



Environmentally responsible trade in waste plastics

Report 1: Investigating the links between trade and marine plastic pollution

Prepared for the Department of Agriculture, Water and the Environment
by UTS Institute for Sustainable Futures

Report 1 of 3

June 2020



Report 1 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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Citation

Dominish, E., Retamal, M., Wakefield-Rann, R., Florin, N., 2020, Environmentally responsible trade in waste plastics Report 1: Investigating the links between trade and marine plastic pollution, Prepared for the Department of Agriculture, Water and the Environment, June 2020

Acknowledgments

The authors would like to thank our interviewees for their time and valuable insights: the Indian Pollution Control Association (IPCA World), Ecoton, Economic Research Institute for ASEAN and East Asia, Sahabat Alam (Friends of the Earth) Malaysia, Vietnam Cleaner Production Centre, GreenHub: Centre for Supporting Green Development, Circular Economy Waste-Free Thailand (CEWT) at Mae Fah Luang University, two Australian MRFs and three independent consultants from Indonesia, Malaysia and Vietnam.

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Glossary

| | |
|--------------|--|
| ABS | Acrylonitrile butadiene styrene |
| APWC | Asia Pacific Waste Consultants |
| AP | Approved Permit [Malaysia] |
| CEFAS | Centre for Environment, Fisheries and Aquaculture Science, United Kingdom government Department for Environment, Food and Rural Affairs |
| CCOA | Commonwealth Clean Oceans Alliance |
| CDS | Container deposit schemes |
| CIE | The Centre for International Economics |
| CLiP | Commonwealth Marine Litter Project |
| ERT | Environmentally Responsible Trade |
| ESM | Environmentally Sound Management [Basel Convention] |
| EU | European Union |
| GAIA | Global Alliance for Incinerator Alternatives |
| HDPE | High-density polyethylene |
| IPEN | International POPs Elimination Network |
| ISF | Institute for Sustainable Futures |
| IUCN | International Union for Conservation of Nature |
| LDPE | Low-density polyethylene |
| MLP | Multi-layer plastics |
| MRF | Material Recycling Facilities |
| OECD | Organisation for Economic Co-operation and Development |
| PC | Polycarbonates |
| PCBs | Polychlorinated biphenyls |
| PET | Polyethylene terephthalate |
| PIC | Prior Informed Consent [Basel Convention] |
| POPs | Persistent organic pollutants |
| PP | Polypropylene |
| PS | Polystyrene |
| PVC | Poly vinyl chloride |
| UNEP | United Nations Environment Programme |
| UK | United Kingdom |
| USA | United States of America |
| VOCs | Volatile organic compounds |

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1. Introduction

Project background

Pollution from plastic waste is a global environmental problem, with an estimated 100 million tonnes of plastic now found in the oceans, 80% of which comes from land-based sources. When plastic leaks into the oceans, it can take hundreds of years to break down, harming fragile marine ecosystems.

In 2016, more than half of the world's plastic waste collected for recycling was traded internationally. The Asia Pacific region is the centre of this trade, as since the mid-1990's China has imported almost half of the world's traded plastic waste for recycling into new plastic products.¹ Following China's strict conditions on imports which began 1 January 2018, patterns of global plastic waste trade have shifted towards countries in Southeast Asia, however the majority of new importing countries have also begun restricting imports following concerns of improper waste management. With the addition of some types of plastic to the United Nations Basel Convention announced in early 2019, the patterns of trade in recycled plastics will continue to change.² Exporting and importing countries are now investigating how to improve their domestic management of plastics, and how trade can be undertaken in an environmentally responsible way.

At the same time, many countries in Asia are struggling to manage their domestic plastic waste alongside the additional volumes of plastic imports.

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 the project *Environmentally Responsible Trade in Waste Plastics*. The objective of this project is to understand:

- whether and how environmentally responsible trade in recycled plastics might reduce leakage of plastic into the ocean, without merely shifting the plastic waste burden from one country to another
- what the opportunities are to ensure that trade in recycled plastics in the Asia-Pacific region is environmentally responsible.

Report overview

This report is the first in a series of three reports as part of the *Environmentally Responsible Trade in Waste Plastics* project. This report seeks to investigate the links between the plastics waste trade and marine plastic pollution. Report 2 analyses capacity gaps and needs to manage plastics within the Asia-Pacific region and identifies key interventions, and the links to environmentally responsible trade. Report 3 presents three in-depth case studies on countries/regions that are illustrative of the challenges and opportunities for environmentally responsible trade of waste plastics in the region.

The first half of this report presents an overview of the current situation regarding trade and recycled plastics in the Asia Pacific region. Chapter 2 provides an overview of the plastic waste industry; Chapter 3 presents an analysis of the trade in waste plastics in the Asia Pacific region, and Chapter 4 provides an overview of the links between plastic leakage and marine plastic pollution. Chapter 5 then investigates the links between trade and leakage, based on a series of interviews with 12 experts on trade, waste management and plastic pollution in the region. Chapter 6 provides examples of the challenges and success factors that lead to trade either exacerbating or reducing leakage. Chapter 7 then presents the principles and practices of environmentally responsible trade in plastic waste developed through this project.

¹ Brooks A.L., Wang S. and Jambeck J.R., (2018) The Chinese import ban and its impact on global plastic waste trade. *Science advances*, 4(6)

² Basel Convention, n.d. *Plastic Waste Overview*. [online] Available at: <http://www.basel.int/Implementation/Plasticwastes/Overview/tabid/6068/Default.aspx> [Accessed 14 Apr. 2020].

2. Overview of the waste plastics industry

The global plastic market is a vast industry with revenue greater than US \$500 billion (2019 data). This market is driven by demand for diverse plastic products such as packaged food and beverages, building materials and plastic products used for automotive manufacturing. Plastic containers and packaging products are the largest market segment.³

This study is focused on 'waste plastics' that are traded globally as part of the global plastics market, with an estimated revenue of US \$35 billion (2017 data).⁴ For the purposes of this study, waste plastics refers specifically to 'post-consumer' waste plastics, defined as plastic products that have been used by households, or by commercial, industrial or institutional consumers that can no longer be used for their intended purpose. This includes returns of material from the distribution chain, but excludes pre-consumer material such as production scrap.⁵

'Waste plastics' refers to plastics that have been collected, sorted and baled for recycling, before they are processed. Plastic is typically baled to be sold as a single plastic or resin type ('single-stream') or a mix of plastic types ('mixed plastics'). 'Recycled plastics' refers to waste plastics that have been sorted and processed to a single resin type, either flaked or pelletised, that can be sold by the reprocessor for use in new manufacturing.

Prior to the COVID-19 crisis, strong growth in demand was expected for recycled plastics, driven by demand for plastic products, particularly packaging, environmental concerns and campaigns that encourage the use of recycled content in manufacturing.⁶ Expanding plastic recyclability and the use of recycled plastics by the packaging industry is also a key focus of government and industry initiatives and a large driver for new demand, such as the Ellen Macarthur Foundation's New Plastics Economy and the Global Plastic Pact.⁷

At the same time, some policy trends and new initiatives are anticipated to impact the growth of the plastics industry, for example, various governments have banned plastic bags and other single-use products. Some initiatives focus on specific resins which are difficult to recycle, such as poly vinyl chloride (PVC), polystyrene (PS) and multi-layer plastics (MLP).

Post-consumer recycled plastic market

The post-consumer recycled plastics market is dominated by two resin types, polyethylene terephthalate (PET) with 55% of the market and high-density polyethylene (HDPE) with 33%. These plastics are both commonly used, particularly for packaging, and easier to recycle than other plastic types and have a higher value than other plastic types. Polypropylene (PP) and low-density polyethylene (LDPE) also have a significant share of the market, both approximately 4% (see Figure 1).

³ Gonzales, E., (2019). *Global Plastic Product & Packaging Manufacturing*, IBIS World, Industry Report C1951-GL

⁴ Locock, K.E.S., (2017). *The Recycled Plastics Market: Global Analysis and Trends*. CSIRO

⁵ International Standards Organisation, 2016, Environmental Standard, ISO 14021:2016(en), Available at: <https://www.iso.org/obp/ui/#iso:std:iso:14021:ed-2:v1:en> [Accessed 14 Apr. 2020]

⁶ Locock, K.E.S., (2017). *The Recycled Plastics Market: Global Analysis and Trends*. CSIRO

⁷ Ellen Macarthur Foundation, (2020). *Plastics Pact*. [online] Available at: <https://www.newplasticseconomy.org/projects/plastics-pact> [Accessed 14 Apr. 2020]

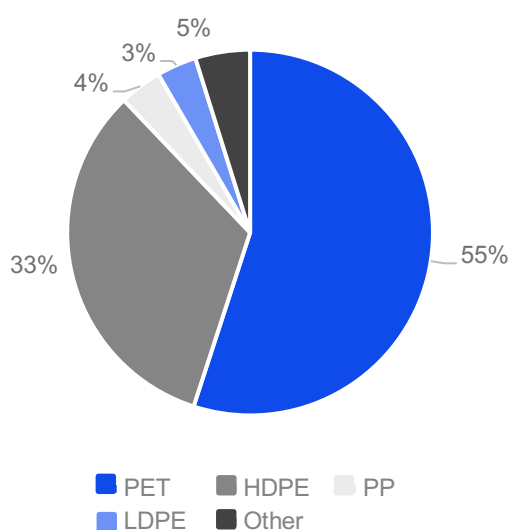


Figure 1. Global plastic recycled market by resin type in 2017⁸

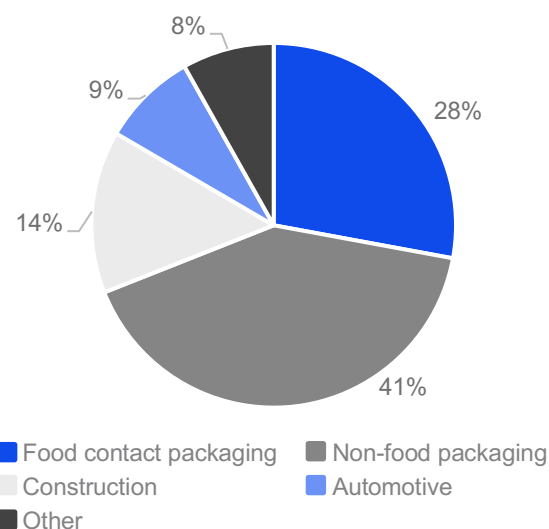


Figure 2. Global end-user shares of post-consumer plastic market in 2017⁹

PET (resin code #1) and HDPE (resin code #2) are usually sorted and separated at material recovery facilities (MRFs) to be sold as single-stream bales. Mixed plastic bales vary across countries and facilities, but are typically either a mix of the 7 resin codes (#1-7 bales), or the remaining plastics once PET (#1) and HDPE (#2) have been sorted out (#3-7 bales). Over the last 5 years, MRFs have shifted towards producing #3-7 bales, and some have begun segregating out other plastics, in particular PP (#5) as it is the next most valuable after PET and HDPE. While less commonly traded as single stream plastics, there are also some markets for other single-stream plastics such as LDPE or PS if they are sorted to a clean stream.¹⁰

Before the global disruption of plastic markets following China's restrictions on imports in January 2018, the export markets for clean baled PET and HDPE were typically steady, fetching around AUD \$500-\$600/tonne and more than AUD \$600/tonne, respectively.¹¹ Since then, prices have fluctuated and fallen significantly, with prices for PET around \$300/tonne as of May 2020.¹² The market price for mixed plastics is currently \$0/tonne or less, and in many cases cannot be sold.¹³

The price of plastics is a key factor influencing a manufacturer's decision to use virgin or recycled plastic. The low price of oil, exacerbated by the COVID-19 crisis, and an increase in virgin plastic manufacturing capacity, has led to virgin resin reaching their lowest prices in many years (as of May 2020). It is anticipated this may reduce the demand for recycled plastics in the near-term.¹⁴

The post-consumer recycled plastics market can be classified into three major end-markets: packaging, construction and automotive, as shown in Figure 2. Packaging, including food-contact and non-food packaging, accounts for about 70% of the post-consumer market. Other users of recycled plastic resin

⁸ Locock, K.E.S., (2017). The Recycled Plastics Market: Global Analysis and Trends. CSIRO

⁹ Locock, K.E.S., (2017). The Recycled Plastics Market: Global Analysis and Trends. CSIRO

¹⁰ Toto, D., Mixed messages. Recycling Today, 7 June 2018. Available online at: <https://www.recyclingtoday.com/article/3-7-plastics-markets-spring-2018/>

¹¹ WMRR and Sustainability Victoria, (2019) Recovered Resources Market Bulletin (March 2019). Report prepared for the Waste Management and Resource Recovery Association of Australia (WMRR) and Sustainability Victoria (SV) by Envisage Works, IndustryEdge and Sustainable Resource Use (SRU) Available at: <https://www.sustainability.vic.gov.au/Business/Investment-facilitation/Recovered-resources-market-bulletin> [Accessed 19 May 2020]

¹² WMRR and Sustainability Victoria, (2020) Recovered Resources Market Bulletin (March – May 2020). Report prepared for the Waste Management and Resource Recovery Association of Australia (WMRR) and Sustainability Victoria (SV) by Envisage Works, IndustryEdge and Sustainable Resource Use (SRU) Available at: <https://www.sustainability.vic.gov.au/Business/Investment-facilitation/Recovered-resources-market-bulletin> [Accessed 19 May 2020]

¹³ Ibid

¹⁴ Ibid

include textiles, industrial and agricultural applications and consumer goods. These overall end markets are broadly similar to the market for virgin plastic; however, the specific application usually varies between virgin and recycled resin of the same plastic type. Table 1 provides a summary of the major plastic resin types, examples of applications using virgin and recycled resin, and level of collection and recyclability.

Global recycling rates of plastic remain low. An OECD report in 2018 estimated that current global recycling rates for plastics are between 14 – 18%.¹⁵ For plastic packaging, it is estimated that only 14% is collected for recycling and only 5% of the material is recovered after additional losses from sorting and reprocessing.¹⁶

There are a wide range of strategies to recover waste plastics to create continued material and economic benefit, according to four major recovery pathways: reuse, recycling, downcycling, and energy recovery. Material recovery can offset the demand for virgin materials; divert materials from landfill and potentially reduce plastic pollution. These are detailed in Appendix A.

¹⁵ OECD (2018) 'Improving Plastics Management: Trends, policy responses, and the role of international cooperation and trade', OECD Environment Policy Paper No. 12. [online] Available at: <https://www.oecd.org/environment/waste/policyhighlights-improving-plastics-management.pdf> [Accessed 21 May 2020].

¹⁶ De Smet, M. (2016). *The New Plastics Economy—Rethinking the Future of Plastics & Catalysing Action*. Cowes, Isle of Wight, UK: Ellen MacArthur Foundation. [Online] Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/NPEC-Hybrid_English_22-11-17_Digital.pdf [Accessed 21 May 2020].

Table 1. Major plastics resins, properties, applications and examples of products made with recycled content and level of collection and technical recyclability

| Resin Code | Name | Applications using virgin plastic ¹⁷ | Applications using recycled plastic ¹⁸ | Technical recyclability ¹⁹ | Level of overall collection and recycling ²⁰ |
|------------|---------------------------------------|--|---|---------------------------------------|---|
| 1 | Polyethylene Terephthalate (PET) | Packaging: food and beverage containers Other: textiles, carpet, films | Packaging: containers for food and beverage Other: carpet, textiles, films | Easy | Packaging: high Textiles: low |
| 2 | High density polyethylene (HDPE) | Packaging: containers for milk, juices, personal care products Retail and grocery bags | Packaging: containers for non-food contact , e.g. personal care products, cleaning Other: pipes, tiles, pots | Easy | Packaging: moderate Other: low |
| 3 | Polyvinyl chloride (PVC) | Packaging: rigid bottles, blister packs, clamshells, medical bags, shrink wrap; Other: pipes, cable covering, framing | Other: windows, pipes decking, fencing, gutters, carpet backing, floor tiles, packing, film | Difficult | Packaging: low Other: low |
| 4 | Low density polyethylene (LDPE) | Packaging: bread bags, bags for dry cleaning, garbage bags, shrink wrap, lids Other: moulding, adhesives, sealants | Other: shipping envelopes, bin liners, tiles, panelling | Easy | Packaging: high |
| 5 | Polypropylene (PP) | Packaging: containers for yoghurt, spreads, take-away meals, caps and closures Other: fibres, consumer products | Other: durable applications, e.g. automotive applications, signal lights, battery casings and cables | Easy | Packaging: moderate Other: low |
| 6 | Polystyrene (PS) | Packaging: food service items including clamshells, meat trays protective foam, packing peanuts Other: agricultural products, electronic housings, insulation | Other: thermal insulation, casings, foamed protective packing (Expanded PS) | Difficult | Packaging: low Other: low |
| 7 | Other, including composites/ mixtures | Packaging: Reusable water bottles, other custom packaging | Other: E.g. plastic lumber applications | Difficult | Collection: high Recyclability: very low |

¹⁷ Locock, K.E.S., (2017). The Recycled Plastics Market: Global Analysis and Trends. CSIRO

¹⁸ Ibid

¹⁹ Leal Filho, W., Saari, U., Fedoruk, M., Iital, A., Moora, H., Klöga, M. and Voronova, V., (2019). An overview of the problems posed by plastic products and the role of extended producer responsibility in Europe. *Journal of cleaner production*, 214, pp.550-558.

²⁰ Ibid

3. Plastic waste trade in Asia Pacific

The Asia Pacific region is the centre of the global trade in plastics. China is the world's largest producer and consumer of plastics, followed by North America and Europe.²¹ Historically China was also the largest importer of plastic waste, which was reprocessed to use in the manufacturing of new plastic products.²² Since reporting began in 1988 until 2016, China had imported approximately 45% of all cumulative imports of plastic waste, totalling 106 megatonnes.²³ High income countries, including the United States of America (USA), Japan, United Kingdom (UK), Canada and various European countries have been the major exporters of plastic waste over this period, exporting 87% of all traded waste plastics.²⁴

Driven by the environmental impacts of the recycling industry, China attempted to reduce the import of low value plastic via the "Green Fence" policy in 2015. In January 2018 China took this policy further with the introduction of the "National Sword" policy, which restricted the import of 24 types of waste.

Plastic waste imports became subject to stringent standards for contamination (a rate of 0.5%), compared to previously when plastics were typically traded with higher contamination rates.²⁵ Countries previously reliant on China to buy their plastics, including the European Union (EU), USA, Canada, Japan and Australia, found their recycling systems disrupted as they found it difficult to meet the new standard for contamination rates with their existing collection and sorting systems.²⁶ Exporting countries began stockpiling or landfilling collected recycling, while looking for new end-markets.²⁷

In 2018, trade of waste plastics shifted towards countries in South East Asia.²⁸ Initially countries including Indonesia, Vietnam and Malaysia began increasing their imports, however, these countries soon after began restricting and regulating imports following concerns of high levels of contamination in the imported products and pollution from improper waste management. Since restrictions were imposed in South East Asian countries, Turkey and the USA have increased their imports.

By the end of 2018, global trade in plastic waste had reduced by almost 50% since China's policy came into force, compared to two years earlier.²⁹ With the addition of some types of plastic to the United Nations Basel Convention announced in early 2019, the patterns of trade in recycled plastics will continue to change.³⁰

²¹ United Nations Environment Programme (2018) *Mapping of global plastics value chain and plastics losses to the environment (with a particular focus on marine environment)*. Ryberg, M., Laurent, A., Hauschild, M. United Nations Environment Programme. Nairobi, Kenya

²² European Environment Agency, (2019). *The plastic waste trade in the circular economy*. [online] Available at: <https://www.eea.europa.eu/themes/waste/resource-efficiency/the-plastic-waste-trade-in> [Accessed 14 Apr. 2020].

²³ Brooks, A.L., Wang, S. and Jambeck, J.R., (2018). The Chinese import ban and its impact on global plastic waste trade. *Science advances*, 4(6),

²⁴ Brooks, A.L., Wang, S. and Jambeck, J.R., (2018). The Chinese import ban and its impact on global plastic waste trade. *Science advances*, 4(6),

²⁵ Contamination includes other types of plastics or other wastes, and can end up as a residual that is burned or dumped if it is not recyclable.

²⁶ <https://www.politico.eu/article/europe-recycling-china-trash-ban-forces-europe-to-confront-its-waste-problem/>

²⁷ 1. Inside Waste, (2019), *China Sword: the Australian response*, [online] Available at: <https://www.insidewaste.com.au/index.php/2019/02/26/china-sword-the-australian-response/>: [Accessed 14 May. 2020]. 2. de Freytas-Tamura, K, 2018, 'Plastics Pile Up as China Refuses to Take the West's Recycling', *New York Times*, [online] Available at: <https://www.nytimes.com/2018/01/11/world/china-recyclables-ban.html> [Accessed 14 May. 2020]. 3. Associated Press, (2019) 'Big plastic user Japan fights waste ahead of G-20 summit', *The Asahi Shimbun*, [online] Available at: <http://www.asahi.com/ajw/articles/AJ201906260030.html> [Accessed 20 May 2020].

²⁸ Global Alliance for Incinerator Alternatives, (2019). *Discarded: Communities on the Frontlines of the Global Plastics Crisis* Available at: <https://www.no-burn.org/wp-content/uploads/PlasticsExposed-3.pdf>

²⁹ Greenpeace.org, (2019). *Data from the global plastics waste trade 2016-2018 and the offshore impact of China's foreign waste import ban*. [online] Available at: https://secured-static.greenpeace.org/eastasia/Global/eastasia/publications/campaigns/toxics/GPEA%20Plastic%20waste%20trade%20-%20research%20briefing-v2.pdf?_ga=2.15646198.1780188481.1558407095-1006420900.1539052287 [Accessed 14 Apr. 2020].

³⁰ Basel Convention, n.d. *Plastic Waste Overview*. [online] Available at: <http://www.basel.int/Implementation/Plasticwastes/Overview/tabid/6068/Default.aspx> [Accessed 14 Apr. 2020].

Analysis of plastic waste trade data

In order to understand the recent flows of plastic waste trade since China's restrictions on imports, data on traded waste plastics was analysed for 2019. The data used for this analysis is plastic waste traded in 2019 within the Asia Pacific region, as declared under HS code 3915 in the UN Comtrade database.³¹ The database was searched for monthly trade statistics reported by all countries in the Asia Pacific region. However, only Australia, Hong Kong, India, Japan, New Zealand, Pakistan, Philippines, Singapore and Thailand reported for this period. In addition, data was included from major exporters of plastic waste: the European Union (EU-28), UK, USA, Turkey, Mexico and Canada. It is important to note that HS code 3915 usually refers to baled waste plastics (before processing), however, it is not known if in some instances countries also report other commodities against this code (such as recycled plastic resin). Data is reported by both exporting and importing countries, and was usually found to align, with the exception of a small number of discrepancies between reported exports and imports. Some countries which are major importers, such as Malaysia, Indonesia and Vietnam, did not report data, so the data is drawn only from reported exports to these countries.

Exporters and importers of plastic waste in Asia Pacific

Figure 3 provides an overview of the exports and imports of plastic waste for countries in the Asia Pacific region, as well as major global traders. This figure only includes countries with reported data, and there are a large number of countries, particularly Pacific island countries, with no trade.

The analysis of data shows that the top exporters of plastic waste in 2019 were the EU, Japan and the USA, followed by the UK, Hong Kong, Mexico, Canada and Australia. Malaysia was overwhelmingly the largest importer of plastic waste in 2019, followed by Hong Kong, Turkey and the USA. Vietnam, Indonesia, Korea, India, China and Thailand also import significant amounts.

In general, it is high income countries which were net exporters of plastic waste, and emerging economies in Asia which were importers. However, the Philippines is an exception as an emerging economy which is a net exporter. Some countries in Asia had small amounts of imports, including Pakistan, Myanmar, the Philippines and Laos. The other Asian countries displayed in Figure 3 have very small amounts of trade of less than 1000 tonnes in 2019. Many of these, including Afghanistan, Bhutan, Cambodia and Nepal are least developed countries,³² and may not have infrastructure to manage plastic waste locally.

Within Pacific island countries there is only a small amount of trade reported for Fiji and Palau. This is consistent with other studies that found that Pacific Island countries with collection mechanisms have difficulty exporting plastic because of low volumes, large distances to recycling markets and high freight costs.³³ In other Pacific Island countries there are little or no collection systems.

Trade flows of plastic waste in Asia Pacific

The major trade flows between countries in the Asia Pacific region are shown in Figure 4. The largest flows are from the EU to Malaysia and Hong Kong, and Japan to Malaysia. The EU also exported significant volumes to Indonesia and India; and Japan to Vietnam and Thailand. The largest exports from the USA were to Hong Kong, India and Malaysia, and the largest exports from Australia were to Malaysia and Indonesia.

³¹ United Nations Statistics Division, n.d. *UN Comtrade Monthly Trade Database* [online] Available at: <https://comtrade.un.org/data> [Accessed 3 May 2020]

³² United Nations Conference on Trade and Development, n.d., UN list of Least Developed Countries [online] Available at: <https://unctad.org/en/Pages/ALDC/Least%20Developed%20Countries/UN-list-of-Least-Developed-Countries.aspx> [Accessed 3 May 2020]

³³ Pacific Region Infrastructure Facility (PRIF), (2018), Pacific Country and Territory Profiles. Available at: <https://www.theprif.org/documents/regional/urban-development-waste-management/pacific-region-solid-waste-management-and> [Accessed 3 May 2020]

Although Hong Kong is a net importer of waste, it is also a large exporter, exporting significant volumes to Thailand, Vietnam and Malaysia. Hong Kong has historically acted as an entry point for plastics into China,³⁴ and it is not known how much plastic waste continues to enter China via Hong Kong.

The map in Figure 4 only illustrates flows greater than 25,000 tonnes, which is equivalent to the top 27 flows in the Asia Pacific region. However, it is important to note that while this figure shows the majority of trade by volume, the trade system is highly complex, and there are hundreds of trade flows not displayed. In addition, this figure only includes trade that involves countries in the Asia Pacific region and does not include all major global flows. For example, the EU exported a similar amount of plastic waste to Turkey as it did to Malaysia, and there is significant trade between countries in North and South America.

Both Figures 3 and 4 are based on cumulative monthly 2019 data, and with shifting policies in both importing and exporting countries, these flows are likely to have shifted in 2020. They will continue to shift with future policy changes and the upcoming amendments to the Basel Convention.³⁵ Detailed data for Figures 3 and 4 are provided in Appendix B.

³⁴ Brooks, A.L., Wang, S. and Jambeck, J.R., (2018). The Chinese import ban and its impact on global plastic waste trade. *Science advances*, 4(6),

³⁵ Basel Convention, n.d. *Plastic Waste Overview*. [online] Available at: <http://www.basel.int/Implementation/Plasticwastes/Overview/tabid/6068/Default.aspx> [Accessed 14 Apr. 2020].

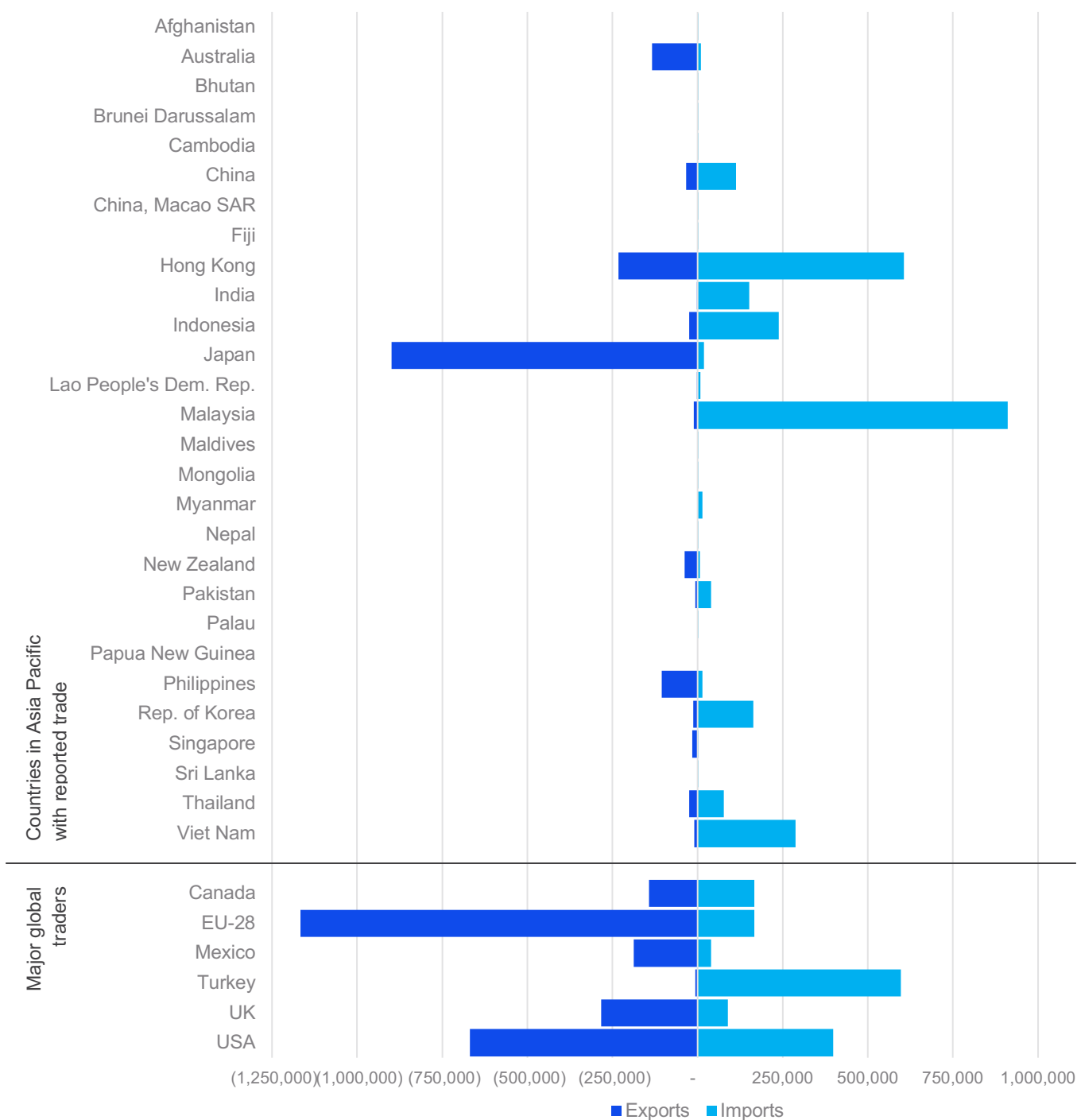


Figure 3: Exports and imports of plastic waste in Asia Pacific in 2019³⁶ (Data source: Comtrade³⁷)

³⁶ Note data is self-reported for Australia, Hong Kong, India, Japan, New Zealand, Pakistan, Philippines, Singapore, Thailand, EU, UK, US and Canada. Data from other countries is reported by the above countries.

³⁷ United Nations Statistics Division, n.d. *UN Comtrade Monthly Trade Database* [online] Available at: <https://comtrade.un.org/data> [Accessed 3 May 2020]

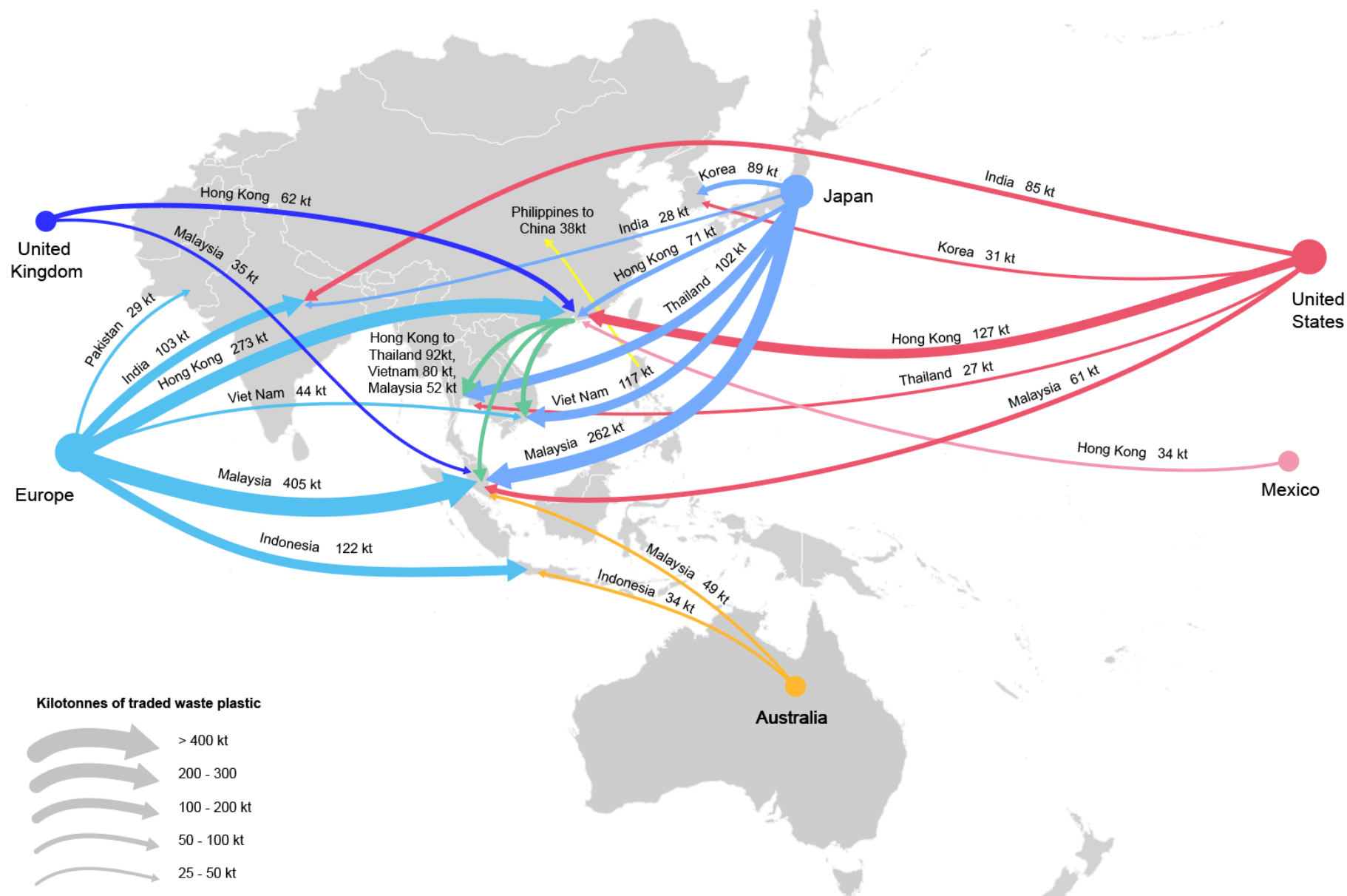


Figure 4: Major trade flows of plastic waste in Asia Pacific in 2019³⁸ (Data source: Comtrade³⁹)

³⁸ Note that the figure only includes the largest flows in/out of Asia Pacific countries and flows greater than 25 kt (the top 26 flows, of more than 1000).

Where countries report different values for imports/exports between countries, the larger value has been used.

³⁹ United Nations Statistics Division, n.d. *UN Comtrade Monthly Trade Database* [online] Available at: <https://comtrade.un.org/data> [Accessed 3 May 2020]

4. Overview of plastic leakage and marine plastic pollution

Estimates of the quantity of plastic leaked into the ocean are still evolving. Recent estimates range from approximately 4.8 to 12.7 megatonnes of plastic entering the ocean each year.⁴⁰ Based on these estimates, in the absence of significant interventions, the ocean will contain around 250 megatonnes of plastic by 2025.⁴¹ Of this waste, it is assumed that only 5% will be visible on the ocean surface or washed up on coastlines. The remaining 95% will be underwater and challenging to recover.⁴²

Plastic waste that enters the environment in an uncontrolled way is referred to as plastic waste leakage. This includes plastic that is not collected, and plastic that is collected but leaves the waste management system when it is improperly managed. When this plastic enters the environment it often enters waterways such as rivers and lakes, and ultimately ends up in the ocean where it is referred to as marine plastic pollution.

At present there is a critical lack of consistent data on the sources and amounts of plastic that are leaking into the ocean. Moreover, available studies do not include the impact of trade in their estimates of leakage. This section reviews the limited studies that are available regarding leakage sources and quantities.

The studies that have been reviewed are based on data from various points in time within the past decade and contain a range of assumptions that will influence how the data is interpreted, and its implications for trade in plastic waste. In the following section, we provide a brief overview of these data sources, their key assumptions, points of differentiation and limitations.

Sources of plastic leakage

Plastic waste leakage can originate from land or ocean-based sources. Land-based sources are estimated to account for 80% of plastics entering the ocean.⁴³ In 2015, an influential study on plastic waste leakage was published by Jambeck et al.⁴⁴ This study defined that land-based leakage is due to the mismanagement of waste when it is littered or inadequately disposed of. Inadequate disposal includes disposal of macroplastics in open dumps and uncontrolled landfills (without containment).

The Ocean Conservancy further expands on this definition to characterise ocean plastic leakage to be from collected and uncollected waste streams. Uncollected waste streams include litter and informal waste piles or open dumps. Collected waste streams include uncontrolled landfills in close proximity to waterways and illegal dumping by 'haulers'.⁴⁵ In addition to this definition, plastic leakage can also occur in the trade and recycling process, for example through the disposal of contaminants and residual plastics that cannot be recycled.⁴⁶ However, leakage from this source is not included in the following studies.

The 2017 International Coastal Cleanup conducted by the Ocean Conservancy surveyed the items that were collected by nearly 800,000 volunteers in 100 countries on beaches and waterways. The most commonly found items were all plastic and the vast majority are not recyclable. Starting with the most common items, the top 10 sources of litter were: 1) cigarette butts, 2) food wrappers, 3) plastic beverage bottles, 4) plastic bottle caps, 5) plastic grocery bags, 6) other plastic bags, 7) straws, stirrers, 8) plastic take away containers, 9) plastic lids and 10) foam (expanded polystyrene) containers.⁴⁷ Of these most prominent litter items, only

⁴⁰ Jambeck J., Geyer R., Wilcox C., Siegler T., Perryman M., Andrady A., Narayan R., and Law KL. (2015) 'Plastic waste inputs from land into the ocean', *Sciencemag*, 2015, Vol 347, Issue 6223.

⁴¹ Ocean Conservancy, (2015) *Stemming the Tide: Land-based strategies for a plastic-free ocean*

⁴² *Ibid.*

⁴³ STAP, (2011). *Marine Debris as a Global Environmental Problem: Introducing a solution based framework focused on plastic*. A STAP Information Document. Global Environment Facility, Washington, DC. Available from Internet: <http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP%20MarineDebris%20-%20website.pdf>

⁴⁴ Jambeck J., et al., (2015), Plastic waste inputs from land into the ocean, *Sciencemag*, Vol 347, Issue 6223.

⁴⁵ Ocean Conservancy, 2015, *Stemming the Tide: Land-based strategies for a plastic-free ocean*

⁴⁶ United Nations Environment Programme, 2018. *Mapping of global plastics value chain and plastics losses to the environment (with a particular focus on marine environment)*. Ryberg, M., Laurent, A., Hauschild, M. United Nations Environment Programme. Nairobi, Kenya

⁴⁷ Ocean Conservancy, 2018, Building a Clean Swell 2018 Report, <https://oceanconservancy.org/wp-content/uploads/2018/06/FINAL-2018-ICC-REPORT.pdf>

plastic beverage bottles and plastic take away containers are readily recyclable. This means that trade of recyclable waste can only influence a small proportion of plastic litter (leakage).

Plastic leaks into the ocean in the form of macroplastics (>5mm) or microplastics (<5mm). While the focus of this research is on macroplastics, such as food packaging and other forms of durable plastic, it is notable that the United Nations Environment Programme (UNEP) estimates that around 37% of total plastic leakage into the ocean is microplastics from numerous sources such as tyre abrasion, city dust, road markings and microbeads in cosmetics.⁴⁸ The ways that macroplastics are managed and traded also has implications for the microplastics in the ocean, as many types of macroplastics are broken down into 'secondary microplastics'⁴⁹ once they enter the ocean. In addition, some recycling pathways may ultimately contribute to microplastic pollution. For example, if PET bottles are recycled into textiles, microplastic may leak in the recycling phase of the product, and in the use phase as microfibrils via laundering.

The remaining 20% of plastic leakage into the ocean is thought to originate from marine sources, including illegal dumping of plastics at sea, and plastic waste associated with commercial and recreational marine activities, such as fishing.⁵⁰ In the following section we discuss studies of land-based leakage, followed by ocean-based leakage.

Quantifying land-based leakage

The majority of studies on plastic waste leakage are based on theoretical models, rather than from bottom-up empirical studies such as surveys. It is challenging to model rates of plastic waste leakage and mismanaged plastic waste, as there is limited available data and the models rely on general assumptions that may not reflect local factors such as how waste is littered and managed. There is currently no standardised method to calculate leakage. According to a report from the International Union for Conservation of Nature (IUCN)⁵¹, leakage can be further defined as 'losses' and 'releases'. The IUCN define 'loss' as 'the quantity of plastic that leaves a properly managed product or waste management system', and thus the 'loss rate' is the proportion of waste that is mismanaged from the waste management system. These losses are released to different pathways in the environment including waterways and oceans, the land or soil and to the air.

Based on the literature reviewed for this report, none of the studies estimating global or regional leakage patterns include a characterisation of the factors contributing to leakage, such as land-use (e.g. agricultural vs industrial), geographic and climatic conditions (e.g. high winds, urban proximity to waterways), types of waste management practices (e.g. informal waste collection, recycling infrastructure) and regional variations (e.g. between urban and rural areas). Further research will therefore be required to determine localised drivers of leakage, including trade. There is some ongoing research, for example as part of the Commonwealth Marine Litter Project (CliP) funded by Commonwealth Clean Oceans Alliance (CCOA). The UK Government Centre for Environment, Fisheries and Aquaculture Science (CEFAS) have undertaken detailed investigations in five countries and in three regions to gain a detailed understanding of the characteristics and conditions that influence leakage both from land- and sea-based sources.

The majority of studies reviewed draw on research by Jambeck et al.⁵² which uses 2010 statistics from the World Bank.⁵³ Given the centrality of the Jambeck et al. report to subsequent modelling and analyses, we will briefly detail the key assumptions and limitations of this report, and the key studies that have relied on it. Using the reference year of 2010, Jambeck et al estimated the mass of mismanaged plastic waste (in

⁴⁸ United Nations Environment Programme, (2018) *Mapping of global plastics value chain and plastics losses to the environment (with a particular focus on marine environment)*. Ryberg, M., Laurent, A., Hauschild, M. United Nations Environment Programme. Nairobi, Kenya

⁴⁹ Boucher J., Dubois C. Kounina A. and Puydarrieux P. (2019). *Review of plastic footprint methodologies: Laying the foundation for the development of a standardised plastic footprint measurement tool*, Gland, Switzerland: IUCN. x + 82pp.

⁵⁰ 1. STAP, (2011). *Marine Debris as a Global Environmental Problem: Introducing a solution based framework focused on plastic*; 2. Jambeck, J., et al., 2015, 'Plastic waste inputs from land into the ocean', *Sciencemag*, Vol 347, Issue 6223.

⁵¹ Boucher J, et al., (2019) *Review of plastic footprint methodologies: Laying the foundation for the development of a standardised plastic footprint measurement tool*, Gland, Switzerland: IUCN. x + 82pp.

⁵² Jambeck J. et al. (2015), 'Plastic waste inputs from land into the ocean', *Sciencemag*, 2015, Vol 347, Issue 6223.

⁵³ Bhada-Tata P. and Hoornweg D.A. (2012). 'What a waste?: a global review of solid waste management' (English). *Urban development series knowledge papers*; no. 15. Washington, DC: World Bank Group.

megatonnes) that leaks into the ocean from populations living within 50 km of a coast in 192 countries (reproduced in Table 2). The purpose of the study was to develop a framework to calculate an order-of-magnitude estimate of the amount of mismanaged plastic waste potentially entering the ocean worldwide, and the factors determining the largest sources of mismanaged plastic waste. The framework includes: 1) the mass of waste generated per capita annually; 2) the percentage of waste that is plastic; and 3) the percentage of plastic waste that is mismanaged (littered and inadequately disposed of in open dumps or uncontrolled landfills) and, therefore, has the potential to enter the ocean as marine debris.

The study is based on top-down assumptions, and does not factor in local characteristics and variables, including the international import and export of waste, illegal dumping, ad hoc recycling and other informal waste collection practices, and whether or not waste infrastructure for local and imported waste is shared, which would affect national estimates. The authors also note a number of points of uncertainty based on the data they are drawing from. These include measurements of waste generation, collection, characterisation, and disposal, particularly outside of urban centres.

These figures are also likely to have been affected by the China Sword policy, which severely restricted the import of plastics into China in 2018. Research by Brooks et al⁵⁴ in 2018 estimated that 111 megatonnes of plastic waste would have been displaced by the China Sword policy by 2030, most of which is expected to flow to other East Asian and Pacific countries.

Table 2: Estimated leaked macroplastic plastic waste into the ocean by country⁵⁵

| Country | Waste generated | Plastic waste | Mis-managed waste | Mis-managed plastic waste | Leaked plastic waste | |
|----------------------|-----------------|---------------|-------------------|---------------------------|----------------------|-------------------|
| | Mt/yr | per cent | per cent | Mt/yr | Mt/yr (Low ~15%) | Mt/yr (High ~40%) |
| China | 105.6 | 11.0 | 76.0 | 8.8 | 1.32 | 3.53 |
| Indonesia | 35.5 | 11.0 | 83.0 | 3.2 | 0.48 | 1.29 |
| Philippines | 15.2 | 15.0 | 83.0 | 1.9 | 0.28 | 0.75 |
| Vietnam | 16.1 | 13.0 | 88.0 | 1.8 | 0.28 | 0.73 |
| Sri Lanka | 27.2 | 7.0 | 84.0 | 1.6 | 0.24 | 0.64 |
| Thailand | 11.4 | 12.0 | 75.0 | 1.0 | 0.15 | 0.41 |
| Egypt | 10.9 | 13.0 | 69.0 | 1.0 | 0.15 | 0.39 |
| Malaysia | 12.7 | 13.0 | 57.0 | 0.9 | 0.14 | 0.37 |
| Nigeria | 7.9 | 13.0 | 83.0 | 0.9 | 0.13 | 0.34 |
| Bangladesh | 11.1 | 8.0 | 89.0 | 0.8 | 0.12 | 0.31 |
| South Africa | 9.4 | 12.0 | 56.0 | 0.6 | 0.09 | 0.25 |
| India | 23.3 | 3.0 | 87.0 | 0.6 | 0.09 | 0.24 |
| Algeria | 7.3 | 12.0 | 60.0 | 0.5 | 0.08 | 0.21 |
| Turkey | 22.0 | 12.0 | 18.0 | 0.5 | 0.07 | 0.19 |
| Pakistan | 4.2 | 13.0 | 88.0 | 0.5 | 0.07 | 0.19 |
| Brazil | 28.1 | 16.0 | 11.0 | 0.5 | 0.07 | 0.19 |
| Burma | 3.1 | 17.0 | 89.0 | 0.5 | 0.07 | 0.18 |
| Morocco | 9.2 | 5.0 | 68.0 | 0.3 | 0.05 | 0.12 |
| North Korea | 3.8 | 9.0 | 90.0 | 0.3 | 0.05 | 0.12 |
| United States | 106.3 | 13.0 | 2.0 | 0.3 | 0.04 | 0.11 |

⁵⁴ Brooks A.L., Wang S. and Jambeck J.R., (2018) The Chinese import ban and its impact on global plastic waste trade. *Science advances*, 4(6)

⁵⁵ Jambeck J. et al. (2015) 'Plastic waste inputs from land into the ocean', *Sciencemag*, Vol 347, Issue 6223.

Several studies expand on Jambeck et al.'s data on mismanaged plastic waste leakage using various other assumptions. This has resulted in a discrepancy in estimates of leakage amounts and sources. For example, Schmidt et al.⁵⁶ extended the review of data on mismanaged waste from Jambeck et al.⁵ – which included 192 coastal countries – by 41 countries which have a share on river catchments that discharge into the sea. They note that coastal plastic waste leakage has been assumed in previous research to be proportional to the amount of mismanaged plastic waste generated in that coastal area, but rivers had not been accounted for. They therefore estimated the amount of plastic 'available' for leakage per person and time (kg/person/day) generated in each catchment connected to most river systems globally. Their findings (shown in Appendix C) indicated that that large rivers with population-rich catchments account for a disproportionately higher fraction of mismanaged plastic waste that leaks into the ocean. They found that the top 10 rivers transport 88–95% of global plastic losses to the ocean, and that approximately 69 megatonnes/year of plastic waste is generated in the 1350 catchments studied, which is potentially available for transport into and within river systems. However, like the Jambeck et al research, this study does not factor the impact of international or informal plastic waste trade into their estimates, nor do they include variables such as land use and industrial practices as drivers of plastic leakage.

Another key UNEP⁵⁷ study of plastic leakage along the value chain, utilises Jambeck et al, but questions their assumption that between 15% and 40% of mismanaged plastic waste is lost to the environment. They state that while these figures may be realistic for direct littering, this value is likely to be overestimated for open dumps and low technology landfills. Rather, the UNEP report assumed that basic measures for reducing waste losses would be utilised in low technology landfills and therefore adjusted their assumption for loss of mismanaged plastic waste down to 10%. These adjusted assumptions about mismanaged plastic waste resulted in a greatly reduced estimate of the contribution of Asia to macroplastic leakage into the ocean (shown in Appendix C).

The final report worth noting is a study by The Ocean Conservancy⁵⁸ focused on land-based plastic leakage into the ocean. This study extended the research by Jambeck et al through additional field work in China and the Philippines. This study also further categorised land-based leakage according to two main pathways: collected and uncollected (summarised in Table 3). They estimate that 75% comes from uncollected waste and the remainder (25%) is from leakages within the waste management system. Importantly, they also estimate higher rates of leakage for lower value residual waste streams indicating that trade and the market value of different recycled plastics may have an impact on what types of plastic leak into the environment.

Based on these estimates, the total estimated volume of leaked plastic waste ranges from 7- 8.6 megatonnes per year.⁹ In contrast to the UNEP and Schmidt studies, they also concluded that a significant proportion (50-60%) of land-based plastic leakage stems from five countries: China, Indonesia, Philippines, Thailand and Vietnam.

⁵⁶ Schmidt C., Krauth T. and Wagner S. (2018) 'Export of plastic debris by rivers into the sea.' *Environmental science & technology*, 51(21), pp.12246-12253.

⁵⁷ United Nations Environment Programme (2018) *Mapping of global plastics value chain and plastics losses to the environment (with a particular focus on marine environment)*. Ryberg, M., Laurent, A., Hauschild, M. United Nations Environment Programme. Nairobi, Kenya

⁵⁸ Ocean Conservancy (2015) *Stemming the Tide: Land-based strategies for a plastic-free ocean*.

Table 3: Sources of leakage based on uncollected and collected pathways and estimated aggregate volumes for China, Indonesia, Philippines, Thailand and Vietnam (Source: Ocean Conservancy⁵⁹)

| | Leakage sources | Estimated volumes of leaked plastic waste from 5 countries (Mt per year) |
|-------------|---|--|
| Uncollected | Low-density rural areas with low or no waste collection | 1.7 -2.1 |
| | Medium-density urban areas where there are significant gaps in waste infrastructure (owing to rapid urbanisation) | 1.9-2.4 |
| | High-density urban areas where waste management infrastructure capacity is limited and/or access to services may be limited owing to high service costs | 1.6-1.9 |
| Collected | Illegal dumping by trash haulers | 0.7-0.9 |
| | Informal or 'open' dump sites in proximity to waterways | 1.1-1.3 |

Ocean-based leakage

While the majority of plastic leakage into the ocean is from land-based sources, approximately 20% originates from ocean-based activities. However, these sources of leakage are even more difficult to quantify and measure than land-based sources. One driver of ocean-based leakage noted by the International Chamber of Shipping is that the quality of waste facilities at ports is highly variable and services can be based on tariff structures which discourage proper waste disposal in port.⁶⁰ One consequence of this may be the illegal dumping of non-traded plastics and other waste at sea. Culin and Bielić⁶¹ also add that because it is hard to detect violations of the law at sea, it is often not possible to link waste with specific ships that ignore dumping legislation.

The Ocean Conservancy has also estimated that illegal dumping in local rivers and tributaries by trash haulers in China, Thailand, Sri Lanka, Malaysia and Indonesia adds between 700,000 and 900,000 tonnes of plastic to the ocean per year, which they attribute to a desire to avoid paying tipping fees at landfills, save time, and reduce fuel expenses.⁶²

A 2019 study examining plastic bottle litter in the South Atlantic Ocean suggests that waste-dumping at sea may be higher than previously estimated as 75% of bottles found were from Asia, with manufacture dates that suggest they were dumped by ships, rather than drifting from Asia.⁶³

In addition to illegal dumping, another key source of plastic leakage at sea is from fishing and other marine industries, in particular, discarded fishing nets, dolly rope abrasion and expanded polystyrene floating devices. While data on the loss of discarded fishing gear is generally lacking, UNEP estimates the annual loss to be 0.6 megatonnes per year.⁶⁴

⁵⁹ Ocean Conservancy (2015) *Stemming the Tide: Land-based strategies for a plastic-free ocean*.

⁶⁰ International Chamber of Shipping (2019) *Action on Plastics*, accessed online at: [https://www.ics-shipping.org/docs/default-source/key-issues-2019/action-on-plastics-\(june-2019\).pdf](https://www.ics-shipping.org/docs/default-source/key-issues-2019/action-on-plastics-(june-2019).pdf)

⁶¹ Čulin J. and Bielić T., (2016) 'Plastic pollution from ships'. *Pomorski zbornik*, 51(1), pp.57-66.

⁶² Ocean Conservancy (2015) *Stemming the Tide: Land-based strategies for a plastic-free ocean*.

⁶³ Peter G. Ryan, Ben J. Dilley, Robert A. Ronconi, Maëlle Connan, (2019) 'Rapid increase in Asian bottles in the South Atlantic Ocean indicates major debris inputs from ships', *Proceedings of the National Academy of Sciences* Oct 2019, 116 (42) 20892-20897; DOI: 10.1073/pnas.1909816116. <https://www.pnas.org/content/116/42/20892>

⁶⁴ United Nations Environment Programme (2018) *Mapping of global plastics value chain and plastics losses to the environment (with a particular focus on marine environment)*. Ryberg, M., Laurent, A., Hauschild, M. United Nations Environment Programme. Nairobi, Kenya

5. Links between trade and plastic leakage

What is leakage?

The previous sections have highlighted the complexities and extent of the pathways in which plastics leak into the environment. For the purposes of this project, the leakage of post-consumer plastic waste is considered as that which enters the environment in an uncontrolled way, including waste that is not collected, and waste that is collected but leaves the waste management system through improper management.

While the focus of this report is understanding the challenge of plastic leakage into the environment, particularly the ocean, and including at various points in the trading system aimed at recovering and recycling the material, plastics that are burnt or deposited in a contained landfill also have environmental and resource implications. From a circular economy perspective, combustion and disposal into landfill means that plastic resources are lost to the economy and cannot be recovered for continued material and economic benefit.

Research on leakage of plastic waste in the trade process

As there is very little published information on the impacts of trade on leakage, we undertook a series of interviews with experts and organisations that are familiar with the plastics waste trade in both exporting and importing countries in the Asia-Pacific region. These included: trade experts, consultants, academics, NGOs and recyclers. Table 4 lists the countries and organisations that were interviewed.

Table 4: Interviewee countries and organisations

| Interviewee country | Organisation |
|---------------------|---|
| Australia | Material Recycling Facilities (MRF) x 2 |
| India | Indian Pollution Control Association (IPCA World) |
| Indonesia | Indonesian packaging consultant |
| | Ecoton |
| Japan | Economic Research Institute for ASEAN and East Asia |
| Malaysia | Sahabat Alam (Friends of the Earth) Malaysia |
| | Malaysian independent waste consultant |
| Thailand | Circular Economy Waste-Free Thailand (CEWT), Mae Fah Luang University |
| Vietnam | Vietnam Cleaner Production Centre |
| | GreenHub: Centre for Supporting Green Development |
| | Independent legal consultant working with IUCN |

The interviews followed a question guide, which is provided in Appendix D. The questions covered the trading process, points of leakage, the characteristics of environmentally responsible trade, domestic waste management issues and mitigation measures. Interviewee perspectives were aggregated and are explained in the following sections.

Explaining the trading process

The process for trading plastics begins with collection at the source country and transport to a material recycling facility (MRF), where it is sorted and baled into large cubes either as a single stream polymer (such as PET or HDPE) or as a mixed stream. The MRF may then stockpile the material until there is sufficient volume to trade, then it will be sold to a trader or international recycler. If selling to a trader, the trader is responsible for labelling the shipment, and sending it to a buyer overseas. The shipping container is sealed at the MRF and is not opened by customs before being loaded onto ships.

Interviewees from Asia explained that before recent government restrictions were imposed, local traders could buy and sell plastic shipments, acting as middlemen for recycling facilities. However, new rules mean that buyers in most Southeast Asian countries must now be licenced recycling facilities. In Vietnam, Indonesia and Malaysia, there are both formal and informal recycling sectors, and only formal recyclers can legally import plastic waste. Plastic waste makes its way to informal recyclers through various routes, including the on-selling of imports from formal recyclers to informal smaller recyclers, incorrect labelling of imports, false licences or smuggling. In Vietnam, Indonesia and India, interviewees mentioned the prevalence of fake recycling licences. One of our interviewees from Vietnam explained that it is challenging for authorities to enforce this sector as there are at least 4000 recyclers and around a million people that rely on this sector for their livelihood.

During the surge of plastic waste shipments arriving in Southeast Asian ports, enforcement was increased, and in several countries, including Thailand, Malaysia and Vietnam, shipments were rejected. Rather than face penalties for non-complying shipments, interviewees reported that the owners of those shipments often abandon them and they remain in the port. This can mean that governments in receiving countries are then responsible for industrial disposal of those shipments. However, some interviewees felt that these shipments would still eventually be processed by the informal sector.

Interviewees in both exporting and importing countries highlighted that shipments of mixed materials, considered “contaminated” because they contain unrecyclable plastics or other contaminants (such as e-waste) typically occur as an agreement between exporter and importer. For example, an interviewee from Indonesia explained that while plastic imports had been banned, paper had not been banned, so in one case where a shipment was discovered by authorities, an agreement had been made between traders to hide plastic within a paper shipment. Interviewees from several countries mentioned the practice of false declarations on customs forms, where alternative HS codes are used in order to avoid inspection and to trade banned goods.

Where does plastic waste leakage occur in the trade process?

Interviewees from Thailand, Vietnam, Indonesia and Malaysia noted that trade had led to increased leakage of plastic waste, as well as other environmental and health impacts. Interviewees from Vietnam were familiar with the plastic waste recycling process and could see an obvious impact of trade on leakage in the waterways and landfills around the plastic recycling villages. Interviewees from export countries Japan and Australia were not clear on what impact trade may have on leakage. Interviewees from Australian material recycling facilities noted that with limited trade options, some in-country processing was being developed, however, in the short term, some mixed plastics are being landfilled in Australia.

The major points of leakage in the trade process can be summarised as follows:

- **Disposal of residual plastics:** Plastics that cannot be processed for recycling were identified as the main source of leakage. After sorting, residual plastics are dumped at an open landfill, where they can be blown by the wind and are often burned, releasing toxic air pollution such as persistent organic pollutants (POPs). Sometimes residual plastics are dumped in nearby waterways to avoid paying the disposal fee. These findings are consistent with an investigation undertaken by the Global Alliance for Incinerator Alternatives (GAIA) that found examples of dumping of residuals and burning of imported plastic in Malaysia, Thailand and Indonesia.⁶⁵
- **Processing without environmental controls:** Plastics are leaked during several stages of reprocessing in informal facilities. Informal processing facilities have limited environmental controls (such as wastewater treatment and sealed storage facilities) and use low-tech machinery. An engineer in Vietnam explained that while washing the plastics, small pieces of plastics are washed directly to waterways through wastewater discharge. An interviewee from Japan explained that in China, much of the recycled plastic scrap is used to make synthetic textiles, in a process which leaks small plastic fibres to waterways. An interviewee in Thailand noted that most new recycling factories have been established in rural areas close to the ports where the local governments are not able to

⁶⁵ Global Alliance for Incinerator Alternatives, (2019). *Discarded: Communities on the Frontlines of the Global Plastics Crisis*, <https://wastetradestories.org/wp-content/uploads/2019/04/Discarded-Report-April-22.pdf>

enforce environmental controls, rather than in industrial estates where pollution control would be more easily enforced.

- **Inadequate management of transport and stockpiling:** Imported plastic waste can leak into the environment during transit and storage at recycling facilities through weathering and poor management. Although this was not mentioned as a key point of leakage by interviewees, the GAIA study described several additional routes for plastic waste leakage. This included plastic waste spilling out from informal stockpiles in Malaysia and Indonesia, plastic flakes lining roadsides where trucks loaded with plastic bales travel, and washed plastics being laid out to dry in Indonesia, where they are exposed to wind and animals.⁶⁶

None of the interviewees thought that intentional ocean dumping was likely, as the plastic has value and costs money to transport. Even when non-complying shipments had been abandoned at ports, our interviewees thought that those shipments would eventually be recycled or landfilled. However, one interviewee noted that they had some concerns about containers that were re-exported from Malaysia after being rejected because of high levels of contamination, as there is no oversight or confirmation that they have been received by the country that is required to receive them.

The pathways for plastic leakage from the trading system are illustrated in Figure 5. Then in Figure 5, additional pathways for leakage have been illustrated, including those that are not currently related to trade, such as uncollected litter from disposal of waste at uncontrolled landfills. Almost all interviewees felt that leakage from domestic waste in importing countries was likely to be a greater overall contributor to leakage, due to significant deficiencies in domestic waste management and its greater overall volume.

Additional environmental impacts in the trade process:

An interviewee from Malaysia highlighted a range of environmental and community health problems arising from plastic reprocessing facilities, in particular from burning of residuals which release heavy metals and persistent organic pollutants (POPs) to air, soil and water. Health issues included eye and skin irritation, respiratory problems and an ongoing smell of plastic burning.

The GAIA report also described numerous other environmental and health impacts arising from plastic waste processing, in particular due to the combustion of unrecyclable plastic residuals. Burning plastic emits toxic substances, including dioxins, furans, mercury, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs) and particulates which impact human health. The residual ash from burning also creates toxic residues, including heavy metals which persist in the environment and enter soil, groundwater, and waterways.⁶⁷ An interviewee from India highlighted the greenhouse gas emissions from shipping long distances. These environmental impacts are highlighted in Figure 5 and 6.

⁶⁶ Global Alliance for Incinerator Alternatives, (2019). *Discarded: Communities on the Frontlines of the Global Plastics Crisis*, <https://wastetradestories.org/wp-content/uploads/2019/04/Discarded-Report-April-22.pdf>

⁶⁷ Global Alliance for Incinerator Alternatives, (2019). *Discarded: Communities on the Frontlines of the Global Plastics Crisis*, <https://wastetradestories.org/wp-content/uploads/2019/04/Discarded-Report-April-22.pdf>

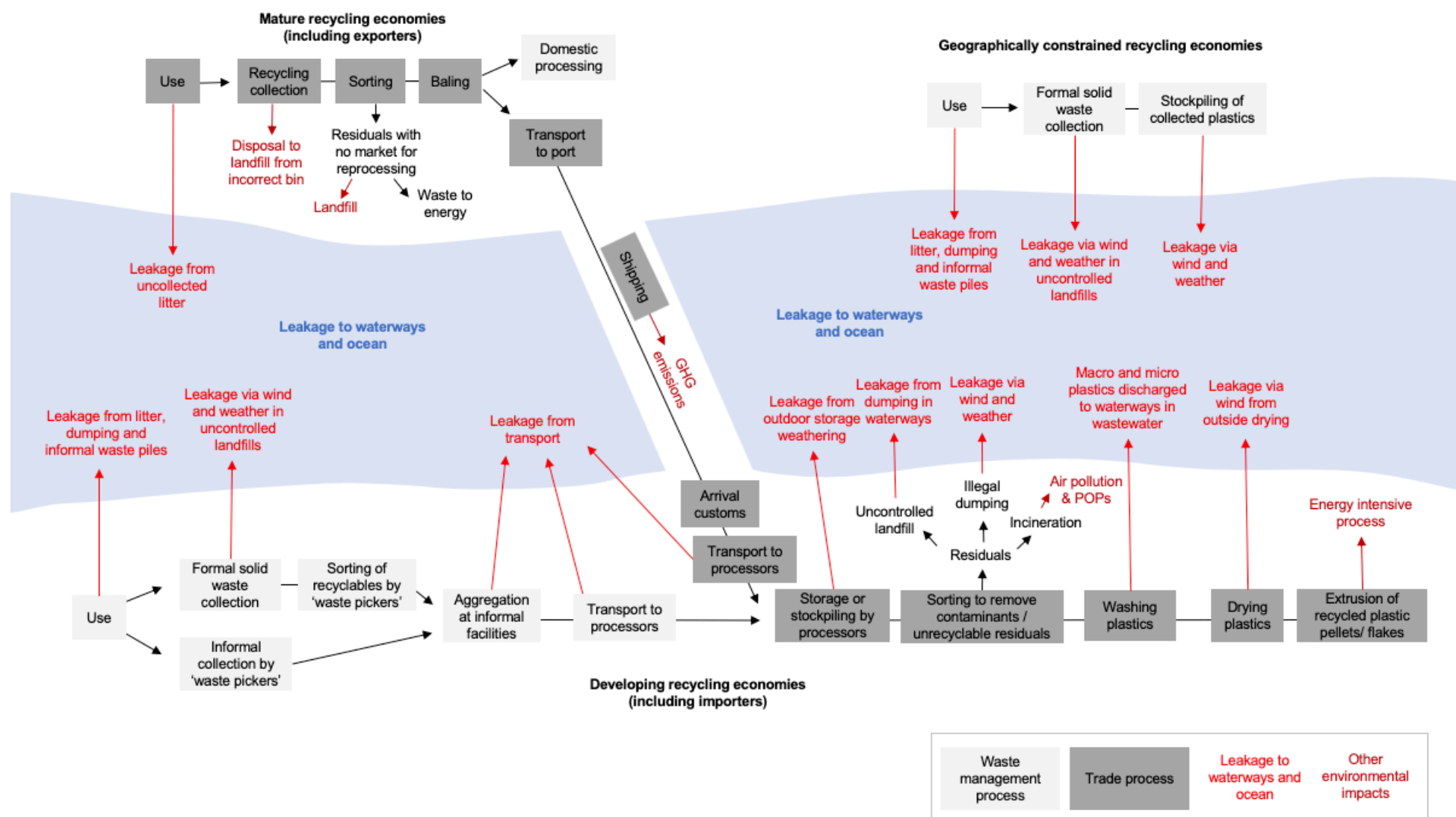


Figure 5: Points of leakage in the broader waste management system (trade related processes are highlighted in darker grey)

Other links between trade and leakage

Interviewees highlighted other indirect links between trade and leakage:

- **Reduced incentive for collection and processing of domestic waste in importing countries:** Interviewees in India, Thailand and Vietnam indicated that imports of plastic recycling inhibited domestic collection by reducing the price that waste pickers could receive from collecting and separating plastic wastes. An interviewee from Vietnam pointed out that while Vietnam reprocessed foreign wastes, enabling high rates of recycling in exporting countries, Vietnam's recycling rate remained at 10%. In India, an interviewee explained that imported plastic waste was better quality and cheaper than locally collected plastic waste, and that recycling facilities were less interested in purchasing local waste. To encourage better domestic waste management, the Indian government banned the import of plastic waste and has now also banned the import of plastic resin with the aim of stimulating domestic reprocessing. An interviewee from Thailand noted that in the past it was easy for waste pickers sell the recyclables they collected to recyclers, but since 2018 the price of recyclables had collapsed globally. Factories have less interest in using domestically collected plastic when they are able to purchase large volumes of imported plastics, as imports have increased to a similar volume to what was collected domestically. This has caused the price of PET to reduce by two-thirds and in certain locations waste pickers have difficulty selling recyclables, which has increased leakage.
- **Quality of bales:** The quality of source separation in the exporting country has a significant impact on down-stream leakage. In particular, mixed plastic bales were identified by several interviewees as a source of environmental problems and leakage. The wide variety of plastic types, the difficulty in sorting them, and their low value means that they are more likely to leak, be illegally dumped or incinerated.
- **False labelling:** False labelling of shipments can lead to import of contaminated waste with a higher percentage of residuals, which leads to greater leakage. This can include shipments that are labelled as clean plastics but are contaminated, or shipments that are labelled as other products (such as new plastic products). Interviewees in India, Vietnam and Malaysia also mentioned examples of hazardous waste such as e-waste being smuggled in plastic shipments.
- **Low prices of traded plastics:** One of the interviewees from Australia noted the increased risk of leakage when bales have very low or negative prices, as importers can make money without needing to take any action. If importers pay \$100-\$200 per bale, then they need to reprocess the plastic to recover their funds.
- **Leakage from lack of trade:** Studies by APWC have highlighted in Pacific Island countries where there are very low volumes of plastic waste and long distances, a lack of export opportunities may increase leakage, as plastics are either not collected or can leak from the environment from uncontrolled landfills or stockpiling.⁶⁸

These systemic links between waste management, trade and leakage are summarised in the conceptual diagram in Figure 6. The diagram highlights pathways of cause and effect for two different scenarios – from countries with high labour costs and low demand (e.g. Australia, Japan) and countries with low volumes of plastic waste (e.g. Pacific Island Countries). Red arrows indicate multiple pathways that lead to leakage and other negative outcomes in the system, such as through stockpiling, incorrect labelling and inadequate sorting. Green arrows highlight more environmentally responsible pathways where investment in collection and sorting can enable cleaner bales, which leads to recycling and production of higher value products, creating market demand, which in turn incentivises investment in collection and sorting.

⁶⁸ APWC (2019). Solomon Islands – Waste Data Report, 13/4/2019, for Centre for Environment Fisheries & Aquaculture Science

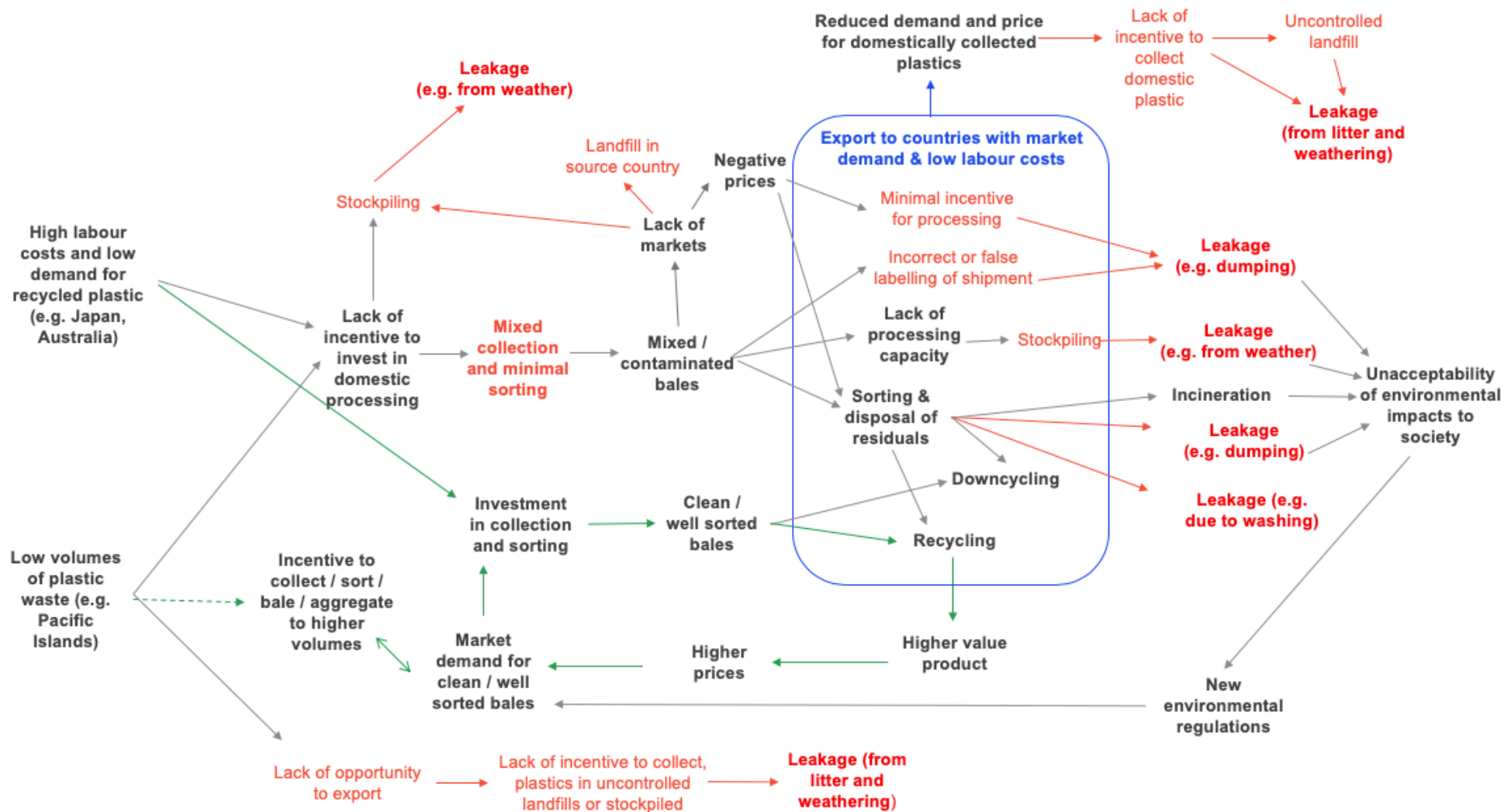


Figure 6: Conceptual diagram of links between waste management, trade and leakage

6. Examples of the links between trade and leakage

In this section, we set out to understand some of the systemic impacts of trade on plastic waste leakage, in particular, to find examples of where trade has either exacerbated or reduced leakage. The impacts of trade on leakage depends on the context and waste management systems in both the exporting and importing countries. In general, trade has a greater potential to reduce leakage in exporting countries, as it supports established waste collection systems and enables access to international end markets. In some countries that have little or no trade, access to international markets may also encourage the development of waste collection systems, in order to facilitate exports. In major importing countries, trade has primarily contributed to leakage due to a lack of processing capacity, technology and environmental controls.

Trade exacerbating plastic leakage

China's restrictions on the importation of plastic waste were driven by the environmental and health impacts of reprocessing. Since the trade of plastic waste shifted to Southeast Asia, imports of plastic waste have reportedly exacerbated plastic leakage throughout the region, including in India, Indonesia, Malaysia, the Philippines, Thailand and Vietnam.⁶⁹

In the following section, we discuss three key challenges that have exacerbated plastic leakage in Malaysia, Indonesia and Vietnam, including perspectives from our interviews.

Reliance on informal recycling sector for collection and processing in Vietnam

The management of plastic waste in Vietnam is dependent on the informal sector, which has led to increased leakage related to the trade of plastic waste in two main ways: directly through informal processing and indirectly by reducing demand for domestic plastic collected by waste pickers.

In early 2019, Vietnam was the second largest importer of plastic waste globally. Plastic waste, both imported and domestic, is processed by both industrial scale and informal recycling facilities. However, according to one interviewee, 90% of plastic waste in Vietnam is processed by informal facilities. The majority of these are in the north of Vietnam, located in 'craft villages', made up of hundreds of household scale recycling businesses. These villages existed before the increase of plastic waste imports in 2018 and 2019, but when the volumes of imports increased they began expanding operations and running 24 hours a day.⁷⁰ Although there is no official data, one interviewee stated that there are approximately 4000 enterprises working in the plastic recycling sector.

Informal plastic processing facilities were mentioned by interviewees as the main driver of leakage related to plastic waste recycling in Vietnam. Residual plastics that cannot be recycled are disposed of at dumping sites or directly into waterways. These residuals are also sometimes burned at dumping sites, creating air pollution and releasing persistent organic pollutants (POPs). In early 2019, it was estimated 20% of the plastic managed at informal facilities that was unrecyclable may end up either dumped or burned⁷¹, although it is not known how this has changed since government restrictions on imports. Secondly, leakage occurs in the washing and cutting process, as small particles of plastic end up in the water which is discharged to local waterways.

⁶⁹ Global Alliance for Incinerator Alternatives (GAIA), 2019, Discarded: Communities on the Frontlines of the Global Plastic Crisis 2019, Accessed online at: <https://www.no-burn.org/wp-content/uploads/Report-April-22.pdf>

⁷⁰ Retamal, M., Dominish, E., Le, T.X., Nguyen, T.A. Sharpe, S. Here's what happens to our plastic recycling when it goes offshore, The Conversation, January 30, 2019. Available online at: <https://theconversation.com/heres-what-happens-to-our-plastic-recycling-when-it-goes-offshore-110356>

⁷¹ Retamal, M., Dominish, E., Le, T.X., Nguyen, T.A. Sharpe, S. Here's what happens to our plastic recycling when it goes offshore, The Conversation, January 30, 2019. Available online at: <https://theconversation.com/heres-what-happens-to-our-plastic-recycling-when-it-goes-offshore-110356>

Although informal facilities are not able to legally import plastic waste, they can obtain this through mislabelling, fake licencing and smuggling of imports. These facilities also process domestic plastic waste, however, one interviewee suggested that imported waste is likely to constitute 50-60% of the plastic waste processed in these areas, and is therefore likely to make a substantial contribution to leakage from this sector.

Although interviewees commented on the contribution of informal recycling facilities to leakage, they also noted that the informal sector was important for the management of domestic plastic waste. In the absence of a government managed waste system, waste pickers collect plastic and other recyclables directly from households and businesses as well from government owned landfills, and sell to aggregators who on-sell to recyclers. One interviewee described waste pickers as the most effective and successful stakeholders enabling source separation of recyclable plastics in Vietnam. The imports of plastic waste have an indirect impact on the market for domestic plastic waste, as recyclers preference for imported plastic waste has made it less profitable for waste pickers to collect plastics, potentially leading to lower recovery rates and more leakage of plastics from uncontrolled landfills.

Smuggling and false labelling of imports in Indonesia

After Indonesia's plastic waste imports increased significantly in late 2018, Indonesia responded with a ban on plastic waste imports. Since then, the majority of plastic waste imports have entered the country as contamination within paper and cardboard recycling bales.⁷²

The Ministry of Trade allows the import of waste paper, and the paper recycling industries guarantee that this has less than 5% contamination. However, an investigation by Indonesian NGO Ecoton found that imported bales had 20-30% contamination with plastic waste, as well as other household waste such as clothing, and in some cases hazardous waste such as e-waste. Three-quarters of the plastic waste found in paper bales is food packaging.⁷³

The paper recycling industry is focused in East Java, and it was estimated that paper mills in the region process 4 million tonnes of waste paper per day. 2.5 million tonnes are from domestic sources and the remainder from imports, mostly from the US, but also the UK, Australia and Canada.⁷⁴

While the volumes of paper imports to Indonesia grew between 2016 and 2018, the price for unsorted paper waste dropped by more than half. It has been suggested that paper mills were willing to accept higher levels of contamination in lower cost imports.⁷⁵ One interviewee noted that recently some paper factories were receiving unsorted paper for free, or had been paid an incentive to take it.

According to a report by GAIA, paper recyclers separate, wash and strip the plastic that is sorted from paper bales. Middlemen then truck it to nearby villages and find workers who are willing to accept the plastic waste being dumped on their fields or front yard, in order for them to be able to sort it for tradable material. In some cases, paper companies pay workers to accept the plastic waste, but usually workers only earn income from the sale of recyclable plastics.⁷⁶ According to one interviewee, PET, HDPE, LDPE and PP are able to be on-sold for reprocessing. However, many of these sorted plastics cannot be recycled because they are contaminated or there is no available technology to recycle them, such as soft plastics and multi-layer packaging. After the valuable plastics have been sorted, the residual plastics are either dumped or often sent to food factories where they are used for fuel. One interviewee estimated that only 2% of plastic from paper bales can be effectively recycled, with the remainder either ending up in the environment, burned or sent to landfill.

⁷² Global Alliance for Incinerator Alternatives (GAIA), 2019, Discarded: Communities on the Frontlines of the Global Plastic Crisis 2019, Accessed online at: <https://www.no-burn.org/wp-content/uploads/Report-April-22.pdf>

⁷³ Ecoton, (2019), Inquiry into Recycling and Waste Management in Victoria

⁷⁴ Ecoton, (2019), Investigation report: Permit Violations and Environmental Impact of Importing Paper Waste on the Brantas River

⁷⁵ Ecoton, (2019), Inquiry into Recycling and Waste Management in Victoria

⁷⁶ Global Alliance for Incinerator Alternatives (GAIA), 2019, Discarded: Communities on the Frontlines of the Global Plastic Crisis 2019, Accessed online at: <https://www.no-burn.org/wp-content/uploads/Report-April-22.pdf>

This has had a significant impact on leakage in East Java, the centre for paper recycling in the country. A recent report from the International POPs Elimination Network (IPEN)⁷⁷ found that plastic waste dumping and burning for food operations in Indonesia had put plastic chemicals into the food chain via the air and soil. In particular, free range chicken eggs were found to contain high levels of toxic chemicals. Studies of the Brantas River downstream from paper factories have found high levels of plastic fragments and microplastics in the water, and microplastics in 80% of fish.⁷⁸

Indonesian authorities have taken measures to reduce the illegal import of contaminated shipments. Thousands of shipping containers of contaminated paper and plastic waste imports were seized by authorities in 2019, and hundreds of these have been re-exported to countries of origin, including the UK, Australia, Canada, Japan, Hong Kong and various European countries.⁷⁹

Following the increased inspection of facilities and the implementation of new regulations in December 2019, it is not known how much plastic waste continues to enter Indonesia. One interviewee noted it has been reported that factories in East Java have begun importing cleaner bales of paper and cardboard from countries including Japan, Korea and Singapore.

Although the smuggling of plastic waste in paper imports is unique to Indonesia, interviewees also noted that smuggling and mislabelling of imports is also a challenge in India, Vietnam and Malaysia. This includes plastic waste mislabelled as other materials, and e-waste smuggled in plastic waste imports. Interviewees noted examples of smuggling across land borders, for example from China, Cambodia and Laos into Vietnam, and via sea from Indonesia and Thailand into Malaysia.

Lack of resources for monitoring and enforcement in Malaysia

After the China Sword policy came into effect, from January to November 2018 Malaysia received 15.7% of the total plastic exports from countries such as the United States and much of Europe, making it the largest importer of plastic scrap from the top exporting countries.⁸⁰ In Malaysia, imported plastic in bales or shipping containers are processed with local scrap in mixed plastic recycling facilities.⁸¹ The influx of waste overwhelmed processing capacity and triggered the establishment of many illegal recycling facilities. According to our interviewees, these illegal facilities are usually Chinese owned, using imported workers and machinery, and then processed resin is exported to China. An interviewee reported that the situation is similar in Thailand, where most recycling businesses set up since 2018 are Chinese owned and export the resin after processing.

In October 2018 the Malaysian government announced that it would restrict the importation of plastic waste and phase out imports of other types of plastic scrap in order to reduce the administrative and environmental burden.⁸² Exporting companies must apply for an Approved Permit (AP) registered with the National Solid Waste Management Department (NSWMD), in which they must specify a factory or premises approved by local authorities and include a permit compliance letter from the Department of

⁷⁷ Petrik, J. Ismawati, Y., DiGangi, J., Arisandi, P., Bell, L., Beeler, B. 2019. Plastic Waste Poisons Indonesia's Food Chain. *International POPs Elimination Network (IPEN)*. Accessed online at https://ipen.org/sites/default/files/documents/indonesia-egg-report-v2_0-web.pdf

⁷⁸ Ecoton, (2019), Investigation report: Permit Violations and Environmental Impact of Importing Paper Waste on the Brantas River

⁷⁹ Karmini, N. Ibrahim, A. (2019). Indonesia to send 'contaminated' waste back to West. *The Independent*, 18 September 2019. Available at: <https://www.independent.co.uk/news/world/asia/indonesia-plastic-waste-west-contaminated-containers-a9110611.html>

⁸⁰ Greenpeace.org. 2019. *Data from the global plastics waste trade 2016-2018 and the offshore impact of China's foreign waste import ban*. Accessed online at: <http://www.greenpeace.org/eastasia/Global/eastasia/publications/campaigns/toxics/GPEA%20Plastic%20waste%20trade%20-%20research%20 briefing-v1.pdf>

⁸¹ Global Alliance for Incinerator Alternatives (GAIA), 2019, Discarded: Communities on the Frontlines of the Global Plastic Crisis 2019, Accessed online at: <https://www.no-burn.org/wp-content/uploads/Report-April-22.pdf>

⁸² Ananthalakshmi, A. 2018, October 26. Malaysia to curb imports of plastic waste - minister (A. Roche, Ed.). Accessed online at: <https://www.reuters.com/article/us-malaysia-waste-imports/malaysiato-curb-imports-of-plastic-waste-ministeridUSKCN1N028P>

Environment. In late 2018 the government also introduced 18 conditions⁸³ that importers must fulfil, including the provision that only post-consumer plastic wastes, or plastic waste generated in industrial facilities that are homogenous and clean are allowed to be imported. The Malaysian government reported they had shut down 139 plastic recycling factories since July 2018, which were either illegal or did not comply with environmental regulations.⁸⁴

However, despite extensive regulations, the Malaysian government are not able to strictly enforce these regulations. One interviewee noted that the government regulations had led to a significant reduction in illegal imports and the closing of hundreds of factories. However, interviewees also noted that traders found loopholes and pollution from plastic waste is still ongoing. Illegal plastic recycling facilities are located close to port areas, and one interviewee noted that when they were shut down they may move to another state. Authorities have also found that plastic waste consignments come through ports that have lower capacity and infrastructure to check containers. According to one interviewee, waste is bypassing major ports and is being smuggled directly to coastal villages on open barges from Indonesia and Thailand. In addition, the government has revealed that importers are falsifying declaration forms, bringing in plastic scraps by using other HS codes.⁸⁵

Trade in plastic waste places a significant burden on the Malaysian Government as they are left with the cost and the responsibility of enforcing environmental regulations and monitoring illegal recycling activities on a much greater scale than previously. While funding for monitoring and enforcement is already limited, these resources are further stretched by the fact that the government do not receive tax revenue from illegal operators.

The inability to control the emergence of illegal recycling facilities and imports of contaminated plastic waste led the government to temporarily ban all imports in 2018, which had adverse economic impacts on licenced recycling facilities. One interviewee noted that during the period, an environmentally sound facility that imports clean LDPE from US supermarkets was no longer able to import.

In addition to enforcement issues, other basic infrastructure and processes required for safe recycling of imported plastics are lacking. These include inefficient storage and collection systems, limited ability to dispose of municipal waste contaminated with toxic waste, and immature record keeping and documentation of waste generation rates and composition. Malaysia was already having difficulty handling their own domestic waste, and imported waste is exacerbating existing issues.⁸⁶ Given the difficulty of enforcing regulations and the lack of infrastructure to safely manage this waste, some NGOs have called for a ban on all new Approved Permits (APs) to import plastic.

Extensive regulations have been introduced across all major importing countries, including bans, standards, licencing systems and inspections. An overview of the key measures implemented in Malaysia, Indonesia and Vietnam is provided in Table 5. In addition, India banned the import of all types of plastic waste in 2019, Thailand indicated in 2018 that plastic waste imports could be banned by 2021⁸⁷ and Taiwan introduced regulations to limit the types of plastic scrap that could be imported.⁸⁸

⁸³ Conditions of Import of Plastic Wastes H.S Code 3915: Accessed online at: https://jpspn.kpkt.gov.my/resources/index/user_1/Pelesenan/Pengimportan_Sisa_Plastik/Syarat_Syarat_Baharu_Pengimportan_Sisa_Plastik.pdf

⁸⁴ Azizi, N. A. 2019. War on illegal plastic waste intensifies. *New Straits Times*. Accessed online at: <https://www.nst.com.my/news/nation/2019/02/463544/war-illegal-plastic-waste-intensifies>

⁸⁵ Malay Mail. 31 May 2019. Minister: Customs' scanners can't tell if plastic is contaminated, illegal importers exploited loophole. Accessed online at: <https://www.malaymail.com/news/malaysia/2019/05/31/minister-customs-scanners-cant-tell-if-plastic-is-contaminated-illegal-imp/1758087>

⁸⁶ The Star. 16 July 2019. Malaysia is overflowing with waste and we're running out of options. Accessed online at: <https://www.thestar.com.my/lifestyle/living/2019/07/16/plastic-waste-landfills>

⁸⁷ Zein, Z. Thailand to ban plastic waste imports by 2021. *Eco-business*, 17 October 2018. Available at: <https://www.eco-business.com/news/thailand-to-ban-plastic-waste-imports-by-2021/>

⁸⁸ Global Alliance for Incinerator Alternatives (GAIA), 2019, Discarded: Communities on the Frontlines of the Global Plastic Crisis 2019, Accessed online at: <https://www.no-burn.org/wp-content/uploads/Report-April-22.pdf>

The limited human and financial resources for monitoring and enforcement of imports was mentioned by all interviewees as a major challenge. The limited capacity of importing countries to undertake greater regulatory enforcement highlights the need for regional or international efforts. This could include greater responsibilities for exporting countries and the requirement for exporting countries to notify states and seek consent from countries that are importing controlled mixed plastic waste, as will be required from 2021 in the amendments to the Basel Convention.

Table 5: Summary of policy responses to impacts of plastic waste imports in Malaysia, Indonesia and Vietnam

| Country (source) | Standards for imports | Bans and phase outs | Environmental compliance of facilities | Import licences | Customs inspections | Deposits or levies | % maximum of imports used in the factory |
|--|---|--|--|---|--|---|--|
| Malaysia (Conditions of Import of Plastic Wastes H.S Code 3915. Enforcement date: 28 October 2018) ⁸⁹ | Plastic waste must be from industrial or post-consumer sources and be clean and homogenised to be used for recycling only | A temporary ban of plastic waste imports in July 2018. In October 2018, the government announced a permanent ban on importing plastic waste by 2021. | Importing facilities must apply for a Compliance Letter from the Department of Environment (DOE) | Companies need to apply for an Approved Permit (AP) with the National Solid Waste Management Department (NSWMD) before ships are loaded at ports. The Compliance Letter, an exporter/supplier approval letter, a photo of the waste, invoice and business licence are required to import. | Inspection of containers at the port by customs officers | Import levy and bank guarantee are being considered. | Facilities must not use more than 70% imported waste, to encourage use of domestic plastic waste. Facilities are inspected and granted licences for 70% of their machinery capacity. |
| Indonesia (interview data on Ministry of Trade Regulation 84/2019) | Standard on allowable contamination of paper waste are currently being debated | Has banned imports of plastic waste, but paper imports are still allowed. | Importing facilities must have a letter from the Ministry of Environment and the EPA | | Inspection of facilities (rather than at the port) | | |
| Vietnam (interview data) | National technical standards on quality, type of waste and cleanliness | New licences / quotas have been stopped. From 2025 plastic can only be imported for manufacturing products, not for pre-processing and on-selling or exporting as a resin. | | Certificate granted to recycling facilities by Ministry of Natural Resources and Environment (MONRE) to guarantee environmental standards at the facility – EIA and EMS required | Inspection of containers at the port by customs officers | Importers have to deposit 10-20% of total value of shipment to the government (depending on size of shipment), the deposit is used to manage the waste if it doesn't meet national standard | |

⁸⁹ Malaysian Government (2018). SYARAT-SYARAT PENGIMPORTAN SISA PLASTIK H.S. CODE 3915 [English translation: Conditions of Import of Plastic Wastes H.S Code 3915] Available online at: https://jpspn.kpkt.gov.my/resources/index/user_1/Pelesenan/Pengimportan_Sisa_Plastik/Syarat-Syarat_Baharu_Pengimportan_Sisa_Plastik.pdf

Trade reducing plastic leakage

In this report, we consider leakage to be plastics entering the environment in an uncontrolled way, essentially becoming litter. In this section of the report, we set out to find examples of where trade has helped to reduce leakage. As discussed previously, only a very small proportion of coastal and waterway litter is actually recyclable and therefore tradeable. Amongst these most common types of litter, it is primarily beverage containers and takeaway containers that are recyclable. Consequently, in the examples we found, container deposit schemes (CDS) for beverage containers provided the clearest link between trade and a reduction in litter.

Access to export markets through clean stream collection in Palau

Palau is an island state located in the western Pacific Ocean, directly east of the Philippines, and has one of the most successful waste management and recycling systems of the Pacific Island countries. Approximately 77% of the population has access to waste collection services and there are numerous awareness programs, policies and infrastructure in place to encourage recycling.⁹⁰

Palau is distinctive amongst Pacific Island countries as it has a Beverage Container Deposit and Redemption Program to increase collection of glass, PET, HDPE or metal containers. A US \$0.10 fee is applied to all types of beverage containers at import, and consumers pay an US \$0.10 extra per PET bottle at purchase and receive US \$0.05 upon return.⁹¹

Previously, beverage containers were one of the most visible forms of pollution around the island, and this had a major impact on tourism.⁹² However the container deposit scheme has enabled a significant increase in beverage container recovery. A study undertaken by APWC for the UN Environment Program found that Palau has imported approximately 140 million beverage containers and nearly 90% have been returned, since the scheme was established in 2011 until 2019.⁹³

In the past, Palau struggled to find buyers for collected PET.⁹⁴ However, PET is now typically exported to Taiwan for processing along with aluminium cans. Aluminium cans are more valuable, and their collection and export facilitates the export of plastics. APWC interviews with stakeholders in Palau explained an agreement between the Palau government and scrap traders, where they trade valuable aluminium bales if they also collect the less valuable PET and some harder to recycle mixed plastics. Other plastics collected for recycling, either through the scheme or through other recycling collection (including HDPE, LDPE and PP), are not exported but used for energy through a waste plastic-to-oil pyrolysis machine.⁹⁵

Island states like Palau are challenged by finite space, sensitive ecosystems and low recycling volumes. However, even with very low volumes of recyclables, the clean streams of aluminium and PET enabled by the Container Deposit and Redemption Program facilitates trade and enables recycling. Without this end market, the containers could end up used for energy recovery, or in an uncontrolled landfill where they could leak into the environment.

The export arrangement set up in Palau facilitates aggregation of recyclables to enable the economies of scale required for plastic reprocessing. This is in contrast to other Pacific Islands, such as the Solomon Islands, which are located to the east of Papua New Guinea and northwest of Vanuatu. In the Solomon Islands less than half of the country's waste is collected and processed; the remainder is burnt, buried, dumped at sea or leaked into the environment. Beverage containers are often reused within communities for water or fuel, however, due to the lack of recycling they are also typically buried, burnt or dumped. The Solomon Islands does not have a broad CDS system for the collection of aluminium and plastic bottles.⁹⁶

⁹⁰ Bureau of Public Works (BPW), (2016). National Solid Waste Management Strategy: The Roadmap towards a Clean and Safe Palau 2017 to 2026. <https://www.sprep.org/attachments/VirLib/Palau/palau-national-solid-waste-management-strategy.pdf>

⁹¹ APWC (2020). Palau – Waste Audit Report. UN Environment Program.

⁹² https://www.sprep.org/attachments/j-prism/events/2013/Nov/1._Manual_for_Beverage_Container_Deposit_Fee_Program.pdf

⁹³ APWC (2020). Palau – Waste Audit Report. UN Environment Program.

⁹⁴ MPIIC. (2014). Beverage Container Recycling Program: Annual Report FY 2011-2014.

⁹⁵ APWC (2020). Palau – Waste Audit Report. UN Environment Program.

⁹⁶ APWC (2019). Solomon Islands – Waste Data Report, 13/4/2019, for Centre for Environment Fisheries & Aquaculture Science

Volumes of recyclables are relatively small, there are a lack of collection systems and there is a lack of exposure to trading opportunities. Recycling is also hampered by prohibitive shipping costs, geographic issues and a lack of recycling infrastructure. Shipping between the Solomon's outer and inner islands is expensive, and shipping recyclables overseas becomes more so, as an export tax is imposed.⁹⁷ Greater access to trading opportunities might create incentives to collect recyclables and improve collection systems overall.

Increasing clean stream collections in Australia to maintain trade

Australia's recycling system has increasingly relied on waste exports since the 1990s to enable processing of recyclables.⁹⁸ Prior to the restrictions on imports that were initially imposed by China and later by Southeast Asian countries, exports included mixed plastics as well as single polymer bales. Two operators of Material Recovery Facilities (MRFs) that were interviewed for this study explained that with restrictions on imports of plastics into Southeast Asia during 2018-2019, mixed plastics have become nearly impossible to trade. However, they report that single polymer bales of PET and HDPE still have a strong market, domestically and internationally. Both interviewees pointed to the need for more single stream processing to ensure markets for recovered plastics. Australia has now moved to ban exports of waste plastics, banning mixed plastic exports from July 2021 and single resin/polymer exports from July 2022.⁹⁹

Bales of mixed plastics represent challenges to reprocessors due to the difficulty in sorting the wide array of plastic types, and the low value of those plastics. Exporting mixed plastics bales has ensured ongoing collection of hard plastics in kerbside collection systems in Australia and diversion from landfill. However, sorting mixed plastics bales has been a major source of leakage in destination countries as they struggle to manage sorting and treatment of residual plastics. With restrictions on the import of mixed plastics in most Asian countries, several things have changed. Bales of mixed plastics are being stockpiled or landfilled as they can no longer be traded. While this situation has been extremely challenging for the Australian recycling industry, the trade restrictions are beginning to drive improvements in the Australian recycling system.

Australian recyclers are now investing in better sorting technology to develop cleaner streams of plastics and aiming to minimise residuals as much as possible. Both MRF operators that we interviewed explained that they had recently invested in optical sorting technology to sort polypropylene (PP), which would have previously been included in mixed plastics bales. The COVID-19 pandemic has reduced international trade even further, however, Australian recyclers are confident that when trade reopens, single stream bales (including PP) will have a stronger international market. At the moment, Australian recyclers are competing to sell their single stream bales, as there are a limited number of domestic buyers. The interviewees felt that the reopening of international trade will ensure better prices for quality bales of single stream plastics. However, trade in single stream waste plastics will only be allowed until July 2022, when the Australian Government's export ban will take effect.

Plastic traders in Australia are now doing more due diligence with regard to their trading partners. This includes checking certifications including import licences, quality standards, environmental credentials and information about wastewater treatment at the overseas recycling facility. Recyclers in Australia that we interviewed have also visited destination recycling facilities to verify their process.

The collection and sorting of single stream plastics has also been supported by broader uptake of container deposit schemes (CDS) in Australia in recent years. The CDS scheme in New South Wales has resulted in a 33% reduction in litter from drink containers since 2017 when the scheme was introduced,¹⁰⁰ and has enabled collection of high-quality recycling streams. Recyclers that we interviewed explained that CDS "changes the game", by shifting plastic recovery values from \$/tonne to \$/item, making collection more economic as well as enabling a much cleaner recycling stream. During the recycling crisis that followed

⁹⁷ APWC (2019). Solomon Islands – Waste Data Report, 13/4/2019, for Centre for Environment Fisheries & Aquaculture Science

⁹⁸ Australian Bureau of Statistics, 2013, 4602.0.55.005 - Waste Account, Australia, Experimental Estimates, 2013. Available online at:

<https://www.abs.gov.au/ausstats/abs@.nsf/Products/4602.0.55.005~2013~Main+Features~Australia%27s+International+Trade+in+Waste?OpenDocument>

⁹⁹ Australian Government Department of Agriculture Water and the Environment, n.d. Waste Export Ban. Available online at: <https://www.environment.gov.au/protection/waste-resource-recovery/waste-export-ban>

¹⁰⁰ <https://wastemanagementreview.com.au/nsw-litter-reduce-third/>

China's ban on exports, Australian states that had CDS had mitigated some of their risk, as CDS helped to reduce the overall quantity of plastics that required sorting at MRFs.¹⁰¹ In addition, CDS provided sorted clean streams of PET that were more valuable and easier to trade.

There has been some recent investment in reprocessing capacity in Australia to manufacturing of recycled resin, but very large volumes of plastics are required, as well as significant end markets, to make it economically viable compared to exporting. According to one interviewee, local processing of plastics would require higher fees for kerbside collection. The other major challenge in Australia is a lack of market demand from manufacturing that requires plastic inputs. One interviewee noted that there is a small amount of processed resin that is exported, but it is less profitable than exporting the unprocessed bales. As interviewees highlighted, plastics need to return to the places where products are manufactured, otherwise they will be replaced with virgin resin. Without trade, more plastics will be lost to the economy and end up in landfill.

Summary of links between trade and leakage

Trade has the potential to reduce leakage in exporting countries as it enables recycling of collected plastics, however, this process can transfer leakage to importing countries which generally have less capacity to manage environmental pollution. In Pacific Island Countries, which do not have large enough volumes of plastic to encourage recycling domestically, the potential to export may encourage the development of waste collection systems.

In major importing countries, trade has had a direct impact on increasing leakage through disposal of residuals to uncontrolled landfills or dumping directly to waterways, through washing of plastics in informal recycling facilities and from uncontrolled stockpiles. This is driven by the export of poorly sorted or contaminated bales, and the smuggling and incorrect labelling of imports. In some cases, the import of plastics can reduce demand and prices for locally collected plastics, which may contribute to leakage of domestic plastic waste.

Trade practices can be improved to reduce leakage in importing countries. However, importing countries need further investment and support for enforcement of trade regulations and environmental safeguards, otherwise leakage may continue. The following section provides a summary of environmentally responsible trade principles and practices.

¹⁰¹ Envisage Works, IndustryEdge & Sustainable Resource Use (2019), Recovered Resources Market Bulletin November 2019, <https://www.sustainability.vic.gov.au/Business/Investment-facilitation/Recovered-resources-market-bulletin>

7. Defining Environmentally Responsible Trade

There is no established definition for the concept of “environmentally responsible trade” (ERT). A key objective of this study was to develop a framework to define ERT, in order to examine its potential to address domestic waste management issues in trading countries. In the first instance, we consider ERT to be a series of principles and practices that avoid and mitigate the environmental harm that can arise due to trade, in this case of plastic waste. We have proposed the following principles that could help to define ERT.

Principles

- ERT avoids trade if there is a local alternative
- ERT enables productive recycling and use of waste materials
- ERT promotes recycling or reduces leakage at the source
- ERT does not transfer or increase leakage at the destination
- ERT does not transfer the burden of unrecyclable waste from one location to another
- ERT does not cause social or environmental harm at the destination

Interviewee perspectives on what could enable environmentally responsible trade

In addition to these principles, we asked interviewees what measures would be needed to enable environmentally responsible trade (ERT). When asking interviewees, we did not offer a definition or principles of ERT. Interviewees had a range of perspectives on what would constitute environmentally responsible trade. Several interviewees suggested that trade in processed resin would be the best way to eliminate environmental impacts in receiving countries. Processed resin is valuable and needed for packaging and manufacturing in receiving countries. Interviewees also suggested that only single stream plastics should be traded, or plastics that are very easy to sort. All interviewees pointed to the need for tighter controls, and greater enforcement, however, the likelihood of this being effective is diminished by the lack of institutional capacity and resources in all receiving countries in Southeast Asia. Several interviewees expressed a view that exporting countries had a responsibility to support importing countries with managing plastic waste imports. Others highlighted that transporting waste should be avoided if possible to reduce carbon footprints and environmental impacts.

Interviewees had mixed views on whether recycling of plastic waste imports could be a long-term sustainable industry for importing countries. Many interviewees noted that there is pushback from the plastics recycling sector to restrict or ban imports, as they claim it will impact local manufacturing. However, interviewees noted that a large proportion of reprocessed waste plastics is exported. For example, Vietnam and Thailand export the majority of recycled resin to China rather than using it in manufacturing, while only using a small proportion of recycled plastic is used in local production. An interviewee from Thailand noted that importing plastic could have a benefit if recycling facilities were located alongside industry that could use the recycled materials and encourage the development of a circular economy, but if resin continues to be exported then it has little benefit for the country. An interviewee from Malaysia noted that Chinese recycling facilities imported workers and machinery, and exported processed resin to China, so it had little economic benefit for the country. However, some interviewees also noted that the industry can provide significant employment and felt that trade with more environmentally responsible practices was possible, and happening in some cases. Others noted that they felt the trade in waste plastic should be stopped altogether, as it wasn't possible for countries to effectively enforce the industry.

Table 6 summarises the issues that were raised during interviews, the mitigation measures suggested by interviewees and a series of eight practices for ERT that could help to define and establish a framework for assessing ERT. The first four practices are essential and should be prioritised. These are supported by practices 5 and 6 in the medium-term, and practices 7 and 8 will contribute to longer-term sustainability. It is important to note that many of these practices align with the requirements of the amendments to the Basel Convention that will come into force from 2021, which place strict requirements on the trade of mixed plastics, and may therefore encourage trade of single stream clean bales. An overview of the implications on the Basel Convention amendments is discussed following Table 6.

Table 6: Environmental issues associated with the plastic waste trade, suggested mitigation measures and proposed practices for ERT

| Issue | Suggested measures from interviews | Proposed ERT practice | Exporter responsibility | Importer responsibility |
|---|---|---|-------------------------|-------------------------|
| Poorly sorted and contaminated bales | Better sorting and management in source countries Increased responsibility to ensure quality by source countries | 1. Improve collection and sorting in export countries to significantly decrease or eliminate unrecyclable plastics from traded bales | X | |
| Limited capacity to safely process mixed plastics and inability to recycle numerous polymer types | Implement extended producer responsibility programs to collect cleaner streams such as through a container deposit 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 Ban single use plastics and packaging Trade only in processed recycled resin | 2. Trading of uncontaminated, pre-sorted, recyclable plastics that do not contain any non-recyclable material and have been prepared for immediate recycling (Basel Convention conditions) | X | |
| Significant environmental impacts in import countries, exacerbated by: - Informal facilities - Waste smuggling and false labelling - Lack of resources for monitoring and enforcement in import countries | Strict standards on imports and clear definitions Use of import licences Use of Prior Informed Consent (PIC) procedures as per Basel Convention for mixed or hazardous plastics Integrate informal sector into formal waste management sector Improve machinery in the informal recycling sector – to reduce energy consumption and improve wastewater quality. In informal settings, wastewater treatment can be as simple as having a settling tank to collect plastic solids from wastewater Increase monitoring and enforcement of imports and processing facilities – limited by budget and capacity Global accreditation of environmentally responsible recycling facilities Export bans to countries or facilities that don't meet standards for sorting and processing | 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 provide insurance for the management of bales that don't meet standards | | X |
| | | 4. Ensuring the importing country has adequate processing facilities to process plastic waste in an environmentally responsible way | X | |
| | | 5. Checking that the importing country has the institutional capacity to monitor and enforce environmental regulations | X | |
| | | 6. Checking shipments and contamination levels at point of export and import and ensure accurate labelling of bales | X | X |
| Lack of monitoring data and accountability | Transparent information, regarding volumes imported and exported, with a marketplace to monitor supply and demand and therefore monitor leakage Ensure traceability and accountability of traded plastic waste Develop regional policies to manage trade impacts and stop the flow of waste from one country to another. Regional policy should encourage the destination country's waste management to improve. Exporting countries can coordinate exports and set export standards | 7. Increasing transparency of traded volumes, enabling traceability and accountability for both export and import countries 8. Improve national and regional oversight to minimise shifting of waste over borders | X | X |

The Basel Convention and restriction on future trade in plastic waste

The *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* was originally developed to control the movement of hazardous waste between countries for the purpose of disposal.¹⁰² In 1995, an amendment referred to as the Basel Ban was adopted to also restrict the transfer of hazardous waste for recycling or recovery, however it did not come into force until 2019.¹⁰³ This amendment has been implemented by 98 of the 187 parties to the Convention at regional and national levels.¹⁰⁴ Countries such as Australia that have not ratified the Basel Ban Amendment are still able to export hazardous waste to developing countries that have not ratified the amendment. Countries that have implemented the Basel Ban Amendment are prohibited from the export of hazardous waste from 2021.¹⁰⁵

In May 2019 the Conference of the Parties to the Basel Convention amended Annexes II, VIII and IX of the Convention relating to plastic waste through the adoption of decision BC-14/12.¹⁰⁶ Under these amendments, plastic waste is categorised into three legal designations:

- ‘Non-hazardous plastic waste’: Pre-sorted, recyclable plastics that are destined for recycling in an environmentally sound manner and almost free from contamination and other types of wastes. These plastics are controlled by the new entry B3011 in Annex IX, which replaces the current entry B3010.
- ‘Hazardous plastic waste’: Plastics containing or contaminated with controlled wastes, such as clinical, pharmaceutical and PCB wastes, or waste that is infectious, corrosive, flammable or poisonous. These plastics are controlled with the addition of new entry A3210 in Annex VIII.
- ‘Plastic waste requiring special consideration’: All other plastic waste (except for the plastic waste covered by entries B3011 and A3210 as noted above), including mixtures of plastic waste, are controlled with the addition of new entry Y48 into Annex II.

The amendments will come into force on 1 January 2021, and will affect all 187 Basel parties and potentially non-party trading partners, including the United States. However, the United States has objected to the changes being incorporated into the OECD decision, which will potentially result in each country being able to determine whether it follows Basel or current OECD rules.¹⁰⁷ Parties to the Basel Convention can no longer import, or ship newly controlled plastic waste to and from non-parties, except where the transfers are controlled under special regional or bilateral arrangements with standards equivalent to those in the Basel Convention.

Non-hazardous plastic waste

Under these new conditions, shipments of non-hazardous plastic waste must be destined for recycling in an environmentally sound manner and consist ‘almost exclusively’ of one plastic type. Specifically, the following plastic or mixed plastics may be included as non-hazardous if they meet the conditions below:¹⁰⁸

- Plastic waste almost exclusively of one nonhalogenated polymer, including but not limited to the following: Polyethylene (PE), Polystyrene (PS), Acrylonitrile butadiene styrene (ABS), polyethylene terephthalate (PET), Polycarbonates (PC).

¹⁰² Basel Convention, supra note 2, art. 1.1(a).

<https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf>

¹⁰³ Decision III/1 Amendment to the Basel Convention, U.N. Doc. UNEP/CHW.3/35 (Nov. 28, 1995).

<http://www.basel.int/Portals/4/Download.aspx?d=UNEP-CHW-COP.3-BC-III-1.English.pdf>

¹⁰⁴ Khan, S, 2019, Basel Convention Parties Take Global Lead on Mitigating Plastic Pollution,

<https://www.asil.org/insights/volume/23/issue/7/basel-convention-parties-take-global-lead-mitigating-plastic-pollution>

¹⁰⁵ Amendment to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, <http://www.basel.int/Countries/StatusofRatifications/BanAmendment/tabid/1344/Default.aspx>

¹⁰⁶ BC-14/12: Amendments to Annexes II, VIII and IX to the Basel Convention,

<http://www.basel.int/Portals/4/download.aspx?d=UNEP-CHW-COP.14-BC-14-12.English.pdf>

¹⁰⁷ Khan, S, 2019, Basel Convention Parties Take Global Lead on Mitigating Plastic Pollution,

<https://www.asil.org/insights/volume/23/issue/7/basel-convention-parties-take-global-lead-mitigating-plastic-pollution>

¹⁰⁸ Alder, A. R, (2019) Basel Convention Plastic Amendments: report by the Institute of Scrap Recycling Industries (ISRI) <https://nrc.org/documents/conferences/Fall%202019%20Conference/Basel%20Convention%20Plastics%20AmendmentAdina%20AdlerFall%202019.pdf>

- Plastic waste almost exclusively consisting of one cured resin or condensation product¹⁰⁹ or fluorinated polymer wastes.¹¹⁰
- 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.¹¹¹

The term ‘almost exclusively’ is used to allow for international and national specifications. Plastics that meet these conditions will not be subject to the controls that apply to Annexes II and VIII.

Hazardous plastic waste and plastic waste requiring special consideration

Exports of plastic waste included under Annexes II and VIII are subject to extensive controls, including: an obligation to ensure environmentally sound management (ESM); the application of the Prior Informed Consent mechanism (PIC); information transmission requirements; mandatory packaging, labelling, and transport and authorisation requirements for traders and processors.¹¹²

According to the convention the obligation to ensure ESM means “taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes”.¹¹³ When ESM cannot be completed, exporters have an obligation to re-import.¹¹⁴

The PIC procedure sets strict requirements for transboundary movements of hazardous wastes and other wastes.¹¹⁵ After an importer and exporter have made an agreement to trade waste, the exporter applies to the exporting country and the exporting country sends a notification of prior notice to the importing country and all transit countries. The importing country is then responsible for checking the capacity of the importing disposal facility before issuing the consent notice and issuance of movement document to the exporting country. The exporter is then issued an export permit and the export can take place. The last stage is confirmation of disposal by the importer.¹¹⁶

The documentation for the PIC for the transboundary movements of relevant wastes is still paper based in many countries, with documents mainly exchanged by email, post, and fax. The Conference of the Parties is hoping to establish electronic approaches to the notification and movement documents more widely to improve efficiency and decrease the administrative burden.

There is also a requirement that Parties commit to packaging, labelling and transporting hazardous and other wastes “...in conformity with generally accepted and recognized international rules and standards in the field of packaging, labelling, and transport, and that due account is taken of relevant internationally recognized practices”.¹¹⁷

¹⁰⁹ Including urea formaldehyde resins, phenol formaldehyde resins, melamine formaldehyde resins, epoxy resins or alkyd resins

¹¹⁰ Including Fluorinated ethylene propylene (FEP), Perfluoroalkoxy alkanes (PFA), tetrafluoroethylene perfluoromethylvinylether (MFA), Polyvinyl fluoride (PVF), Polyvinylidene fluoride (PVDF)

¹¹¹ Alder, A. R. (2019) Basel Convention Plastic Amendments: report by the Institute of Scrap Recycling Industries (ISRI) https://nerc.org/documents/conferences/Fall%202019%20Conference/Basel%20Convention%20Plastics%20Amendment_Aldina%20Adler_Fall%202019.pdf

¹¹² Basel Convention, supra note 2, arts. 4, 8. <https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf>

¹¹³ Basel Convention, supra note 8, art. 2. <https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf>

¹¹⁴ Basel Convention, *Framework for the environmentally sound management of hazardous wastes and other wastes* <http://www.basel.int/Implementation/CountryLedInitiative/EnvironmentallySoundManagement/ESMFramework/tabid/3616/Default.aspx>

¹¹⁵ Basel Convention, *Electronic approaches to the notification and movement documents*, <http://www.basel.int/Implementation/Controllingtransboundarymovements/eapproachesfornotificationandmovement/Overview/tabid/7375/Default.aspx>

¹¹⁶ Kojima, M., 2019, The impact of recyclable waste trade restrictio on producer’s recycling activities. Presentation at EcoDesign 2019, Yokohama, Japan.

¹¹⁷ Basel Convention, supra note 2, arts. 4, 8. <https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf>

Implications for trade of plastic waste

These amendments to include plastics in the Basel convention have the potential to reduce the amount of plastic leakage into the ocean caused by current trade practices from countries that did not previously control for the types of plastics listed for greater control. In particular, the requirement for exporters to receive Prior Informed Consent from importing countries, may reduce the importation of non-recyclable or contaminated mixed plastics which account for the majority of plastic leaked. This may be achieved through decreased exports of mislabelled or contaminated bales from developed countries, and poor checking practices and corruption in importing country ports.

8. Potential for environmentally responsible trade to reduce leakage

This section of the report sets out to understand the influence of trade on the leakage of plastic wastes into the ocean. Our search of literature and interviews with experts within the Asia-Pacific region helped to identify the specific ways in which trade can contribute to plastic waste leakage. It was more challenging to identify direct links between trade and a reduction in leakage. One reason for this is that the majority of plastics found as litter in coastal areas and waterways globally are not readily recyclable and are therefore not tradeable commodities. Consequently, the impact of trade on leakage varies according to plastic type.

- Trading mixed plastics, mixed recyclables (paper and plastic), and plastics contaminated with unrecyclable materials invariably leads to leakage in the destination country. This is due to the fact that major destination countries such as Indonesia, Malaysia and Vietnam have significant informal sectors, low-tech processing equipment, a lack of environmental controls on discharges and landfills, and limited reward for sorting less valuable plastics.
- Leakage from processing mixed plastics occurs during sorting and washing, due to wind and a lack of wastewater treatment. Leakage also occurs due to residuals being dumped in uncontrolled landfills or directly into waterways.
- Trading clean, single stream plastics limits the potential for leakage as homogenous bales are valuable and sorting processes are not required in the destination country.
- In the major destination countries, there is a lack of data quantifying leakage in general, however, all interviewees felt that leakage from domestic uncollected waste was likely to be more significant than leakage from imported plastics in overall quantity.
- Trade is only likely to help to reduce litter in relation to beverage containers, often with the incentive of container deposit schemes. This is due to the fact that beverage containers are one of the common types of litter that are used away from home, and are also recyclable and tradeable. Other common types of coastal and waterway litter including food wrappers, plastic bottle caps, plastic bags, straws, stirrers etc are either unrecyclable or very low value plastics.

About half of plastic waste intended for recycling was traded globally until recently. Presently, the system is in flux with many countries introducing import bans or very tight restrictions on plastic imports and the upcoming restrictions under the Basel Convention. In addition, the COVID-19 pandemic has significantly slowed international trade. In response to this cascade of restrictions in recent years, many exporting countries are investing in improved processing, including Australia, the United States, European Union and Japan. Therefore, reliance on plastic waste exports is changing and the future is currently uncertain.

Appendices

Appendix A: Plastics Recovery Overview

Reuse

Reuse is defined as the recovery of value from discarded resources without processing or remanufacture, such as the refilling of PET beverage containers. Reuse can reduce leakage by reducing the amount of material that is placed on the market.

Recycling

There are three main recycling pathways: (i) mechanical recycling, (ii) chemical recycling and (iii) organic recycling.

These pathways aim to convert discarded plastic back into materials at the same grade as the original materials (or lower in the case of downcycling). Importantly, the recycled materials substitute for and avoid the use of primary materials in new applications and divert materials from landfill where there may be a risk of leakage.

Closed-loop recycling is where the material from one product is recycled back into the same product system, such as the recycling of PET bottles back into PET bottles. By contrast, open-loop recycling is the conversion of material from one product system into a different product system. Examples of this include the recycling of PET bottles into fibre for use in clothing and other textiles. If the recovered material is of a lower quality and functionality than the original material, then this may be defined as downcycling with different implications for end of life management, described below.

(i) Mechanical recycling uses physical processes including sorting, chipping, grinding, washing and extruding to convert scrap plastics to a usable input for the manufacture of new plastic products

(ii) Chemical recycling involves the use of chemical and thermal conversion processes, such as pyrolysis to convert scrap plastics into a hydrocarbon gas or liquid that is usable as an input for manufacturing plastics resins.

(iii) Organics recycling or “biological recycling” involves micro-biological treatment of “compostable” plastic material. These processes can be under aerobic conditions, such as composting that is characterised by the presence of oxygen (O₂); or anaerobic conditions, such as anaerobic digestion, characterised by the absence of free oxygen (O₂). Aerobic processes yield carbon dioxide (CO₂), water, inorganic compounds and biomass, and anaerobic conditions yield CO₂, methane (CH₄), water, inorganic compounds and biomass.

The terms “compostable” and “biodegradable” are used interchangeably and this can be misleading. “Biodegradable” is a generic term that indicates a polymer can undergo degradation by biological processes, with no detail on breakdown products, time or extent of degradation or end environments.¹¹⁸ This means that products designated as biodegradable may breakdown into microplastics (plastics smaller than 5mm), when subjected to environmental conditions such as sunlight or wave action. “Compostable” indicates a polymer designed to undergo degradation by biological processes to yield CO₂, water, inorganic compounds and biomass at a rate consistent with other known compostable materials and leaves no visible, distinguishable or toxic residue.¹¹⁹ There are accepted industrial standards for compostable packaging, such as “AS4736-2006 Biodegradable plastics suitable for composting and other microbial treatment”. Compliance with accepted industrial standards implies that packaging can fully degrade within a specified timeframe under standard composting conditions and leaves no toxic residue.

Downcycling

Downcycling refers to conversion pathways whereby the material is recovered at a lower quality and functionality than the original material, for example, a mixture of HDPE, low-density polyethylene (LDPE) and polypropylene (PP) into rigid timber substitute products for outdoor furniture. Downcycled materials may be

¹¹⁸ SRU and Helen Lewis Research <http://www.helenlewisresearch.com.au/wp-content/uploads/2014/03/Compostable-DSMG-082013.pdf>

¹¹⁹ ISO 472:2013, Plastics Vocabulary; ISO 17088:2012, Specifications for compostable plastics

more difficult to recycle at end-of-life. This means they may be more likely be disposed of to landfill at end-of-second-life.

Energy recovery

Energy recovery refers to conversion pathways whereby a substantial portion of the thermal energy value in a discarded plastic is recovered. There are a number of treatment processes and technologies including combustion, pyrolysis and gasification that can be used to generate a usable energy from waste in the form of heat, electricity or fuel. This recovery pathway does not avoid the use of primary materials in the new applications; however, it may divert materials from landfill where there may be a risk of leakage.

Summary of definitions of plastics and recycling

| | |
|--|---|
| Biodegradable | A generic term that indicates a polymer is biologically available for microbial decomposition, with no detail on breakdown products, time or extent of degradation or end environments |
| Compostable | Indicates a polymer designed to undergo degradation by biological processes to yield CO ₂ , water, inorganic compounds and biomass at a rate consistent with other known compostable materials and leaves no visible, distinguishable or toxic residue |
| Downcycling | The process of converting discarded material back into raw materials at a lower grade or functionality than the original material to be usable for the manufacture of new products |
| Organics recycling | The treatment of separately collected organics waste by anaerobic digestion, composting or vermiculture (composting using worms) |
| Photo-degradable, landfill degradable or oxo-degradable | Conventional fossil-based polymers (usually polyethylene or polypropylene) that have additives incorporated into the polymer at low rates (2-3%) to provide highly accelerated fragmentation of the plastic in sunlight or in the presence of oxygen or in an anaerobic environment. |
| Recovery | The process of reclaiming resources (material and/or energy) from discarded products. This includes collection, sorting and aggregation to provide material for reuse or recycling. It includes the reprocessing of material to be usable for the manufacture of new products, or the recovery of energy. |
| Recyclate | Scrap material either before or after reprocessing. |
| Recycling | The process of converting discarded material back into raw materials at the same grade as the original material to be usable for the manufacture of new products |
| Reprocessing | An industrial process that changes a material such that it may be used again for the manufacture of new products, e.g. a plastic flaking and washing facility |
| Residual waste | Residual material that is left over after any recovery process |
| Resin | Raw plastic polymer |
| Waste | Any discarded, rejected, unwanted, surplus or abandoned material, including where intended for recovery, or sale. Anything that is no longer valued by its owner for use or sale and which is, or will be, discarded. |

Appendix B: Plastic waste trade data

Table 7: Total exports and imports of plastic waste for countries in Asia Pacific and major economies (2019 Comtrade data)

| Country | Exports (tonnes) | Imports (tonnes) |
|------------------------|------------------|------------------|
| Afghanistan | - | 619 |
| Australia | 133,347 | 9,003 |
| Bhutan | - | 154 |
| Brunei Darussalam | - | 6 |
| Cambodia | 88 | 74 |
| Canada | 142,151 | 166,663 |
| China | 33,728 | 112,996 |
| China, Macao SAR | 230 | 348 |
| EU-28 | 1,166,398 | 166,605 |
| Fiji | 100 | 138 |
| Hong Kong | 232,345 | 606,556 |
| India | 2,597 | 152,342 |
| Indonesia | 25,216 | 238,664 |
| Japan | 898,458 | 18,571 |
| Lao People's Dem. Rep. | 2,413 | 7,419 |
| Malaysia | 11,546 | 910,846 |
| Maldives | - | 1 |
| Mongolia | 120 | 22 |
| Myanmar | 432 | 14,153 |
| Nepal | - | 19 |
| New Zealand | 37,837 | 6,170 |
| Pakistan | 6,744 | 39,116 |
| Palau | 8 | 6 |
| Papua New Guinea | - | 0 |
| Philippines | 105,915 | 14,357 |
| Rep. of Korea | 12,956 | 163,785 |
| Singapore | 16,063 | 1,789 |
| Sri Lanka | 101 | 958 |
| Thailand | 24,699 | 76,866 |
| UK | 283,746 | 89,582 |
| USA | 669,429 | 398,827 |
| Viet Nam | 9,597 | 287,360 |

Table 8: Top flows of plastic waste traded within Asia Pacific (2019 Comtrade data)

| Origin | Destination | Tonnes | USD (thousand) | Reporter |
|--------------------------|----------------------|---------|----------------|--------------------------|
| EU-28 | Malaysia | 404,660 | 90,062 | EU-28 |
| EU-28 | China, Hong Kong SAR | 273,098 | 73,621 | EU-28 |
| Japan | Malaysia | 261,743 | 92,705 | Japan |
| United States of America | Hong Kong | 127,167 | 50,241 | Hong Kong |
| EU-28 | Indonesia | 121,708 | 28,254 | EU-28 |
| Japan | Viet Nam | 116,617 | 43,879 | Japan |
| EU-28 | India | 102,635 | 30,953 | EU-28 |
| Japan | Thailand | 102,333 | 37,632 | Japan |
| Hong Kong | Thailand | 91,625 | 22,834 | Hong Kong |
| Japan | Rep. of Korea | 88,879 | 34,460 | Japan |
| United States of America | India | 85,467 | 32,996 | United States of America |
| Hong Kong | Viet Nam | 80,438 | 25,182 | Hong Kong |
| Japan | Hong Kong | 71,046 | 24,967 | Hong Kong |
| United Kingdom | China, Hong Kong SAR | 62,231 | 13,083 | United Kingdom |
| United States of America | Malaysia | 60,625 | 15,992 | United States of America |
| Hong Kong | Malaysia | 51,128 | 13,800 | Hong Kong |
| Australia | Malaysia | 49,100 | 6,086 | Australia |
| EU-28 | Viet Nam | 44,182 | 9,504 | EU-28 |
| Philippines | China | 38,131 | 37,520 | Philippines |
| United Kingdom | Malaysia | 35,189 | 11,941 | United Kingdom |
| United States of America | Other Asia, nes | 34,765 | 14,726 | United States of America |
| Australia | Indonesia | 34,417 | 6,648 | Australia |
| Mexico | Hong Kong | 33,615 | 18,804 | Hong Kong |
| United States of America | Rep. of Korea | 31,045 | 11,427 | United States of America |
| EU-28 | Pakistan | 29,237 | 7,537 | EU-28 |
| Japan | India | 27,821 | 11,512 | Japan |
| United States of America | Thailand | 27,220 | 8,620 | United States of America |
| United States of America | Indonesia | 24,339 | 10,691 | United States of America |
| EU-28 | China | 23,690 | 9,083 | EU-28 |
| EU-28 | Rep. of Korea | 23,453 | 7,424 | EU-28 |
| United Kingdom | Indonesia | 22,538 | 2,390 | United Kingdom |
| China, Hong Kong SAR | Thailand | 22,378 | 2,865 | Thailand |
| United States of America | Viet Nam | 21,620 | 7,343 | United States of America |
| Japan | Thailand | 21,520 | 2,476 | Thailand |
| Philippines | Viet Nam | 20,136 | 11,467 | Philippines |

Table 9: Exports of plastic waste from Australia (2019 Comtrade data)

| Origin | Destination | Tonnes | USD (thousand) | Reporter |
|-----------|--------------------------|--------|----------------|---|
| Australia | Malaysia | 49,100 | 6,086 | Australia |
| Australia | Indonesia | 34,417 | 6,648 | Australia |
| Australia | Hong Kong | 10,386 | 2,649 | Hong Kong (9,358t reported by Australia) |
| Australia | Thailand | 9,870 | 1,580 | Australia (2,853t reported by Thailand) |
| Australia | Philippines | 7,781 | 578 | Australia (46t reported by Philippines) |
| Australia | Other Asia, nes | 7,621 | 2,299 | Australia |
| Australia | EU-28 | 6,141 | 2,625 | EU-28 |
| Australia | Rep. of Korea | 3,832 | 1,035 | Australia |
| Australia | France | 2,164 | 518 | Australia |
| Australia | Viet Nam | 1,797 | 436 | Australia |
| Australia | Romania | 1,119 | 304 | Australia |
| Australia | Turkey | 1,060 | 248 | Australia |
| Australia | United States of America | 1,001 | 604 | United States of America (161t reported by Australia) |
| Australia | Belgium | 1,000 | 326 | Australia |
| Australia | New Zealand | 824 | 989 | New Zealand (195t reported by Australia) |
| Australia | India | 670 | 199 | Australia (91t reported by India) |
| Australia | Brazil | 597 | 448 | Australia |
| Australia | Mozambique | 547 | 135 | Australia |
| Australia | Myanmar | 523 | 81 | Australia |
| Australia | Ireland | 346 | 98 | Australia |
| Australia | Dominican Rep. | 310 | 22 | Australia |
| Australia | China | 191 | 111 | Australia |
| Australia | Bangladesh | 120 | 45 | Australia |
| Australia | Spain | 111 | 48 | Australia |
| Australia | Japan | 95 | 33 | Australia |
| Australia | Pakistan | 61 | 25 | Pakistan |
| Australia | Mexico | 58 | 10 | Australia |
| Australia | Nigeria | 50 | 30 | Australia |
| Australia | Bulgaria | 45 | 25 | Australia |
| Australia | Russian Federation | 40 | 9 | Australia |
| Australia | Panama | 39 | 18 | Australia |
| Australia | Singapore | 37 | 8 | Singapore |
| Australia | Germany | 36 | 11 | Australia |
| Australia | United Arab Emirates | 36 | 5 | Australia |

| | | | | |
|-----------|--------------|----|----|-----------|
| Australia | Canada | 32 | 16 | Canada |
| Australia | Saudi Arabia | 16 | 6 | Australia |
| Australia | Cambodia | 16 | 16 | Australia |
| Australia | Switzerland | 14 | 2 | Australia |
| Australia | Singapore | 12 | 14 | Australia |

Table 10: Imports of plastic waste into Australia (2019 Comtrade data)

| Origin | Destination | Tonnes | USD (thousand) | Reporter |
|--------------------------|-------------|--------|----------------|---|
| EU-28 | Australia | 3,879 | 1,369 | EU-28 |
| New Zealand | Australia | 3,348 | 161 | New Zealand (399t reported by Australia) |
| China | Australia | 1,416 | 811 | Australia |
| Germany | Australia | 1,193 | 853 | Australia |
| Belgium | Australia | 1,182 | 799 | Australia |
| Thailand | Australia | 835 | 821 | Thailand |
| Rep. of Korea | Australia | 819 | 484 | Australia |
| Japan | Australia | 809 | 501 | Australia (61t reported by Japan) |
| Spain | Australia | 697 | 477 | Australia |
| Indonesia | Australia | 514 | 366 | Australia |
| Singapore | Australia | 455 | 327 | Singapore |
| Netherlands | Australia | 359 | 219 | Australia |
| Other Asia, nes | Australia | 274 | 166 | Australia |
| Portugal | Australia | 183 | 94 | Australia |
| United States of America | Australia | 178 | 800 | United States of America |
| Viet Nam | Australia | 169 | 87 | Australia |
| Fiji | Australia | 100 | 59 | Australia |
| Singapore | Australia | 89 | 96 | Australia |
| Sweden | Australia | 89 | 59 | Australia |
| United Kingdom | Australia | 78 | 36 | Australia (1t reported by United Kingdom) |
| India | Australia | 53 | 23 | Australia (30t reported by India) |
| United States of America | Australia | 48 | 57 | Australia |
| Hong Kong | Australia | 46 | 6 | Hong Kong |
| Philippines | Australia | 41 | 17 | Australia |
| Finland | Australia | 39 | 27 | Australia |
| Pakistan | Australia | 26 | 19 | Pakistan |
| France | Australia | 2 | 2 | Australia |

Appendix C: Additional data on leakage

Table 11: Schmidt et al¹²⁰ findings of mismanaged plastic waste and plastic loads for the top ten catchments, sorted by mismanaged plastic waste (MMPW)

| River | Receiving Sea | Continent | Catchment Area [km ²] | MMPW Generation per capita [kg d ⁻¹] | Population | Population density [per km ²] | MMPW generated in the catchment [tons y ⁻¹] | Microp. load Model 1 [tons y ⁻¹] | Microp. load Model 2 [tons y ⁻¹] | Macrop. load [tons y ⁻¹] |
|-----------------------------|-----------------------------|-----------|-----------------------------------|--|------------|---|---|--|--|--------------------------------------|
| Chang Jiang (Yangtze River) | East China Sea (Yellow Sea) | Asia | 1907295 | 0.092 | 503258473 | 264 | 16883704 | 1469481 | 85440 | 69282 |
| Indus | Arabian Sea | Asia | 854106 | 0.069 | 191277131 | 224 | 4809288 | 164332 | 12378 | 11977 |
| Huang He (Yellow River) | Yellow Sea | Asia | 761437 | 0.092 | 122167489 | 160 | 4098569 | 124249 | 9678 | 9561 |
| Hai He | Yellow Sea | Asia | 211489 | 0.092 | 102782394 | 486 | 3448223 | 91858 | 7434 | 7515 |
| Nile | Mediterranean | Africa | 2851708 | 0.049 | 182955620 | 64 | 3293385 | 84792 | 6919 | 7043 |
| Meghna, Bramaputra, Ganges | Bay of Bengal | Asia | 1571571 | 0.013 | 620596218 | 395 | 3017170 | 72845 | 6039 | 6230 |
| Zhujiang (Pearl River) | South China Sea | Asia | 388705 | 0.092 | 74999426 | 193 | 2515374 | 52958 | 4577 | 4823 |
| Amur | Sea of Okhotsk | Asia | 2004785 | 0.089 | 64344272 | 32 | 2086763 | 38267 | 3429 | 3708 |
| Niger | Gulf of Guinea | Africa | 2090967 | 0.059 | 92689954 | 44 | 1989695 | 35196 | 3185 | 3469 |
| Mekong | South China Sea | Asia | 771941 | 0.086 | 61740094 | 80 | 1931483 | 33431 | 3044 | 3330 |

Table 12: Share of mismanaged waste for each region, the total amounts of plastic Municipal Solid Waste (MSW), and amount of plastic waste lost to the environment¹²¹

| Regions | Mismanaged share of MSW | Mismanaged plastic MSW [million tonnes/yr] | Amount lost to the environment [million tonnes/yr] |
|--------------------------------------|-------------------------|--|--|
| NAFTA (incl. rest of North America) | No mismanaged waste | | |
| Western Europe | No mismanaged waste | | |
| Japan | No mismanaged waste | | |
| Central Europe & CIS | 1% | 0.12 | 0.01 |
| Asia (excl. Japan, India, and China) | 17% | 5.09 | 0.51 |
| Africa | 93% | 9.47 | 0.95 |
| Latin America & Caribbean | 31% | 8.86 | 0.89 |
| Oceania | No mismanaged waste | | |
| India | 90% | 3.87 | 0.39 |
| China | 32% | 3.75 | 0.37 |
| Middle East | 53% | 7.53 | 0.75 |
| Total | | 38.70 | 3.87 |

¹²⁰ Schmidt, C., et al. 2018. Export of plastic debris by rivers into the sea. *Environmental science & technology*, 51(21), pp.12246-12253.

¹²¹ United Nations Environment Programme (2018) *Mapping of global plastics value chain and plastics losses to the environment (with a particular focus on marine environment)*. Ryberg, M., Laurent, A., Hauschild, M. United Nations Environment Programme. Nairobi, Kenya

Appendix D: Interview questions

1. Can you give an overview of plastic trade and recycling in [focus country]? e.g.:
 - a. What is the exporting / licencing / import process?
 - b. What types of plastics are usually traded (e.g. mixed/single-stream bales)
 - c. Where do imports go (types of facilities)?
 - d. Where does processed resin go (end-markets)?
2. What contribution does trade make to plastic pollution in [focus country] (increase or reducing plastic pollution)?
3. At which points in the trade and recycling process does plastic pollution occur? E.g. sorting, transport, processing (formal vs informal)
4. Is imported plastic waste or domestically generated plastic waste is more likely to end up in the ocean?
5. What can be changed in the process of trade and recycling to prevent plastic ending up in the ocean? (e.g. by exporters and importers)
6. Do you think trade helps to reduce or increase plastic pollution?
7. Do you think it's possible to trade waste plastics in an environmentally responsible way?
8. If so, how could plastic waste trade become more environmentally responsible? (e.g. policies for exporters and importers)
9. What are the key challenges for domestic waste management in [focus country]?