the world. The requirements and capacity available are different (yet interrelated) for countries that predominantly generate, collect and sort recyclable plastics prior to sending them overseas for reprocessing (exporting countries) to those countries that receive most of these plastics for reprocessing in addition to generating plastics requiring recycling domestically (importing countries).

Recycling can be an environmentally and economically viable process. However, gaps in the supply chain remain, leading to plastic resources being dumped in rivers, oceans and landfills around the world. There is an opportunity for more efficient production, use and disposal of plastics in line with the principles of the circular economy. Despite this interest, plastics recycling rates are still relatively low, at between 9% to 30% globally².

Project objectives

The linkages between trade and leakage of plastic into the ocean are not well understood. The Australian Government Department of the Agriculture, Water and Environment (DAWE) commissioned the UTS Institute for Sustainable Futures (ISF), Asia Pacific Waste Consultants (APWC) and the Centre for International Economics (CIE) to undertake research regarding *Environmentally Responsible Trade in Waste Plastics*. The objectives of this project are to understand:

- how environmentally responsible trade in recycled plastics might reduce leakage of plastic into oceans without merely shifting the plastic waste burden from one country to another;
- what opportunities exist to ensure trade in recycled plastics in the Asia—Pacific region is environmentally responsible.

Report overview

This report is the second in a series of three reports as part of the *Environmentally Responsible Trade in Waste Plastics* project. Report 1 seeks to investigate the links between the plastics waste trade and marine plastic pollution. Report 3 presents three in-depth case studies on three countries/regions that are illustrative of the challenges and opportunities for environmentally responsible trade of waste plastics in the region. This Report (Report 2) identifies the needs, capacities and gaps in the waste management and recycling of post-consumer plastic in the Asia–Pacific region. This was undertaken through an analysis of existing data sets and an extensive literature review complemented by a series of interviews with industry experts.

The report includes a summary of barriers that currently challenge improved management potential and recycling of plastic materials, and explores the main drivers and impacts of country-level policy, economics, legislation and market-based approaches regarding the management of post-consumer plastics across a number of economies in the Asia–Pacific region. It focuses on the barriers that exist within secondary plastics markets and identifies potential interventions that may help overcome them.

¹ d'Ambrières, W. (2019) Plastics recycling worldwide: current overview and desirable changes. Field Actions Science Reports The journal of field actions. Available at: https://journals.openedition.org/factsreports/5102

² OECD. (2018), Improving Markets for Recycled Plastics: Trends, Prospects and Policy Responses, OECD Publishing, Paris. Available at: http://dx.doi.org/10.1787/9789264301016-en

2. Capacity gaps and requirements for plastics recycling

Defining Exporting and Importing Countries

As the focus of this study is on the trade of waste plastics, countries in the Asia–Pacific region are broadly divided according to their position in trading relationships, that is as either exporting or importing countries for post-consumer plastics. However, there are a number of other important distinctions between countries' internal recycling capacity and trading ability and we have therefore further categorised Asian and Pacific countries into the following categories, as summarised in Table 1 on the following page.

Exporting Countries

Mature recycling economies

Exporting countries in the Asia–Pacific region - specifically Australia, Japan and New Zealand, and other major exporters, such as those in Europe and the United States - rely on significant infrastructure for sorting and processing plastic waste by polymer type or as mixed plastics. These countries also apply disincentives, such as taxes and levies, to discourage landfill and incineration. Countries such as the USA, Australia and New Zealand focus on conventional waste-management methods using landfills and separation at material recycling facilities (MRFs). In these cases, less than 10% of plastic waste is recycled, most of it internationally.³

Geographically constrained and developing recycling economies

Geographically constrained recycling economies such as the Pacific Island Countries (PICs), are generally geographically isolated and have a small land mass. PICs face unique challenges, including limited landfill space and high shipping costs. This category also includes developing recycling economies in Asia with low trade volumes. Both these groups are discussed together, as they lack policies and legislation to encourage recycling, lack waste management infrastructure (collection systems, landfills and MRFs) and have relatively low labour costs. Waste is not always collected; when it is collected, it uses low-cost, labour-intensive processes. Recyclable plastics are predominantly picked from landfills by the informal sector — waste pickers collect recyclables, which are then sorted (usually by polymer type) and baled (low-density baling). In the case of PICs, waste may be stored for shipping until sufficient material is available to make shipping to international markets financially viable. PICs often have extensive stockpiles of recyclable materials awaiting export.

Importing Countries

Developing recycling economies

Countries importing recyclable plastics are predominantly in Asia, including China, India, Vietnam, Malaysia, Indonesia and Thailand. Since the implementation of China's 'National Sword' policy in 2018, Turkey, Spain, Russia and the USA ⁴ have started importing some of the plastic waste previously received by China as well as the South and Southeast Asian countries.

These countries often represent industrialised developing economies and are generally characterised by inadequate waste management infrastructure. Collection is not systematic; a large proportion of household and industrial waste continues to be dumped at numerous unofficial and unregulated sites⁵. Infrastructure for sorting is underdeveloped and is replaced by informal labour, which tends to be well-developed, organised and creates local jobs⁶.

³ Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. [Online] Science Advances, 3(7), e1700782. Available at: https://advances.sciencemag.org/content/3/7/e1700782.full

⁵ d'Ambrières, W. (2019) Plastics recycling worldwide: current overview and desirable changes. Field Actions Science Reports The journal of field actions. Available at: https://journals.openedition.org/factsreports/5102

Table 1 Exporting and importing country definitions

Trade role	Recycling economy type	Regions/Country	Collection practices	Reprocessing practices	Trade practices
TRIES	Mature recycling economies	Australia, Japan, New Zealand (United States, Europe, UK, Canada also major global exporters)	Regulations encouraging recycling; good traditional waste management infrastructure (collection systems, landfills and MRFs); relatively high labour costs. Waste is collected and segregated using sophisticated technology.	Minimal domestic plastic-processing capacity, mainly for high-value polymers such as PET and HDPE.	Recyclable plastics are sorted, often by polymer type, baled and a large proportion is shipped overseas.
EXPORTING COUNTRIES	Geographically constrained recycling economies	Pacific Island Countries (PICs)	General lack of policy and legislation to encourage recycling; lack of wastemanagement infrastructure (collection systems, landfills and MRFs); relatively low labour costs. Waste is not always collected; when	No domestic plastic-processing capacity, with most collected plastics going to landfill.	Lack of economies of scale and expensive shipping lead to challenges with exporting recyclable plastics and an inability to have financially sustainable in-country reprocessing.
	Developing recycling economies	Asian countries which do not/minimally import, including Cambodia, Nepal, Myanmar, Laos	collected, it uses low-cost, labour-intensive processes. Recyclable plastics are predominantly picked from landfills by the informal sector	Minimal domestic plastic-processing capacity, with most collected plastics going to landfill.	Minimal or no exports or imports.
IMPORTING	Developing recycling economies	Importers of post- consumer recyclable plastics, including Malaysia, Vietnam, Thailand, Pakistan, India, Indonesia, etc.	(i.e. waste pickers); sorted, usually by polymer type; baled (low-density baling); taken to local reprocessors and stockpiled awaiting trade.	Plastic-reprocessing capacity exists at industrial and/or informal scale, depending on the country.	Import most of the world's post-consumer recyclable plastics for reprocessing into resin, either to export or for use in local manufacturing.

3. Challenges – exporting countries

Mature recycling economies

To manage post-consumer plastics predominantly through recycling, countries require strong and reliable processes to collect, sort, and trade plastics. Table 2 below summarises the economic, technological, environmental and regulatory challenges facing exporting countries in recycling post-consumer plastics.

Table 2. Exporting countries: economic, technological, environmental, and regulatory challenges

Туре	Issue	Challenges		
All expo	rting countries			
Economic	Volatile Markets Supply constraints	Limited resilience of the sector to market shocks Global market for plastics waste concentrated in small number of countries Lack of differentiated demand for recycled plastics, therefore recycled resins compete with virgin plastics Lack of local reprocessing, manufacturing and end-markets for recycled plastics Costs of collecting, sorting and processing waste plastics		
	Cappi, condumite	Fragmented collection and sorting of materials leads to limitations on economies of scale		
	Wide variety of polymers and additives	 Multi-layer plastics and problematic additives mean further separation and sorting is required More recently, biopolymers are mixed in with other plastics 		
Technology	Contamination in post- consumer waste plastics	 Collection systems lack source separation in most exporting countries High level of contamination in the collected waste means advanced technology is required to segregate recyclable plastics from waste 		
	Limited availability of technology for mixed plastics	Limited technology available for recycling of mixed plastics. A large amount of plastics are still hand-sorted and end up in landfills		
Environmental	Presence of hazardous chemicals in some plastics	Hazardous additives used in primary plastics can make their way into recycled plastics where they may pose a health risk, particularly where they are present in products used for sensitive applications such as toys and food packaging		
Envir	Competition between technologies	Risk, in specific contexts, that energy-from-waste will compete for access to waste plastics as a feedstock		
ory	Existing regulation that supports certain technologies over others	 Lack of regulation that supports source separation Lack of regulation that supports simpler materials to be used for packaging Lack of regulation that prevents end-of-life disposal of recyclable plastics into landfills 		
Regulatory	Lack of monitoring data and accountability	 Poor data on the plastics recycling sector and a lack of consistency in reporting of international trade and market survey data on recycled plastics. Currently no international governance and reporting framework exists on trade of plastics A number of exporting countries have not ratified the Basel Convention, e.g. USA 		

Key **economic challenges** to recycling, which are common to mature recycling economies and developing economies, include:

- a) Lack of commercial viability of recycling for some plastics Recycling of some plastic, such as soft plastics and multi-layer plastics is not commercially viable relative to alternatives such as waste-to-energy and landfilling. For highly recyclable plastics like PET and HDPE, challenges include a combination of the high costs of collection, sorting and processing of plastics for recycling and the price of the main competitor resin produced from raw materials.
- b) Limited resilience to market shocks The recycling sector in exporting countries lacks resilience to changing market conditions. The two options available for collected and sorted post-consumer plastics are domestic reprocessing and export. There is limited domestic reprocessing for plastic in countries such as Australia and New Zealand. The existing industry faces the same challenges as the international importing countries, such as contaminated input materials, instability of the market for recycled resins, and competition with virgin plastics. Falling oil prices have led to these challenges becoming acute. Combined with high cost of labour in mature recycling economies, the viability of the domestic reprocessing sector is continually being challenged.

The global market for recyclable plastic waste is currently in turmoil. When China — which accounted for more than two-thirds of plastic waste imports — closed its borders to all but the cleanest material, it precipitated a deluge of plastic waste imports into South and Southeast Asia. This shift has highlighted the vulnerability of the recyclable plastic export sector to market shocks.

Currently, recycled plastics compete with virgin plastics in the new product manufacturing process. Without legislated policies that mandate the use of recycled products, the price of crude oil will continue to drive prices for recycled products. This increases market uncertainty for export of post-consumer plastics.

c) Supply constraints – The costs of collection, sorting and processing of post-consumer plastics are high. Post-consumer plastics are often collected in commingled bins from households and segregated using advanced recycling sorting technologies, including optical sorting at MRFs — all expensive processes. While collection systems for post-consumer plastics, such as PET and HDPE, are well established, a range of plastic resins including multi-layer plastics are increasingly being used for product packaging. This diversity of plastics increases contamination, limits the economies of scale and results in little or no incentive for recycling the less-common plastics.

Numerous **technical challenges** exist for the production of high-quality, high-value recycled plastics in exporting countries with mature recycling economies. The largest of these challenges include fit-for-purpose technologies for the cost-effective collection of waste, appropriate sorting technologies that allow the extraction of high-quality waste streams for reprocessing, and processes that maximise the volume, usability and value of waste collected. A summary is provided below:

a) Wide variety of polymers and additives used – Separation of polymers of different types can be a technically challenging process. For example, a waste expert from Australia interviewed for this project noted that it is mechanically possible to segregate lids and labels from PET bottles when lids and labels are made from PP or HDPE (sink float method)⁷. However, when PVC labels are used, flaked PVC cannot be separated from flaked PET because PVC has a similar molecular weight to PET. This results in contamination. It is also difficult to mechanically segregate PVC bottles from PET bottles without the use of ultraviolet light.

Merrington. Dr A. (2011). Recycling of Plastics. [online]. Science Direct Available at: https://www.sciencedirect.com/topics/engineering/plastic-recycling

Complex packaging — for example, plastics in multi-layer plastics and in e-waste and other electrical equipment — presents challenges in disassembly and targeted extraction of polymers⁸. Technically, the inclusion of additives can have a detrimental effect on the physical characteristics of recycled plastics including brittleness, flame retardancy and oxidation⁹. The additives act as a disincentive for plastic recycling because the reprocessors cannot ascertain if their feedstocks are free of additives.

The recent push to use biodegradable plastics has led to increases in contamination because they are not suitable for recycling using traditional techniques. Incorrect classification of biodegradable plastics in traditional MRFs can contaminate both mechanical and biological treatment systems ¹⁰.

- b) Contamination of post-consumer plastics is high due to the use of commingled systems for collection of plastics from the consumers. This often requires the deployment of technologies that may not always be available (or financially viable). Where viable, MRFs deploy advanced technologies such as optical sorting to separate the different types of polymers. This method results in plastic polymer streams like PET, HDPE and PP as well as mixed plastic, all with a contamination rate between 5% and 15%. In the current recycling market, it is challenging to find appropriate markets for reprocessing of this material to resin due to the high contamination rates.
- c) Limited availability of technology for mixed plastics After the removal of high-value polymer streams such as PET, HDPE and PP, a mixed plastics stream is generated at most MRFs. There is limited availability of technology for further separation of these mixed plastics. Most mixed plastics are baled and sent to importing countries where these are sorted by hand by untrained labour or burned.

There are two key **environmental challenges** associated with the recycling of plastics. These are:

- a) **Hazardous additives used in primary plastics** can be retained in recycled plastic resin¹¹, leading to health risks, especially when used for food packaging. This is complicated by the lack of transparency or a requirement to label plastics when additives are used¹². This can cause confusion and a diminishing demand for recycled plastic resin.
- b) Competition between technologies There is a concern among environmental groups that in some jurisdictions the rise of waste-to-energy technologies will compete with the recycling sector for access to waste plastics. This can also have the serious consequence of pushing plastics towards a sub-optimal environmental outcome if the environmental regulations for waste-to-energy are not sufficiently strong or implemented or enforced correctly.

Several regulatory challenges create barriers to improved recycling of post-consumer plastics. These are:

a) Existing regulation supports certain technologies – Generally, exporting countries with mature economies such as Australia and the United States have relied on legislation supporting collection rather than recycling. A waste expert from Australia interviewed for this project noted that current policies such as collection and recycling targets set by states and councils favour the collection of plastic waste, which results in waste stockpiles, mixed plastics to landfill or offshore export rather than addressing other issues in the supply chain so that this plastic can be redirected into recycled products. Domestically, there is significant variance between states within countries (in both

⁸ OECD. (2018), *Improving Markets for Recycled Plastics: Trends, Prospects and Policy Responses*, OECD Publishing, Paris. Available at: http://dx.doi.org/10.1787/9789264301016-en

⁹ Ibid

¹⁰ Ibid. ¹¹ Ibid.

¹² COWI-Denmark in cooperation with Danish Technological Institute. (2013) Hazardous substances in plastic materials. Accessed at: https://www.miljodirektoratet.no/globalassets/publikasjoner/klif2/publikasjoner/3017/ta3017.pdf

- Australia and PICs), meaning that businesses often do not have access to national waste volumes or the ability to replicate or aggregate existing approaches across state borders.
- b) Absence of regulation and standards around the different types of plastic packaging that can be imported (or manufactured) contributes to a number of materials like multi-layer packaging (MLP) and PVC ending up in commingled bins. This leads to greater contamination in the recycling bins where materials like PET and HDPE are commingled with MLP and PVC. This impacts the overall recyclability of the contaminated polymers. Slow uptake or voluntary-only Extended Producer Responsibility (EPR) schemes disincentivise a large-scale separation of plastic materials by polymer type.
- c) Data and accountability Currently, there is a lack of transparency and consistency of reporting by different countries regarding volumes imported and exported, nor is there a marketplace to monitor supply and demand, which would allow for monitoring of leakage. It is not possible to undertake end-to-end traceability to waste plastics and therefore assign accountability. There is also no international policy regime beyond the Basel Convention that lays down a governance and reporting framework for traded plastics. Finally, a number of exporting countries are not signatories to the Basel Convention.

Geographically constrained and developing recycling economies

This section presents challenges for exporting countries such as PICs and those in Asia that not only lack collection and recycling infrastructure but have several economic, regulatory and environmental challenges in common. While the location of these geographically constrained economies pose shipping constraints which severely challenging their ability to trade post-consumer plastics, in developing economies in Asia, the imported plastics compete with the domestic recyclables for reprocessing.

Table 3. Geographically constrained and developing economies: economic, technological, environmental, and regulatory challenges

Туре	Issue	Challenges and Barriers
. <u>o</u>	Resources for collection, sorting and processing Competing economic	Collection systems in developing economies are not available for substantial amounts of the population due to low revenue base and no or limited incentives for collection of recyclables
Economic	priorities	Sorting is almost always performed at the disposal sites by waste pickers, and sometimes directly from households by waste pickers Ongoing finances are not available for sorting and processing infrastructure
		Waste management is not prioritised as investments are required in other sectors
logy	Sorting and processing technology	Lack of availability of infrastructure for sorting and reprocessing
Technology		Low-tech equipment is used for reprocessing, which is less safe for workers and lacks environmental controls
		Lack of technical skills to operate and maintain infrastructure where available
nental	Environmental standards	Weak environmental standards may lead to flow of plastics to destinations that have low costs because their environmental standards are low
Environmental	Compliance with existing standards	Lack of human resources for enforcement and compliance with environmental standards leading to uncontrolled dumping and burning of waste
Regulatory	Lack of regulation for collection, sorting and disposal	Lack of targets and strategies for collection, sorting and recycling or the management of end-of-life disposal of post-consumer plastics

Non-signatory to multilateral environmental agreements that allow for the appropriate transport of waste through overseas trade

Economic Challenges

a) Lack of available finances for collection and sorting services – The challenges faced by geographically constrained and developing recycling economies tend to emerge at the collection stage. Countries in this category often lack a user-pays system for collection of waste. This means that the community expects the waste service to be provided free of charge, leading to little success in achieving a well-developed and adequately resourced collection service. Some countries are trialling a pre-paid collection service or including a waste charge in water and electricity bills and this is showing positive results.

Most countries provide only general waste collection services, with no source separation, and covering a small percentage of households. The lack of collection services leads to burning, burying or dumping of waste on land and in waterways. Figure 1, based on data collected by APWC in 2018 from Vanuatu, shows that communities with collection systems in place have a much lower rate of dumping waste on land compared with communities that don't have a collection service. For the communities with no collection services available, waste is either dumped on land, burned, buried or dumped in waterways, all resulting in mismanaged waste and leakage into the environment.

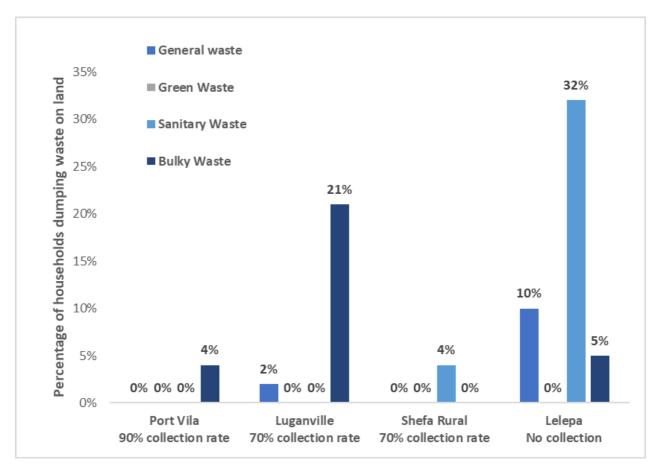


Figure 1 Percentages of households dumping waste on land Vanuatu, 2018¹³

¹³ Asia Pacific Waste Consultants. (2018). Vanuatu – Waste Data Report: Analysis of waste generation and disposal data collection in November 2018

- b) No source separation: In cases where household waste is collected, it is not source separated (with the exception of a few trials). Consequently, even if collected, recyclables often end up in uncontrolled landfills where waste pickers recover some recyclables. Several countries are starting to introduce legislation such as container deposit scheme (CDS) policies that allow for an incentivised collection of recyclable plastics, aluminium and liquid paper board (LPB) containers. For geographically constrained economies, the challenges arise in the form of economies of scale and lack of readily available markets. It may take years for enough material to be collected to make shipping possible. With the current volatility in export markets, it is challenging for local recyclers to take the risk of storing and stockpiling material that may not have any value in 12 months. For developing economies in Asia, the recyclable material collected from dumpsites is often soiled and cannot compete with the imported material coming in from overseas.
- c) Lack of available finances to fund infrastructure and equipment for sorting and lack of accessible market opportunities. Sorting in the countries in this category is undertaken by waste pickers, with little or no technology, with the collected material sold at minimal prices to local recyclers. No resources are available for the sustainable financing of appropriate sorting equipment, which leads to an ad hoc recovery system dependent on international markets.

Technological

In exporting countries with an emerging recycling sector (with a few notable exceptions such as Palau), the technology/infrastructure challenges start from the beginning of the waste management chain with a lack of fit-for-purpose collection infrastructure and no processing facilities in place.

a) Lack of sorting and processing infrastructure – In countries that do have collection services, the focus is on more densely populated cities and towns, often omitting rural and remote communities and islands. This leads to burning, burying, and dumping of waste on land and in waterways, leading to environmental leakage. The technological challenge lies in the availability of small-scale, fit-for-purpose collection technology that can be easily deployed in difficult terrain.

The challenges continue in the availability of infrastructure required for sorting, cleaning, and processing of plastics that is fit-for-purpose and necessarily smaller in scale and simpler in operations.

Limited landfill capacity and sorting facilities lead to an increase in logistics costs as waste is being transferred greater distances for processing and storage. Many PICs face imminent challenges in securing appropriate landfill space for safe disposal. In developing economies in Asia, where landfills do exist, they are often not sanitary, leading to direct leakage into the environment.

b) PICs also face the challenge of the availability of **trained personnel** to operate and service machinery in cases where infrastructure has been established/installed.

Environmental

- a) Weak environmental standards in developing recycling economies often leads to domestic postconsumer plastics ending up in places where management costs are the lowest because the environmental standards are the lowest. In many instances, this means that recyclable plastics end up in uncontrolled dumpsites due to low or no gate fees or environmental levies.
- b) Lack of human and financial resources for **enforcement and compliance** with environmental standards (where they exist) often leads to uncontrolled dumping and burning of waste. Data

collected by APWC in 2018^{14,15} and 2019^{16,17} indicates that there are a large number of instances of waste being buried, dumped and burned in several developing recycling economies where authorities are unable to enforce existing bans on dumping and burning due to lack of human and financial resources.

Regulatory

- a) In geographically challenged developing economies, there is often limited legislation allowing for collection, recycling and EPR. Although regional and international aid organisations have recently supported countries in the development of national waste management strategies, these remain severely under-resourced and consequently, implementation is minimal. Where EPR exists, it is usually industry-run and voluntary in nature.
- b) Lack of strategies for end-of-life disposal of post-consumer plastics Geographically challenged recycling economies lack circular economy approaches to policy making with few countries having strategies and targets in place to incentivise industry/private sector investment in collection, sorting and recycling. With the introduction of deposit scheme legislation in various countries, the first approaches to the circular economy are focused on developing the ability to collect and store plastics. However, the lack of available recycling markets and relatively small volumes makes it difficult for PICs to find a sustainable, long-term solution for recycling these materials.
- c) A number of geographically constrained and developing economies are not signatories or have not ratified multilateral environmental agreements, such as the Basel Convention, that allow for the regulated transboundary movement of waste. This leads to illegal trade of waste plastics or in some cases inability to trade.

¹⁴ Ibid.

Asia Pacific Waste Consultants. (2018). Solomon Islands – Waste Data Report: Analysis of waste generation and disposal data collection in November 2018

¹⁶ Asia Pacific Waste Consultants. (2019). Belize – Waste Data Report: Analysis of waste generation and disposal data collected in Belize.

¹⁷ Asia Pacific Waste Consultants. (2019). Tuvalu – Waste Audit Report: Included analysis of waste generation and disposal data collected in September 2019

4. Challenges – Importing countries

Table 4 below summarises the economic, technological, environmental and regulatory challenges facing importing countries leading to problems with recycling post-consumer plastics.

Table 4 Economic, technological, and regulatory challenges for importing countries

Туре	Issue	Challenges and Barriers
Economic	Changing government regulatory arrangements leading to volatility in markets	Unstable market conditions with ebb and flow of materials leading to confusion in the ability of countries to impose strict standards for import of plastics
	Sustainable financing of end-of-life disposal	Lack of sustainable financing models that promote collection, recycling and end-of-life disposal of all waste including imported recyclable plastics
		Current economic burden for end-of-life disposal of all contamination in imported plastic waste is borne by the importing country
Technology	Wide variety of polymers and additives Contamination in	Multi-layer plastics and problematic additives mean further separation and sorting is required
	imported plastics	More recently, biopolymers are mixed in with other plastics
		Post-sorting, plastics that don't have an economic value end up in uncontrolled dumpsites and furnaces as fuel
	Limited availability of technology or old technology for mixed plastics	There is limited technology available for sorting of mixed plastics. A large amount of plastics are still hand sorted in unsafe conditions
		A large proportion of reprocessors in Southeast Asia use old machinery or sort by hand, which is inefficient, energy intensive, unsafe for workers and lacks wastewater treatment
Environmental	Low environmental standards	Hazardous additives used in primary plastics can make their way into recycled plastics where they may pose a health risk, particularly if they are present in products that are used for sensitive applications such as toys and food packaging
	Compliance and enforcement	Lack of funding and personnel to undertake monitoring and enforcement of environmental controls resulting in activities like burning and dumping of residual plastics
	Institutional disconnect and lack of clarity of roles	Different levels of governments have differing drivers for waste management enforcement, leading to confusion around roles for implementation and resulting economic burden
Regulatory	Lack of regulation around environmental safeguards	Many jurisdictions lack regulation safeguarding the health of the environment and the people engaged in waste segregation and recycling
	Lack of regulation/enforcement that prevents illegal trade of plastics	Poor data on the plastics recycling sector and a lack of consistency in reporting of international trade and market survey data on recycled plastics
		Currently no international governance and reporting framework exists on trade of plastics. Basel has started this process by including plastics however, Mixtures of plastic wastes consisting of PET, PE or PP, provided they are sent to separate recycling facilities and processed in an environmentally responsible way without contamination will not

be subject to hazardous waste restrictions limiting the environmental controls and standards applicable to mixed plastic bales	
Many importing countries are not signatories to international multilateral environmental agreements (MEAs) that govern the trade of different wastes, e.g. Turkey is not a signatory to Basel Convention and is the most recent recipient of Australian post-consumer plastic waste	

Economic challenges

- a) Changing standards have led to rapidly changing market conditions China's restrictions on plastic imports have led to market fluctuations causing exporters to seek new markets. The rapid influx of plastics into new importing countries has led to quickly enacted and differing regulatory responses, which are also changing over time. This has led to rapidly changing market conditions in recent years.
- b) Transfer of the economic burden of recycling As a result of recyclable material trade, this burden of sorting and salvaging recyclable material from contaminants shifts from exporting countries to importing countries. The contamination, after being sorted, ends up in uncontrolled dumpsites leading to leakage. The economic cost of managing these dumpsites still lies with local authorities.
- c) The importing countries lack sustainable financing models that promote the safe end-of-life disposal of all recyclable plastics. The domestic recyclable plastics compete with the imported plastics for recycling, often leading to a reduction in domestic recycling rates.

Technology gaps

a) Contamination in recycling is a major issue for recyclers in order to produce clean bales for sale to importing countries. Mixed plastic bales consist of low-quality, low-value and hard-to-recycle materials owing to variations in plastic resin types, use of colorants, additives, and fillers in plastic production, and the complexity of products and product packaging which consist of one or more types of polymers or are combined with other materials. Most of the sorting is undertaken by unskilled workers in less-than-ideal conditions. Fit-for-purpose technology that continues to employ the current set of workers while providing them with safe working conditions does not exist. Materials that end up as fuel in unregulated furnaces will often have harmful additives, leading to the emission of harmful persistent organic pollutants (POPs).

Environmental gaps

- a) Institutional disconnect and lack of clarity of roles When China closed its borders to recyclable plastics, it was considered by various governments in Southeast Asia as an opportunity. Although thinking at the national level is positive for receiving recyclable plastic, it does not flow through to the authorities at the local and municipal level which are faced with the burden of enforcing environmental safeguards once the plastic arrives in country. This disconnect between the national governments' aspirations to capitalise on a favourable trade outcome and the local governments' ability to control the influx of plastics has led to the current situation of leakage of mismanaged plastics into the environment through lack of environmental controls, compliance and enforcement.
- b) **Difficulty in enforcement of environmental standards and safeguards** After limiting licences for plastic waste imports, governments in importing countries are shouldering the burden of enforcement. They receive no tax revenue from the illegal plastic recycling operators yet they are responsible for the clean-up, enforcement, and monitoring of sorting, reprocessing and end-of-life disposal. In Indonesia, an industry expert noted that due to the importation of recyclable plastic from

overseas, there is increased competition for domestic waste plastic, which is often neglected and results in the domestic waste stream being dumped in rivers and oceans. A number of experts interviewed for this project emphasised that most importing countries do not have appropriate landfills and dumpsites for disposal of the contamination left behind after the removal of valuable plastics from mixed plastic bales. The enforcement agencies also lack resources and trained personnel to effectively implement existing laws.

c) Low environmental standard – As the sorting of valuable recyclable material from contamination is largely undertaken by hand, it also poses a significant human health issues, with women and children at the forefront¹⁸. After sorting, a large amount of the non-recyclable contaminants are burned or dumped, thus leading to perverse environmental outcomes.

Regulatory gaps

- a) Most importing countries are catching up and implementing a raft of measures to ensure consistent quality of the recyclable plastic material entering the countries. Many governments have struggled to adopt and enforce effective policies for reasons such as lack of personnel, resources, and information.
- b) Data on trade and movement of waste is poor. This data is not based on standardised definitions and therefore often cannot be compared. This leads to an inability of the importing countries to be able to recover any costs from the receipt of contaminated plastic bales and for the exporting countries to effectively monitor the recycling process to ensure the traded material is being recycled effectively.
- c) A lack of an international regime governing the trade in plastic waste is creating environmental pollution and health risks arising from localised hand-sorting through plastic waste. It was noted by multiple interviewees in Indonesia and Australia that in recent times, licences for the importation of recyclable paper have been used to import recyclable plastic instead. This waste plastic has been imported without licences and ends up in backyard-style recycling factories where families sort bales to separate valuable recyclables from contamination. Due to the lack of appropriate disposal facilities, the contaminants are often leaked into the environment, via informal disposal sites, rivers and other waterways. All non-recyclable plastics often end up at local factories for fuel¹⁹.
- d) National-level governments are usually responsible for national legislation, strategies and policy frameworks for waste, including measures that give effect to obligations under international agreements. There is a need to regulate the movement of hazardous waste in and out of countries and to ensure it is managed in a way that reduces the risk of harm to the environment and human health. During the Basel Conference of the Parties in 2019, governments amended the Basel Convention to include plastic waste in a legally-binding framework, which will make global trade in plastic waste more transparent and better regulated, while also ensuring that its management is safer for human health and the environment. However, whether inclusion of plastic waste in Basel will be effective in providing a governance framework around international trade of plastic waste is yet to be seen.

¹⁸ Global Alliance for Incinerator Alternatives (2019). Discarded: Communities on the Frontlines of the Global Plastic Crisis [Online] Available at: https://wastetradestories.org/

¹⁹ Ibid.

5. Potential interventions

Exporting and Importing Countries

Given the diversity and scale of the challenges facing markets for recycled plastics, a range of measures and interventions can be deployed to mitigate these challenges. This will require close partnership working among multiple stakeholders, including governments, regulators, municipalities, industry and communities. Further, it will be important to engage all parts of the supply chain (for example, product designers or primary resin producers) for effective implementation of any future policy interventions. A wide range of potential regulatory, technology, innovation-based and industry-led interventions are presented in this section to address the challenges to effective recycling of post-consumer plastics.

Management of domestic waste remains challenging for both exporting and importing countries with respect to leakage of plastic waste. The Ocean Conservancy²⁰ study focused on land-based plastic leakage into the ocean and categorised this leakage according to two main pathways — collected and uncollected. It estimated that 75% comes from uncollected waste and the remaining 25% is from leakages within the waste management system. Ocean Conservancy also estimated higher rates of leakage for lower value residual waste streams, indicating that trade and market values of different recycled plastics may have an impact on what types of plastic leaks into the environment. A number of interviewees in the importing countries indicated that imports of plastic recycling inhibited domestic collection by reducing the price that waste pickers could receive from collecting and separating plastic wastes.

Several interventions are proposed below that will potentially alleviate the challenges identified in the section *Challenges – Exporting countries* and *Importing countries*. These interventions focus on improving waste management processes and promoting circular economy outcomes throughout the supply chain thereby reducing leakage from both exporting and importing countries and sharing between the two. These interventions, although not directly related to trade, improve the effectiveness of trade through cleaner, high-value waste streams and improved waste collection systems that reduce leakage.

Economic:

- a) Recycling markets currently have significant variability due to a variety of global and local economic issues. Developing a long-term financial strategy (for example, a comprehensive deposit scheme supported by a plastics aggregation service) that does not rely on a cyclical recyclables market can help mitigate these fluctuations by ensuring appropriate collection, segregation and processing capacity. This can also be supported by long-term policy and legislative planning. The Scottish Materials Brokerage Service²¹ is an example of a policy solution that reduces the reliance on market conditions. Viable recycling markets are often contingent on the inclusion of, or led by, the higher value commodities aluminium, metals, glass, etc. Therefore, there is a need to develop recycling programs that are driven, or led by, higher value commodities that act as a 'pull factor' for plastics.
- b) In emerging economies, the **investment** needs to be made **in collection systems** (typically by government) and processing infrastructure (typically by the private sector) to ensure all

²⁰ Ocean Conservancy, 2015. Stemming the Tide: Land-based strategies for a plastic-free ocean.

²¹ Zero Waste Scotland Limited, (2020) Scottish Materials Brokerage Service. [online] Zero Waste Scotland. Available at: https://www.zerowastescotland.org.uk/brokerage

- recyclable material can be collected and either recovered for recycling or disposed of appropriately in sanitary landfills.
- c) In PICs, where deposit return schemes are leading to the collection of recyclables, finding appropriate end markets for its subsequent sale after baling remains a challenge, due to the tyranny of distance, high freight costs and poor economies of scale. Therefore, small-scale, fit-for-purpose infrastructure, which allows for value to be added locally prior to export, are beneficial. End markets can be elusive, however.
- d) It is highly recommended to make funds available in emerging economies to allow for building and maintaining sanitary landfills appropriate for safe disposal of materials that cannot be recycled.

Regulatory – Product and recycling targets including environmental levies Government-led solutions

- a) Promote use of recycled content in plastic products A push for recycling through policy targets that support circular economy approaches can increase market demand for recycled plastics. Recent low oil prices have pushed the virgin plastic resin prices even lower and therefore minimum content targets will be instrumental in keeping the market demand for recycled products alive²². To protect the recycling sector from crude oil price volatility, measures could be taken to decouple the market for recycled plastic from the market for virgin plastic. A requirement to include recycled plastic in products made from plastic would help to create a discrete market in recycled plastic, one where virgin plastic could not be simply used instead. The implementation can be in the form of tax incentives to encourage use of recycled plastics, providing information and training to designers and manufacturers to encourage use of recycled content, as well as encouraging consumers to purchase products with recycled content and as a consequence drive demand. For example, in October 2018 the European Parliament voted to make it mandatory for beverage containers to contain at least 35% recycled plastic by 2025 ²³.
- b) Regulations that restrict the entry of complex polymers as packaging Import restrictions that allow for simpler packaging will be necessary to achieve improved downstream recycling of plastic packaging ²⁴ in commingled systems. A country-level restriction on the import of difficult-to-segregate-and-recycle packaging material would therefore help domestic systems generate clean material streams which will attract higher prices in the recyclables market. For example, in January 2020 South Korea banned the use of difficult-to-recycle plastic for packaging of food and beverage items ²⁵.
- c) Reduction in the use of additives Banning or increasing taxation on toxic additives to virgin plastics, which undermine its safe recycling and require the increased use of postconsumer plastic in recycling, can help facilitate the collection and recycling of existing plastic.

²² Bremer, C. (2018). *Governments need to act to encourage plastic recycling markets*. [online] OECD Available at: https://www.oecd.org/newsroom/governments-need-to-act-to-encourage-plastic-recycling-markets.htm

²³ Directive(EU) 2019/904 of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment. 2019.

²⁴ OECD. (2018), *Improving Markets for Recycled Plastics: Trends, Prospects and Policy Responses*, OECD Publishing, Paris. Available at: http://dx.doi.org/10.1787/9789264301016-en

²⁵Neo, P. (2020) No colour, no PVC: South Korea bans hard-to-recycle plastic materials for F&B [online] Food navigator-asia.com. Available at: https://www.foodnavigator-asia.com/Article/2020/01/31/No-colour-no-PVC-South-Korea-bans-hard-to-recycle-plastic-materials-for-F-B-packaging

Additives are used in primary plastics manufacturing to improve their performance, for example for: heat stabilisation, to reduce static, to improve flexibility or to prevent fire ignition²⁶. Future investment can be sought for research and development of alternatives to additives and for the development of technology that can identify the existing additives and possibly remove them during the reprocessing phase. Work also needs to be carried out on enhancing supply-chain awareness of problematic additives so that the impact on markets for recycled plastics is understood and communicated.

d) Deposit legislation – In countries without recycling systems in place, deposit schemes can incentivise the return of used plastics, metals and glass, and is a proven way to engage the community in recycling and maintaining contamination levels at exceptionally low levels. Container deposit schemes around the world have demonstrated an up to 40% reduction in litter streams²⁷. A schematic of a deposit return scheme is presented below.

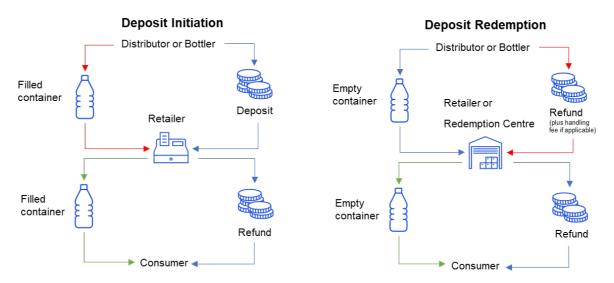


Figure 2 Image depicting a deposit scheme adapted from source: Container Recycling Institutions 2007²⁸

- e) An **international** plastic import/export **licensing scheme -** whereby an exporting country must get a licence to be able to export post-consumer recyclable plastic, would be beneficial. The licence fee can be used to offset costs of infrastructure investment, personnel training and enforcement in the importing country. The licensing can be managed by an exporting or an importing country or through an international system.
- f) To promote recycling whilst pushing for investment in waste-to-energy it will be essential to regulate the use of recyclable plastics in waste-to-energy plants and ensure appropriate regulations are in place to ensure minimal environmental harm. Recycling should be incentivised over waste-to-energy by introducing a levy or tax to reflect the relative

²⁶ British Plastics Federation (2020). Plastic Additives [online] BPF. Available at: https://www.bpf.co.uk/plastinedia/additives/default.aspy

https://www.bpf.co.uk/plastipedia/additives/default.aspx

27 Schuyler, Q. Hardesty, B. Lawson. TJ, Opie, K. Wilcox, C. (2018) Economic incentives reduce plastic inputs to the ocean.

Marine Policy, Volume 96, Pages (250 255)

²⁸ Bottle Bill Resource Guide (2020) What is bottle bill? [Online] Available at: http://www.bottlebill.org/index.php/about-bottle-bill

- environmental burden/benefit of waste-to-energy and recycling (and landfill). The taxation amount will depend on the country and the current recycling and landfilling costs.
- g) Ensure all countries are signatories to, and have ratified, MEAs that regulate the transboundary movement of waste.

Actions from manufacturers and industry-led solutions

- a) Sustainability targets by producers Multinational companies are setting ambitious sustainability targets and adopting more circular-economy approaches due to increased pressure from consumers and environmental concerns (for example, Nike, DELL, P&G, Adidas, Nestle, Coca-Cola and Target). Even higher rates of recycled plastic use in the automotive industry has now been mandated due to increased consumer acceptance and the downstream effects of EU legislation (Ford, Chrysler, General Motors, Nissan and Toyota). Some examples include the decision in 2019 by Fiji Water to use recycled material for all plastic water bottles (including exported products) to encourage the use of recycled materials. Global giant Nestle has committed to 100% of its packaging being recyclable or reusable by 2025. Coca-Cola has also committed to 100% of its packaging to be recyclable or reusable by 2030 and by pledging to recycle a used bottle for each bottle they sell globally. These private-sector initiatives will create demand for recycled resin and provide much-needed stability to the recyclable plastics market.
- b) Extended producer responsibility (EPR) is based upon the principle that because producers (usually brand owners) have the greatest control over product design and packaging, they have the greatest ability and responsibility to reduce toxicity and waste. British Columbia has piloted a novel EPR program in recent years that has transferred the cost of recycling programs from local government to manufacturers and their trade associations ²⁹. This was cited by an interviewee as an effective way to ensure design solutions are encouraged through the sector creating the packaging. See schematic in figure 3 below.
- c) Research and development into simplifying design of packaging Products can only be recycled in economically acceptable conditions if recycling is built into their design. For instance, recycling becomes far more complex when dealing with products that use multilayer plastics, particularly different polymers or materials. Using single-layer plastics facilitates easier and more cost-effective recycling. Therefore, recycling can be promoted when manufacturers choose to use polymers that are already in widespread use on the market and for which there are pre-established collection, recovery and recycling systems.

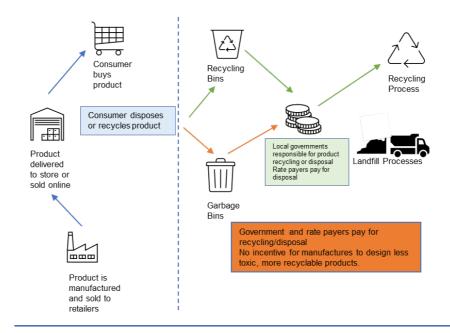
Technology

a) Efficiency gains are possible in collection, sorting and processing – Investment in innovative sorting technologies that make it possible to sort materials more efficiently – and

²⁹ Rogoff, M. Morris, J. Gaffigan, B. (2018) China's Recycling Import Ban: Uncertain Times for Solid Waste Agencies. [Online] Waste Advantage Magazine. Available at: https://wasteadvantagemag.com/chinas-recycling-import-ban-uncertain-times-for-solid-waste-agencies/

open the possibility of processing new flows – with greater yields. Some of the latest sorting robots use artificial intelligence to improve their ability to recognise waste. The sector can also benefit from the scaling effect achieved by concentrating sorting and processing at centralised sites. The resultant marginal decrease in production costs per metric ton of recycled plastic can help to drive the recycling sector.

Waste Management System



How Does Extended Producer Responsibly Work? Consumer Discarded by consumer Collected by local authority/waste management company Cost of program is funded by producers and consumers that purchase the product Product delivered Residual to store or sold online Sorting/Bulking Design and Reprocessing Manufacture Virgin material

Figure 3 Traditional waste management system (adapted from Producer Responsibility: A Tool to Manage Toxic Garbage (2016)³⁰ vs Extended Producer Responsibility system (adapted from Our Waste, Our resources: A strategy for England (2018)

Potential interventions - Importing countries

The preceding section lists potential interventions that could promote clean waste streams, improved collection and processing systems, and innovation in product design and production that are shared

³⁰ Thermos, P. (2016) Producer Responsibility: A Tool to Manager Toxic Garbage. [Online] in Slide Share <u>Available at:</u> https://www.slideshare.net/Nisqually/producer-responsibility-a-tool-to-manage-toxic-garbage.

between exporting and importing countries. This section focuses on interventions in the importing countries, that is in countries that predominantly receive post-consumer plastic waste and proposes potential solutions that target the plastic trading process.

Financial

a) Where it is economically more feasible to export recyclable plastics, financial provisions could be made to support the importing countries' tracking and enforcement capabilities, as well as providing technical support for advanced recycling facilities.

Regulatory

- a) Import permits and licensing A number of policy responses can be implemented in importing countries that allow for appropriate monitoring of recyclable plastic entering a country's ports followed by an enforcement and compliance regime that prevents the burning and dumping of non-recyclable or contaminated plastic waste. Malaysia is leading the importing countries in this aspect and is subjecting incoming shipments to a series of stringent new requirements. These include an import levy of about USD\$3.60 per metric ton as well as requiring the importers to deposit a bond that will be used to fund against violation of import regulations and to cover the cost of shipment repatriation³¹. There is a further need to promote private-sector investment in appropriate infrastructure that allows for environmentally safe recycling outcomes.
- b) Investment in local government capacity-building and role clarity It is recommended that local governments, enforcement agencies and municipalities are supported in implementing the latest restrictions being imposed by importing countries to prevent environmental pollution.
- c) This support can be in the form of **training for personnel**, greater number of staff and sometimes increased power to implement and enforce the regulations.
- d) Due to the speed at which the new legislation is being introduced, it leads to a lack of clarity around who is responsible for implementing different aspects of legislation. Passing of new legislation should be **supported by training** in all aspects of implementation of this legislation. The exporting countries can offer this support through technical assistance programs.
- e) International systems to ensure appropriate end-of-life disposal If there is domestic demand for recycled product in the exporting countries (which should increase if recycled-material targets are further introduced), there will be international demand in importing countries for recycled plastic resin, therefore providing impetus for continuing trade to importing countries. There should be a systematic reform to ensure there is a process for plastic waste exporters to seek prior informed consent from countries receiving their exported waste. The licensing system should provide the required funds to the importing countries to enforce appropriate environmental safeguards and support enforcement.
- f) **Multilateral agreements and data collection** Beyond Basel, governments should take collective action through and binding international agreements to address the production,

³¹ Staub, C. (2018). Malaysia outlines new plastic import criteria. [Online]Plastics Recycling Update: A Resource Recycling, Inc. publication. Available at: https://resource-recycling.com/plastics/2018/10/31/malaysia-outlines-new-plastic-import-criteria/

export, recycling and disposal of plastic. Measures in exporting countries, including a phase-out of problematic single-use plastic products and packaging, reduction in the use of multi-layer plastics and difficult-to-recycle plastics, have also been proposed. Now that plastics have been added to the Basel Convention, the importing countries will need support from national governments, industry and civil society for implementation of these measures. The first step is the ratification of the Basel Convention by all exporting and importing countries. This should be followed by the development of an international data-capture system that allows for the flows of plastic waste to be mapped and the appropriate economic burden of recycling to be apportioned to the generators of plastic waste. Under recent amendments mixed plastic bales (if they pass certain criteria and with certain exceptions) are exempt from hazardous waste requirements under Basel. Currently, the data reported through the HS code system for recyclable waste plastic is ad hoc and often under reported. A data capture system that allows for the collection of all hazardous vs non-hazardous waste data for imports and exports followed by disposal information would help record the pathway of disposal of waste plastic under current conditions.

Technology

a) Reduction in contamination – Sorting technology in exporting countries needs to be improved to reduce contamination that requires management by importing countries. In addition, a number of recommendations have been made in the previous section to promote reduction in contamination, as well as promoting domestic recycling in exporting countries. This includes design solutions, EPR and various regulatory and economic responses.

6. Mapping challenges with interventions

Exporting countries

The tables below summarise the economic, technological, environmental and regulatory challenges and multisectoral interventions affecting all exporting countries and geographically challenged developing recycling economies.

Table 5 Environmental challenges and multisectoral interventions for exporting countries

(M = Mature recycling economies; G = Geographically constrained recycling economies; D = Developing recycling economies)

Issue	Capacity gaps and needs	Interventions	М	G	D			
Environmental	Environmental							
Presence of hazardous chemicals in some plastics	Hazardous additives used in primary plastics can make their way into recycled plastics where they may pose a health risk, particularly where they are present in products used for sensitive applications such as toys and food packaging	Ban or reduce hazardous additives from primary plastics and develop alternatives Develop technologies for identifying or tracking hazardous additives so that they can be eliminated from recycled plastics	X	X	X			
Competition between technologies	There is a risk that, in specific contexts, energy-from- waste will compete for access to waste plastics as a feedstock	Incentivise recycling over energy-from-waste by introducing a tax to reflect the relative environmental burden/benefit of energy-from-waste and recycling (and landfill) Regulate inclusion of recyclable plastics in energy-from-waste projects	X	X	X			
Environmental standards	Weak environmental standards lead to the flow of plastics to infrastructure solutions where management costs are the lowest	Ensure environmental standards exist that prevent the dumping, burning or landfilling of recyclable materials Provide financial and technical support in the development and implementation of these standards		X	Х			
Compliance with existing standards	Lack of human resources for enforcement and compliance with environmental standards leading to uncontrolled dumping and burning of waste	Provide financial and human resources and training in the enforcement and implementation of environmental standards		Х	X			

Table 6 Economic challenges and multisectoral interventions for exporting countries

 $M = Mature \ recycling \ economies; \ G = Geographically \ constrained \ recycling \ economies; \ D = Developing \ recycling \ economies$

Issue	Capacity gaps and needs	Interventions	М	G	D		
Economic	Economic						
Volatile markets	Limited resilience of the sector to market shocks as the global market for plastics waste has been	Support development of domestic reprocessing capacity to reduce reliance on global markets	Х		Х		
	concentrated in a small number of countries	Develop and share market information to allow expansion into new markets. A more globalised market will reduce reliance on a limited number of importing countries.	Х				
	Lack of differentiated demand for recycled plastics, so recycled resins compete with virgin plastics	Create demand for recycled plastic by promoting the use of recycled content in plastic products by:	X	X	X		
		Regulating the use of minimum recycled content in packaging					
		Introducing tax incentives to encourage use of recycled plastics					
		Providing information and training to designers and manufacturers to encourage use of recycled content					
		Providing information to consumers to encourage purchase of products using recycled content and drive demand					
Supply constraints	Costs of collection and sorting are high	Support development of most cost-effective, fit-for-purpose technologies for sorting waste plastics. These could be high-tech in mature economies and low-tech, labour-intensive processes in developing economies		X	Х		
	Fragmented collection and sorting of materials leads to limitations on economies of scale	Drive supply of recycled material to increase economies of scale and reduce costs. For example: Brokerage exchange in Scotland ³²					
	Collection systems in developing economies are not available for substantial amounts of population due to low revenue base and no or limited incentives for collection of recyclables	Expand collections through the introduction of user pays systems and introduction of targets through policies and strategies		X	X		
Resources for collection, sorting and	High costs of collecting, sorting and processing waste plastics	Invest in collection infrastructure to reduce operating costs (e.g. collection vehicles, shredders and balers to reduce recycling transport costs)		Х	Х		
processing		Introduce user-pays systems for collection and disposal of waste					
	Ongoing finances are not available for sorting and processing systems	Develop alternative technologies that enable recyclers to process poor-quality material (e.g. low-value and contaminated materials)	Х	X	Х		

³² Zero Waste Scotland Limited, (2020) Scottish Materials Brokerage Service. [online] Zero Waste Scotland. Available at: https://www.zerowastescotland.org.uk/brokerage

Table 7 Technological challenges and multisectoral interventions for exporting countries

M = Mature recycling economies; *G* = Geographically constrained recycling economies; *D* = Developing recycling economies

Issue	Capacity gaps and needs	Interventions	М	G	D
Technology					
Wide variety of polymers and additives	Multi-layer plastics and problematic additives mean further separation and sorting is required	Reduce the prevalence of additives in primary plastics through bans on their use and increased taxation on harmful additives	Х		
		Invest in research and development of alternatives to additives and develop technologies for identifying biodegradable and other types of plastics			
	More recently, biopolymers are mixed in with other plastics	Invest in research and development of technology that can identify the existing additives and possibly remove them during the reprocessing phase.			
		Enhance supply-chain awareness of problematic additives so that the impact on markets for recycled plastics is understood			
Contamination in post-consumer waste plastics	Collection systems lack exporting separation in most exporting countries	Support regulatory reform that allows for exporting separated collection of plastics — deposit legislation and EPR		X	X
Practical		Support technology innovation for sorting plastics and removing contamination or handling of contaminated plastics			
challenges of collecting and sorting waste to a high level of	waste to a vel of waste	A country-level restriction on the import of packaging material that is difficult to segregate and recycle would help domestic systems generate clean material streams that will attract higher prices in the recyclables market	X	X	X
cleanliness		Encourage manufacturers to choose to use polymers that are already in widespread use on the market and for which there are pre-established collection, recovery and recycling systems			
		Standardise recycling collection schemes to create economies of scale and improve recyclate quality			
	Lack of availability of infrastructure for sorting and processing	Support investment in collection systems (typically by government) and processing infrastructure (typically by the private sector) to ensure all recyclable material can be collected and either recovered for recycling or disposed of appropriately in sanitary landfills		Х	Х
Limited availability of technology for mixed plastics. A large amount of plastics are still hand-sorted and end up in landfills. Develop advanced sorting technology for better sorting of plastics. Support interventions to reduce contamination leading to clean downstreasing.		Support interventions to reduce contamination leading to clean downstream	Х		

Table 8 Regulatory challenges and multisectoral interventions for exporting countries

M = Mature recycling economies; *G* = Geographically constrained recycling economies; *D* = Developing recycling economies

Issue	Capacity gaps and needs	Interventions	М	G	D		
Regulatory	Regulatory						
Existing regulation that supports certain technologies	Lack of regulation that supports separation Lack of regulation that supports simpler materials to be used for packaging	Implement regulation, such as deposit legislation, which supports source separation is universally adopted Ensure regulation promotes the use of packaging that can be recycled through existing systems	X	X	X		
Lack of regulation/ enforcement that prevents illegal trade of plastics and promotes an international reporting regime for recycled plastics	Poor data on the plastics recycling sector and a lack of consistency in reporting of international trade and market survey data on recycled plastics Currently no international governance and reporting framework exists on trade of plastics Ratification of MEAs	Introduce international mandatory data-reporting mechanisms for recycled post-consumer plastics Ensure all exporting countries are signatories to MEAs that regulate waste trade	х	X	X		
Lack of regulation that supports collection, sorting and disposal	Lack of stringent targets and strategies for collection, sorting and recycling	Development of strategies and policies that mandate minimum requirements of collection and resource recovery.		Х	Х		
	Lack of regulation that prevents end-of-life disposal of plastics into landfills	Impose taxes or levies on recyclables going to landfill					

Mapping gaps and interventions – Importing countries

To manage post-consumer plastics predominately through recycling, countries need strong and reliable processes to collect, sort, and trade plastics. Currently these processes face several challenges that are detailed in this section.

Table 9 below summarises the economic, technological, environmental and regulatory challenges and possible interventions for importing countries in stimulating recycling of post-consumer plastics.

Table 9 Economic, technological, environmental and regulatory challenges and possible interventions for importing countries

Туре	Issue	Capacity gaps and needs	Multisectoral interventions
Importing	countries		
Economic	Volatile markets	Unstable market conditions with ebb and flow of materials leading to confusion in the ability of countries to impose strict standards for import of plastics	Support local governments, national enforcement agencies and municipalities in implementing the latest restrictions being imposed by importing countries to prevent environmental pollution
Econ	Sustainable financing of end- of-life disposal	Lack of sustainable financing models that promote collection, recycling and end-of-life disposal of all waste, including imported recyclable plastics	Introduce a levy and licensing system where the levy/licence fees provide the required funds to the importing countries to enforce appropriate environmental safeguards and standards
	Wide variety of polymers and additives	Multi-layer plastics and problematic additives mean further separation and sorting is required	Innovative packaging design and elimination of unrecyclable plastics, such as multi-layer laminates, to streamline recycling
) do	Contamination in imported plastics	More recently, biopolymers are mixed in with other plastics Post-sorting, plastics that don't have an economic value end up in uncontrolled dumpsites and furnaces as fuel	Use product stewardship schemes to ensure manufacturers take back unrecyclable packaging to aggregate them and develop new products
Technology	Old machinery A large proportion of reprocessors in Southeast Asia use old machinery or sort by hand, which is inefficient, energy intensive, unsafe for workers and lacks wastewater treatment		Exporting countries should avoid exporting mixed plastics to countries that cannot effectively recycle them. Trade should be limited to single streams, e.g. PET, HDPE or PP.
			Support interventions in exporting countries to reduce contamination leading to clean downstream processing.

	Low environmental	Hazardous additives used in primary plastics can make	Support increased power to implement and enforce the regulations
Environmental	standards	their way into recycled plastics where they may pose a health risk, particularly where they are present in products used for sensitive applications such as toys and food packaging	Passing of new legislation should be supported by training and assistance in all aspects of implementation of the legislation
	Compliance and enforcement	Inability of local law enforcement to implement measures to prevent inappropriate disposal of contaminated plastic to land and water	Exporting countries can introduce export quality regulations and take responsibility to check shipments at customs and ensure that only clean, uncontaminated or single-stream bales are being shipped overseas
	Institutional disconnect and lack of clarity of roles	Different levels of governments have differing drivers for waste management enforcement, leading to confusion around roles for implementation and resulting economic burden	Support for local governments, enforcement agencies and municipalities in the form of training for personnel, greater number of staff
Regulatory	Lack of regulation around environmental safeguards	Many jurisdictions lack regulation that safeguards the health of the environment and the people engaged in waste segregation and recycling	All importing countries to sign on to the Basel Convention, for example, Turkey.
	Lack of regulation/enforcement that prevents illegal trade of plastics	Poor data on the plastics-recycling sector and a lack of consistency in reporting of international trade and market survey data on recycled plastics	Introduce international mandatory data-reporting mechanisms for recycled, post-consumer plastics Beyond Basel, governments should take collective action through binding
		Currently no international governance and reporting framework exists on trade of plastics	international agreements to address the production, export, recycling and disposal of plastics

7. Potential for Environmentally Responsible Trade (ERT) to address recycling challenges and needs

Based on the principles of environmentally responsible trade (ERT) discussed in Report 1, the table below links the proposed ERT practices and their links to the challenges discussed in the preceding sections as well as the interventions proposed. The table also links the ERT practices, challenges and interventions to the exporting and importing countries.

Table 10 ERT practices to address challenges and needs in both exporting and importing countries

ERT practices	Interventions	Capacity gaps and needs (for reference)	Exporting countries	Importing countries
Improve sorting in export countries to significantly decrease or eliminate unrecyclable plastics from traded bales	Regulatory reform to help standardise MRF performance Improve collection and sorting and reduce contamination Develop recyclable product targets and implement resource-recovery targets Harmonise contamination targets Implement measures to simplify packaging and support regulation that prohibits entry of difficult-to-recycle packaging into the country Raise public awareness to create demand for plastics recycling, reduce contamination, and to reduce littering and dumping Export bans to countries or facilities that don't meet standards for sorting and processing	Lack of regulation that promotes source separation in exporting countries leads to contamination in plastic and other waste streams High level of contamination in the collected waste means advanced technology is required to segregate recyclable plastics from waste There is limited technology available for recycling of mixed plastics. A large amount of plastics are still hand-sorted and end up in landfills	X	
2. Trading of uncontaminated, presorted, recyclable plastics that do not contain any non-recyclable material and have been prepared for	Investment in technology for better sorting and management in exporting countries Implement extended producer responsibility programs to collect cleaner streams such a through a container deposit	Multi-layer plastics and problematic additives mean further separation and sorting is required More recently, biopolymers are mixed in with other plastics	X	Х

immediate recycling (Basel Convention conditions)	scheme, or to manage unrecyclable packaging and find innovative solutions Eliminate low-value and difficult-to-recycle plastics from the market, including by introducing packaging standards that reduce the number of packaging types to minimise residuals Trade only in processed recycled resin	Packaging product design that includes a number of complex plastics that cannot be easily separated Significant difficulty sorting plastics and reprocessing them without causing pollution	
3. Implementing environmental controls in import countries, including import licences, inspection of imports and facilities, quality standards for bales and/or deposits or levies to ensure the management of bales that don't meet standards	Use of import licences Introduce quality standards for bales and deposits to ensure correct management Ensure traceability and accountability of traded plastic waste Regulations should provide the required funds to the importing countries to enforce appropriate environmental safeguards	Lax standards on imports/flouting of rules Many jurisdictions lack regulation that safeguards the health of the environment and the people engaged in waste segregation and recycling Where regulation exists, lack of human and financial resources for implementation and compliance	X
4. Ensuring the importing country has adequate processing facilities to process plastic waste in an environmentally responsible way	Exporting countries should avoid exporting mixed plastics to countries that cannot effectively recycle them. Trade should be limited to single streams, e.g. PET, HDPE or PP Use product stewardship schemes to ensure manufacturers take back unrecyclable packaging to aggregate them and develop new products Systematic reform process for plastic waste exporters to seek prior informed consent from countries receiving their exported waste Global accreditation of environmentally responsible recycling facilities	Plastics that don't have an economic value end up in uncontrolled dumpsites and furnaces as fuel A large proportion of reprocessors in Southeast Asia use old machinery, which is inefficient, energy intensive, unsafe for workers and lacks wastewater treatment There is limited technology available for sorting of mixed plastics. A large amount of plastics are still hand-sorted in unsafe conditions.	X

5. Checking that the importing country has the institutional capacity to monitor and enforce environmental regulations	environmental monitoring and enforcement enforcement of environmental control entertaint			X
6. Checking shipments and contamination levels at point of export and import and ensure accurate labelling of bales	Implement export quality regulations and take responsibility to check shipments at customs and ensure that only clean, accurately labelled, uncontaminated or single-stream bales are being shipped overseas	ms and ensure countries taminated or		Х
7. Increasing transparency of traded volumes, enabling traceability and accountability for both export and import countries	Ansparency of traded blumes, enabling acceability and accountability for both apport and import Nations and binding international agreements to address the production, export, recycling, and disposal of plastic Poor data on the plastics-recycling sector and a lactor consistency in reporting of international trade and consistency in reporting of international agreements to address the production, export, recycling, and disposal of plastic		X	X
8. Improve national and regional oversight to minimise shifting of waste over borders	All exporting and importing countries to sign on to the Basel Convention and other MEAs that regulate waste trade Regional policies to manage trade impacts and encourage the importing country's waste management to improve. Exporting countries can coordinate exports and set export standards	Not all exporting or importing countries signatories to the Basel Convention, for example Fiji, Solomon Islands and Tuvalu. Currently no international governance and reporting framework exists on trade of plastics Lack of plastic waste import/export data and standards	X	Х

Conclusions

This report aims to provide a better understanding of the existing challenges embedded within the current recycling ecosystem in the Asia–Pacific region. It identifies potential interventions to enhance and stabilise recycling markets to provide improved recycling outcomes. The interventions proposed suggest holistic improvements across the waste management and recycling sector. While not always directly affecting trade, the interventions proposed will improve recycling outcomes and reduce leakage of plastics across the entire waste management supply chain.

Falling plastics manufacturing costs have accelerated the production of virgin plastics. However, the market price of virgin plastic today does not represent its full lifecycle costs to nature and society. The current recycling systems do not distribute the economic cost of managing post-consumer plastics upstream to producers and users. Insufficient incentives exist to ensure plastic waste is managed properly, let alone recaptured for recycling or reuse. Plastics leakage from mismanaged waste is a direct result of underdeveloped waste management infrastructure and a major challenge in low and middle-income countries, leading to low collection rates and high rates of open dumping and uncontrolled landfilling. These negative externalities of plastics are tied to a fragile global waste trade and a system that is struggling to adapt to national trade policy reforms in the region.

The principles of Environmentally Responsible Trade (ERT) through a systems approach can be adopted to address the leakage of plastics by deploying strategic interventions across the plastics lifecycle. For example, including the promotion of ERT through enabling productive recycling, use of waste materials and avoiding trade where not necessary. Interventions to improve the management and recycling of post-consumer plastics require the reinforcement of existing initiatives, such as banning problematic single-use plastics and upgrading national waste management plans.

We recommend consideration of various interventions from the following waste management initiatives to reduce plastic leakage and enable recycling in the Asia-Pacific region:

Design and avoidance

- Eliminate problematic plastics (e.g. multi-layer) and reduce complexity and variety of plastics through product standards
- Design readily recyclable plastics
- Promote waste-prevention strategies, such as the introduction of reusable packaging

Collection

- Improve or introduce collection systems, preferably source separated, to increase the volume of recovered plastics
- Introduce product stewardship/EPR to enable take back of unrecyclable plastics to facilitate development of new recycled products or provision of alternatives
- Introduce or expand container deposit schemes (CDS) to provide financial incentives for recovery and enable cleaner recycling streams

Sorting and processing

- Invest in improved sorting systems to minimise contaminants, particularly from exporting countries
- Invest in domestic reprocessing facilities to minimise exports
- Introduce standards or targets for recycled content in plastics to stimulate demand for recycled resins
- Develop technologies that enable processing of poor quality and unrecyclable plastics to make innovative products

Trade

- Ensure importing and exporting countries are signatories to Multi-lateral Environmental Agreements
- Limit trade to uncontaminated, pre-sorted, recyclable plastics e.g. PET, HDPE and PP
- Fund capacity building to support environmental monitoring and enforcement in importing countries

· Consider a levy and licensing system to fund and enable environmental safeguards

Globally, accountability mechanisms featuring multilateral agreements which outline clear, on-the-ground plans, robust domestic laws, and commercial devices to tackle underlying issues would help distribute the responsibility of plastic waste management appropriately across the plastic life cycle; preventing the transfer of the burden of recycling from exporting to importing countries through trade. Finally, measures should be put in place to ensure the global price of plastic reflects the full lifecycle cost to nature and society, preventing social or environmental harm at the destination and supporting the final principle of ERT.

Governments, industries, and members of the public need to work together for a regional and global approach to addressing the plastics crisis.

8. Case study criteria

The case study criteria matrix listed below reflects a diverse range of challenges that illustrate the needs, challenges and opportunities for trade in and leakage of recycled plastics. Table 11 below outlines the case study criteria matrix and suggests countries that represent the three types of recycling economies to be considered for the development of the full case study.

Table 11 Case study criteria matrix

Туре	Summary of challenges	Mature recycling economies (Source)	Geographically constrained and developing recycling economies (Source)	Developing recycling economies (Destination)
Economic	Cost-effective collection of recyclable plastic	Exists but expensive	Needed	Needed
	Maximising the volume, usability and value of plastic waste collected	Exists to some extent	Needed	Needed
	Stable markets for recyclable products	Needed	Needed	Needed
Technology	Fit-for-purpose solutions in place for the effective collection, processing and recycling of post-consumer plastics	Exist	Needed	Needed
	Solutions that improve source separation and reduce cost of transport and labour	High tech	Low tech	Mix of low and high tech
Environmental	Resources for better disposal facilities, such as sanitary landfills	Exist	Needed	Needed
	Resources for implementing, monitoring and enforcing improved environmental standards	Exist	Needed	Needed
	Resources for universal collection and sorting	Exist	Needed	Needed
Regulatory	Policies driving improved/universal collection	Exist	Needed	Needed
	Policies driving domestic reprocessing	Needed	Partially needed	Need improvement
	EPR programs	Partially exist	Partially exist	Partially exist
	Policies driving low contamination in post- consumer plastics	Partially exist	Needed	Needed
	Signing up to multilateral environmental agreements	Some have signed up	Some have signed up	Most have signed up
Suggested country		Japan	Palau	Indonesia, Malaysia or Vietnam

Case study 1: Exporting country with a mature recycling economy

Suggested country: Japan

As per Table 11, the case study will focus on the regulatory, technological and environmental factors that make Japan one of the leaders in producing clean polymer streams with low contamination that attract a good price in the post-consumer recycled plastics market. The existence of EPR programs and a high degree of compliance measures put in place by government will also be discussed. Japan is an example of a country with a progressive policy regime in place with a high degree of compliance within the private sector

and the community, allowing it to be more resilient to volatility in the recycled plastics market and therefore little or no leakage is reported to the environment.

Case study 2: Exporting country/ies, geographically constrained with a developing recycling economy

Suggested country/region: Pacific region, highlighting specific examples such as Palau, Samoa, Vanuatu and Solomon Islands.

This case study will focus on the Pacific Island Countries (PICs), many of which share similar challenges for collection, sorting and lack of resources which will be highlighted using a range of countries as examples. The case study will then examine the situation in the PICs which are implementing various systems and trade practices to improve waste management practices and comply with international standards for environmentally responsible trade in recyclable materials. Palau, for example, has put in place a CDS program and is working with the private sector to ensure they can export the material that is collected. Samoa is considering a waste deposit levy to improve and incentivise return of materials at end of life. Vanuatu has a number of impressive initiatives in place. Solomon Islands has long term corporate knowledge about waste issues with a number of challenges that are resonated in the remaining countries as well.

Case study 3: Destination country, with a developing recycling economy

Suggested country: Vietnam

This case study will focus on an Asian destination country that faces the twin challenges of being a developing recycling economy domestically as well as importing a large quantity of post-consumer recycled plastics. The case study will include examples on trade exacerbating leakage as the country has a poor collection and recycling sector that depends on the informal sector, faces smuggling and false labelling of plastic imports and has a lack of resources for monitoring and enforcement. Vietnam does not plan to fully ban plastic waste imports.