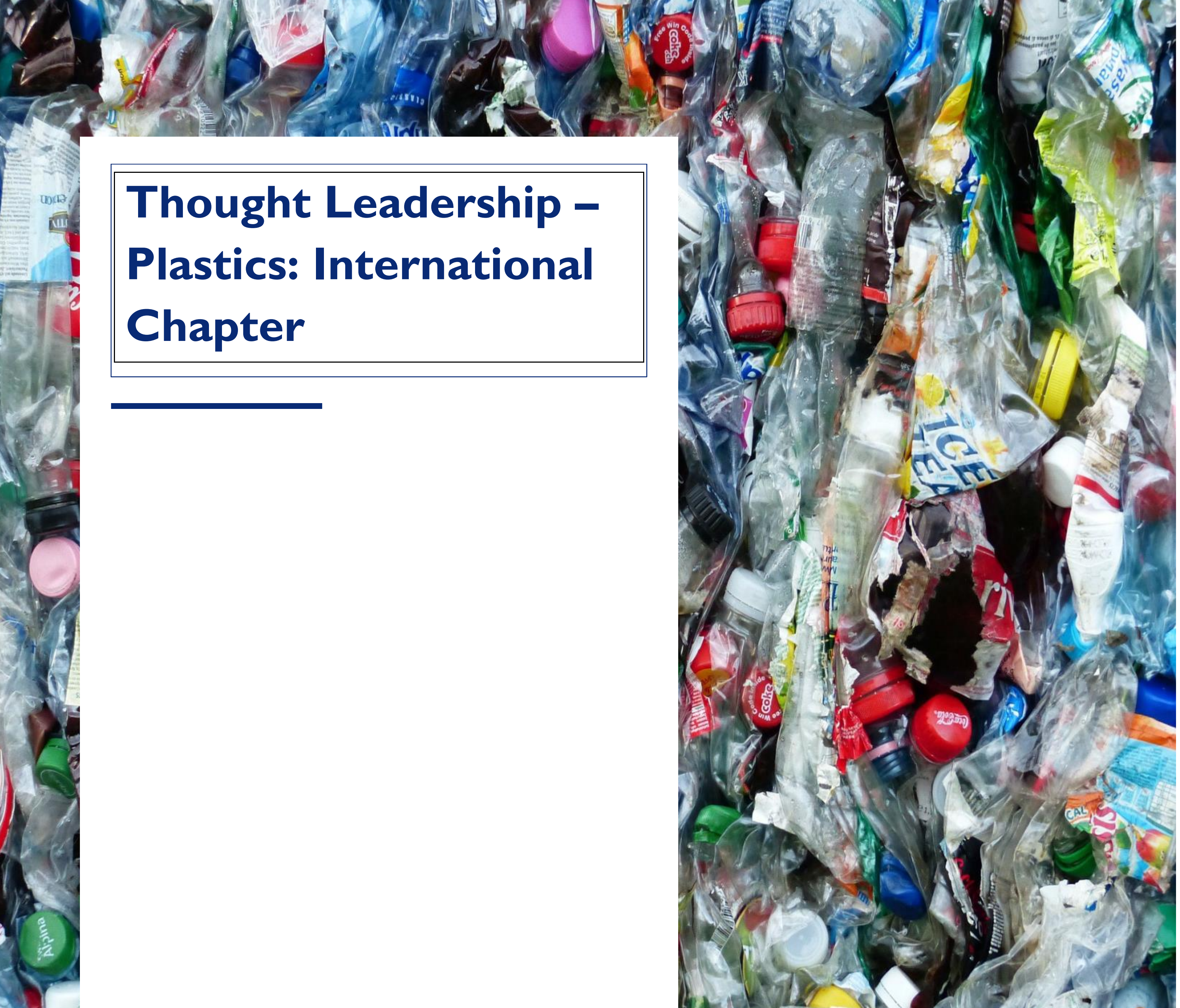

Thought Leadership – Plastics: International Chapter

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Funded by HEIF
Authored by: Godwin Chukwukelu

MANCHESTER 1824
The University of Manchester

Table of Contents

Abstract

The surge in plastic production over the past decades creates key environmental challenges that continue to receive increasing interest in research and policy. This increased interest is emphasised with the consideration of the fact that significant proportions of plastics produced since the 1950s still exist in landfills and marine environment due to difficulties involved with disposing and recycling waste plastics. In the literature, many policy and technical documents increasingly provide awareness on the issues of waste plastics disposal and recycling, and the implication of existing measures for climate change and the natural environment. Such awareness has led to a rise in national government policies such as the Chinese "National Sword" policy that has significantly impacted the transnational trade flows of plastic waste. The challenges brought about by ongoing changes in the international trade flows of plastic waste – in the context of existing international environmental regulations and programs – have seldom been researched. Hence, this chapter explores the international dimension of waste plastics to highlight key trends and challenges to global waste plastics disposal, recycling and trade flows. It further discusses recycling policies and standards, the global distribution of recycling capacity and various (plastics) pact initiatives focusing on the challenges of waste plastics disposals and recycling. The writing of this chapter was funded by HEIF to contribute to ongoing research and policy efforts.

1. Global Waste Plastics Trade Flows

1.1 Setting out the scale of the problem:

1.1.1 Trends in Global Waste Plastics

Global plastic production has increased in recent years. The plastic generation for 2015 was 407 million tonnes per annum surpassing the production of paper (400 million tonnes per annum)[1] and is projected to reach 1,600 million tonnes per annum by 2050 if the current rate of plastic production continues.[2] The global annual revenue from plastics is about USD 600 billion per annum.[3] The rise in plastic production has been mainly due to the unique characteristics of plastics, such as a high strength-to-weight ratio, moldability, impermeability to liquids and resistance to physical and chemical degradation. These characteristics, combined with low cost of production, informs the increasing preference of plastics over other materials, such as concrete, glass, metals, wood, natural fibres and paper.

The surge in the production and use of plastics has impacted the composition of solid waste streams, which has begun to attract research and policy interest because of the harm waste plastics pose to the environment. The process of managing waste plastics is complicated, particularly in areas with high rates of economic and population growth. Plastic waste (collected for export) is typically made up of 89% of those polymer groups found in food-grade single-use plastic packaging (such as Polyethylene (PE), Polypropylene (PP) and Polyethylene terephthalate (PET)), which underscores the need for global efforts to address the production and recycling challenges of single-use plastics.[4]

In most instances, comprehensive collection schemes exist for plastics used for packaging. Packaging had the highest plastic application recycling rate (39.5%) in 2015. This recycling rate is low in comparison to the average recycling rate (65%) of other packaging materials. The recycling rate for metal packaging was 76%, paper and cardboard packaging was 83% and glass packaging was 73%.[5] The use of different polymers, such as PP, PET and Polyvinyl chloride (PVC) to produce plastics for various uses constitutes a primary reason for the low recycling rates of waste plastics. The use of multi-material and multi-layer of different plastics in packaging further complicates the recycling process because of the need to isolate different polymers for effective management of polymer types in the recycling process.

[1] WWF (2018), Pulp and paper | WWF, http://wwf.panda.org/about_our_earth/deforestation/forest_sector_transformation/pulp_and_paper/

[2] EMF (2017), Rethinking the future of plastics and catalysing action, https://www.ellenmacarthurfoundation.org/assets/downloads/publications/NPEC-Hybrid_English_22-11-17_Digital.pdf.

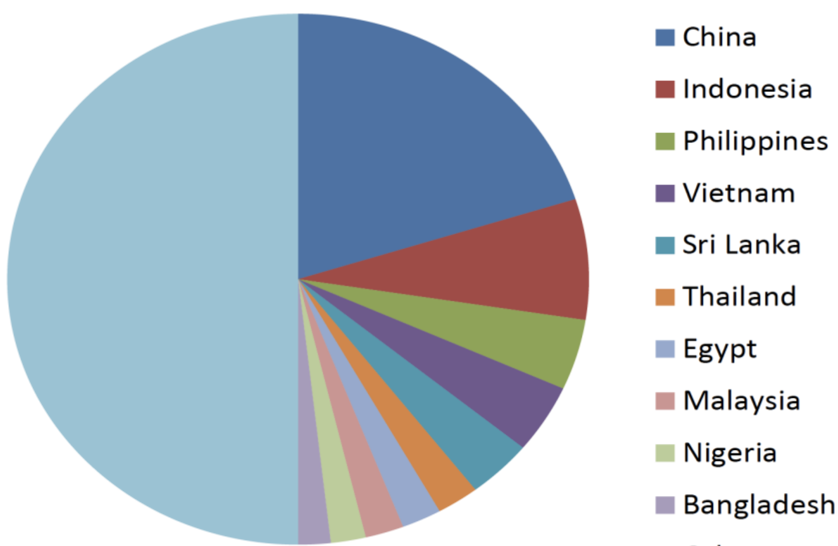
[3] First Research, Plastic Resin & Synthetic Fiber Manufacturing Industry Profile (Austin, TX: 2014).

[4] Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018SC0016&from=EN

Insufficient plastic waste processing capacity in many countries has led to a rise in the trade flows of plastic waste. In 2016, 123 countries exported 14.1 million tonnes of waste plastics accumulated for recycling. Of this number, 7.35 million tonnes from 43 countries were sent to China. China has imported approximately 106 million tonnes of waste plastics from 1992 to date, which represents 45.1% of cumulative global waste plastic import. China, together with Hong Kong, has imported 72.4% of all waste plastics globally. However, 63% of all plastic waste imported to Hong Kong in 2016 were exported directly to China, which confirms the role of Hong Kong as a port of entry for waste plastics intended for China. The recent China waste policy, to ban the import of solid waste from January 2018, is estimated to displace 111 million tonnes of waste plastics by 2030.[6] The result of modelling plastic waste trends shows that in 2010, about 10% (or 30 million tonnes) of the globally generated plastic waste was mismanaged; with G7 countries contributing less than 2% and around 50% originating from 10 emerging countries (See figure 1.1 for details).[7] [8] Hence, the need for improved waste management programmes in low and middle-income countries.

Figure 1. 1: Mismanaged plastics waste by country in 2010



Source:[9]

[6] Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.

[7] Jambeck, J. et al. (2015), "Marine pollution. Plastic waste inputs from land into the ocean.", Science (New York, N.Y.), Vol. 347/6223, pp. 768-71, http://dx.doi.org/10.1126/science.1260352.

[8] The authors define mismanaged plastics waste as those that arise through littering or dumping in low quality landfill or open dump sites

[9] Jambeck, J. et al. (2015), "Marine pollution. Plastic waste inputs from land into the ocean.", Science (New York, N.Y.), Vol. 347/6223, pp. 768-71, http://dx.doi.org/10.1126/science.1260352.

1.1.2 Waste Plastics Production and Uses

Plastics are generally produced from oil and natural gas, although plants, such as corn and sugarcane, are increasingly being used.[10] Approximately 4% of global petroleum is used in plastics with another 4% deployed in plastic manufacturing processes.[11] There has been a significant surge in plastic production over the past five decades. The production of plastics has grown at an average of 8.7% per annum from 1.7 million tonnes in 1950. Approximately 299 million tonnes of plastics were generated in 2013, which is a 3.9% increase from the 2012 figure.[12] [13]

As of 2017, the cumulative total of 8.3 billion tonnes of plastics have been generated.[14] This rise in the demand for plastics has been a result of the consumerism and convenience from the use of plastics and relatively low cost of plastic materials.[15] The consumption of plastics in Western Europe and North America is 100kg per capita while the figure in Asia is 20kg per capita. The figure from Asia is expected to rise in the coming years.[16]

Plastic is predominantly produced in three main regions of the world. In 2013, Asia supplied 45.6% of the global plastics (with China responsible for 24.8%). The plastic production capacity of China overtook that of Europe in 2010.[17] China produced about a quarter of the global plastic in 2013.[18] Europe and North America produce 20% and 19.4% of the global plastics, respectively. See figure 1.2 below for details. Plastic production capacity in India has also increased due to its rising population and manufacturing activities.

10 American Chemistry Council, Economics and Statistics Department, Plastic Resins in the United States (Washington, DC: 2013).

11 U.N. Environment Programme (UNEP), Valuing Plastics: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry (Nairobi: 2014).

12 PlasticsEurope, Plastics–The Facts 2014: An Analysis of European Plastics Production, Demand and Waste Data (Brussels: 2014).

13 The European House–Ambrosetti, The Excellence of the Plastics Supply Chain in Relaunching Manufacturing in Italy and Europe (Milan: 2013)

14 Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e1700782.

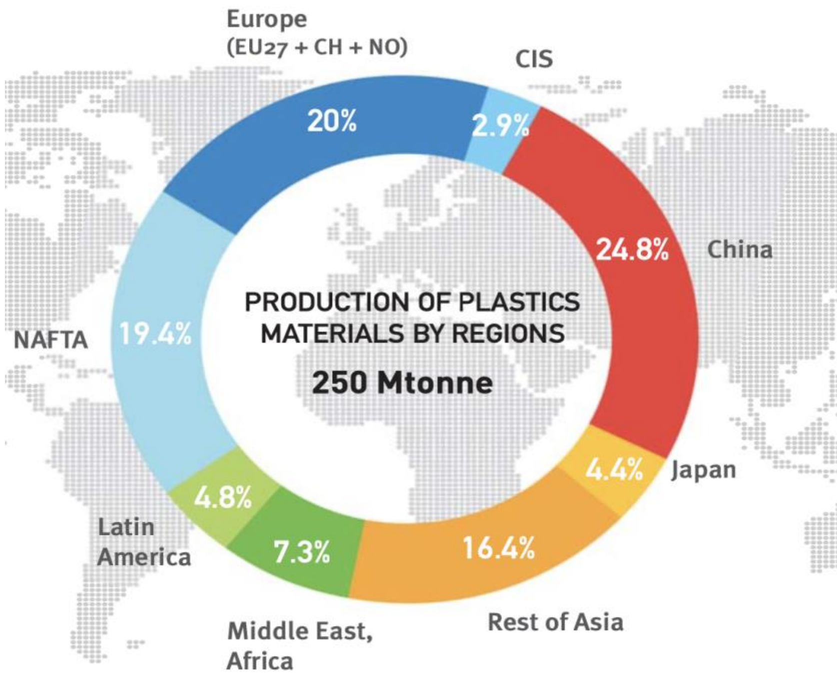
15 U.N. Environment Programme (UNEP), Valuing Plastics: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry (Nairobi: 2014).

16 Germany Trade & Invest, Industry Overview: The Plastics Industry in Germany (Berlin: 2014)

17 The European House–Ambrosetti, The Excellence of the Plastics Supply Chain in Relaunching Manufacturing in Italy and Europe (Milan: 2013)

18 PlasticsEurope, Plastics–The Facts 2014: An Analysis of European Plastics Production, Demand and Waste Data (Brussels: 2014).

Figure 1. 2: 2013 World production of plastics materials (thermoplastics and polyurethanes)

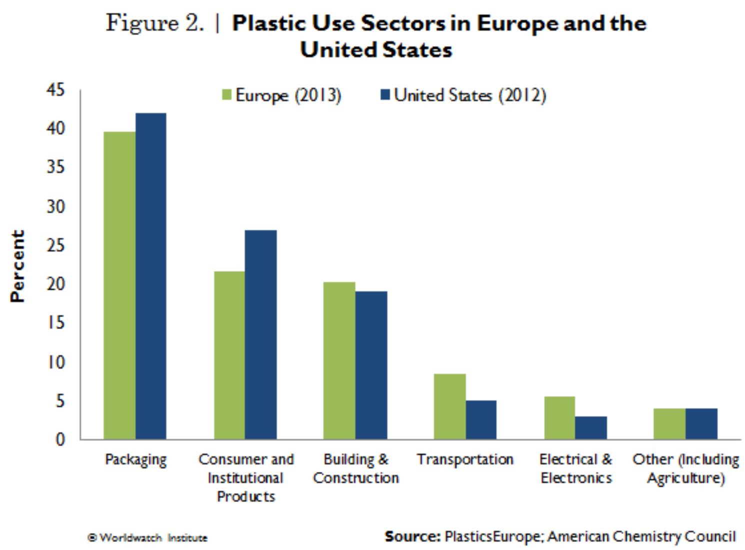


Source:[19]

The use of plastics can be categorised into six broad areas: packaging, consumer and institutional products (such as appliances, toys, plastic cutlery and furniture), building and construction, transportation, electrical and electronics and others (including agriculture).[20] As figure 1.3 below shows, plastics are primarily used in packaging, which is also the main source of waste plastics because of the short life of packaging products.[21]Approximately 40% of the demand for plastics in Europe and 42% in the United States is for use in packaging.[22] About 15.2 million tonnes of plastic packaging was produced in the domestic sector in 2014.[23] The consumer and household products make up the second-highest demand for plastics with the building and construction sector coming in the third place.[24]

19 https://www.plasticseurope.org/application/files/5515/1689/9220/2014plastics_the_facts_PubFeb2015.pdf
20 PlasticsEurope, Plastics–The Facts 2014: An Analysis of European Plastics Production, Demand and Waste Data (Brussels: 2014).
21 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018SC0016&from=EN
22 Germany Trade & Invest, Industry Overview: The Plastics Industry in Germany (Berlin: 2014)
23 Source Eurostat http://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework
24 PlasticsEurope, Plastics–The Facts 2014: An Analysis of European Plastics Production, Demand and Waste Data (Brussels: 2014)

Figure 1. 3: Plastic Use Sectors in Europe and the United States



Approximately 79% of all plastics produced since the start of plastic production still exist in landfills and the natural environment.[25] It is estimated that 150 million tonnes of waste plastics have been dumped in the ocean or marine environment since 1980 with the EU contributing between 1.4 to 3.7 million tonnes. The challenge of waste plastics in the oceans is a consequence of inadequate waste management practices on land, including the poor rate of waste plastics collection and recycling.[26]

1.1.3 Waste Plastics Disposals

Plastic waste can be disposed of in three main ways: discarded (landfills, oceans and others), thermal destruction (including incineration and energy recovery) and recycling. A significant amount of plastics are disposed of in landfills while some end up in the oceans because of the current limitations in waste plastics recycling.[27] Approximately 9% of the global plastic waste has been recycled, and about 80% accumulates in landfills or contaminated environment.[28] In 2012, about 26% (6.6 million tonnes) of post-consumer plastic produced in Europe was recycled and 36% was incinerated. The remainder 38% was sent to landfills, which represents a 26% decline in plastic waste sent to landfills when compared with

25 Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e170078

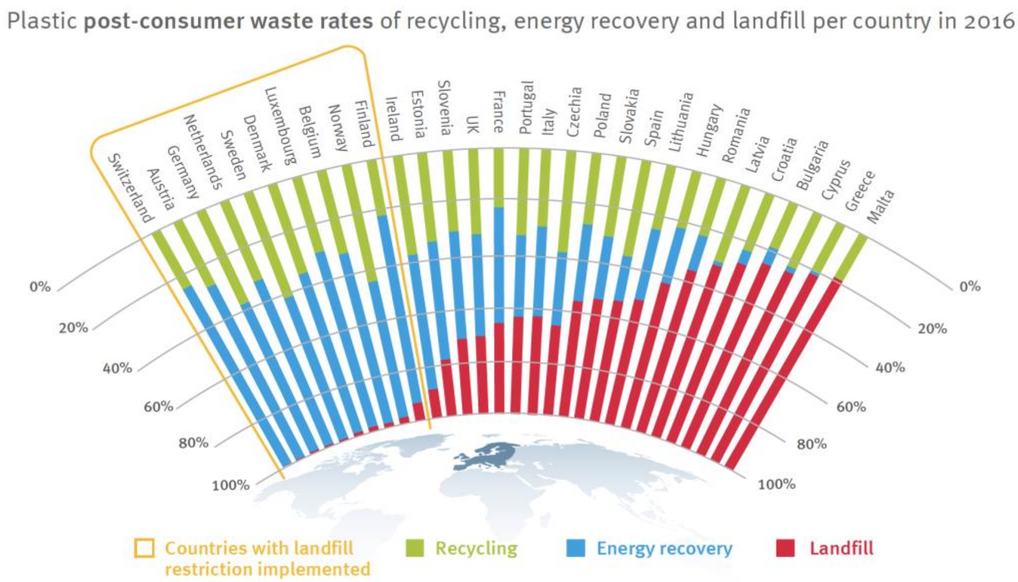
26 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018SC0016&from=EN

27 Gourmelon, G. (2015). Global plastic production rises, recycling lags. New Worldwatch Institute analysis explores trends in global plastic consumption and recycling. Recuperado de http://www. worldwatch. org.

28 Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e1700782.

2006 figures. Nonetheless, about 50% of all European countries still send a significant proportion of their waste plastics to landfills.[29] The figure 1.4 below shows that countries with landfill bans for recyclable waste generally have higher recycling rates. Nine European countries (Austria, Belgium, Denmark, Germany, Luxembourg, Netherlands, Norway, Sweden and Switzerland) have instituted landfill bans for waste plastics. These countries mostly have higher recycling rates than those without landfill bans even though most waste plastics are incinerated.[30]

Figure 1. 4: Plastic Post-Consumer Waste Rates of Recycling, Energy Recovery and Landfill per Country in 2016



Source:[31] Conversio Market & Strategy GmbH

The recycling rate of waste plastics differs significantly across different nations. Only 9% of waste plastics (2.8 million tonnes) were recycled in the US in 2012 with 32 million tonnes discarded, which represent about 13% of its municipal solid waste stream.[32] The rate of waste plastics collection is lower in other parts of the world. For example, about 57% of plastic in Africa, 40% in Asia, and 32% in Latin America is not collected but are instead dumped and burned in the open.[33] Figure 1.5 below shows that between 1950 and 2015, 6300 million tonnes of primary and secondary (recycled) waste plastics have been produced out of which 600 million tonnes (9%) have been recycled, and merely 10% of that has been recycled more than once. About 800 million tonnes (12%) of plastic waste has been incinerated. The

29 PlasticsEurope, Plastics–The Facts 2014: An Analysis of European Plastics Production, Demand and Waste Data (Brussels: 2014).

30 PlasticsEurope, Plastics–The Facts 2014: An Analysis of European Plastics Production, Demand and Waste Data (Brussels: 2014).

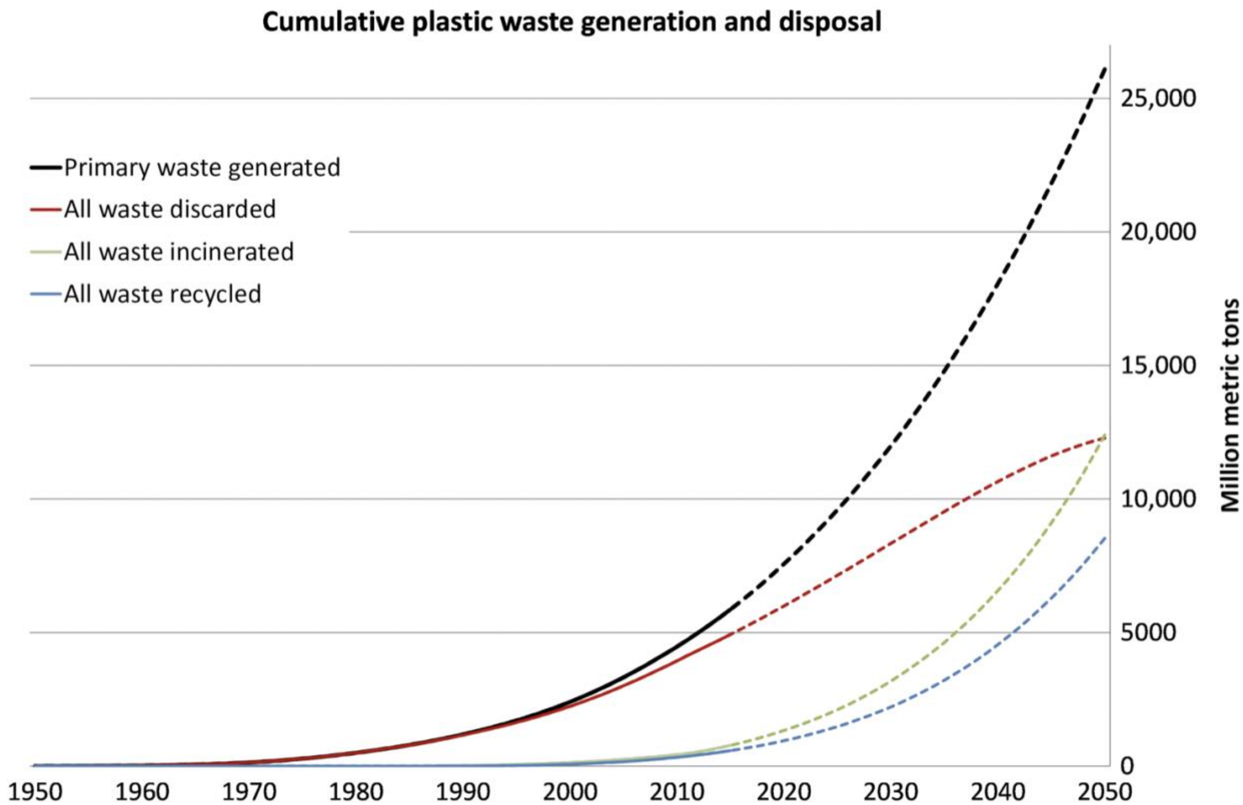
31 https://www.plasticseurope.org/application/files/6315/4510/9658/Plastics_the_facts_2018_AF_web.pdf

32 U.S. Environmental Protection Agency, Plastics (updated 2014), at www.epa.gov/osw/conserve/materials/plastics.htm.

33 Gourmelon, G. (2015). Global plastic production rises, recycling lags. New Worldwatch Institute analysis explores trends in global plastic consumption and recycling. Recuperado de http://www. worldwatch. org.

incineration or thermal destruction of waste plastics is inefficient, requires air emission controls and produces harmful ash.[34] The global production and incineration of waste plastics is estimated to contribute 400 million tonnes of CO_2 per annum.[35] Approximately 4900 million tonnes (60%) of all plastic wastes are dumped in landfills or the natural environment.[36] Dumping waste plastics in landfills is significantly harmful to the environment and should be avoided at all cost.

Figure 1. 5: Cumulative plastic waste generation and disposal (in million metric tonnes)



Source:[37] Solid lines show historical data from 1950 to 2015; dashed lines show projections of historical trends to 2050.

The environmental impact of waste plastics can be minimised by collecting plastics from waste streams for recycling.[38] However, waste plastics cannot be recycled infinitely as some chemical properties limit

[34] U.N. Environment Programme (UNEP), Valuing Plastics: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry (Nairobi: 2014).
[35] https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf
[36] Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e1700782.
[37] Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e1700782.
[38] U.N. Environment Programme (UNEP), Valuing Plastics: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry (Nairobi: 2014).

the number of times they can be recycled.[39] Much of the plastic collected for recycling is shipped to locations with low-technology and lower environmental standards, which makes it challenging to balance environmental protection, clean material cycles and resource use.[40] About 15 million tonnes of waste plastics are traded transnationally per annum.[41] The US, followed by Japan, Germany and the UK, are the biggest exporters of waste plastics. The majority of US waste plastics export goes to China and Hong Kong; even though some are sent to Canada and Mexico. Europe is the largest global exporter of waste plastics destined for recycling and exports half of all the waste plastics it collects. Around 87% of Europe's waste plastics collected for recycling were sent to China.[42] This condition has changed following the recent Chinese ban on the import of waste that impacts waste plastics.

In general, low and middle-income countries import waste materials for recycling.[43] These waste materials come from high-income (or wealthier) countries with substantial waste management infrastructure while the low and middle-income countries importing the waste have poorly established waste management infrastructure. One of the primary drivers of this trend in trade flow of waste plastics is the significant difference in the cost of processing or recycling waste in high-income countries in comparison to low and middle-income countries. For example, the cheap cost of processing waste plastics in China made it the source of almost 50% of waste plastics exports intended for recycling. The presence of environmental policies and regulations in high-income countries impacts the higher cost of processing wastes in those countries. The details shown in Tables 1 and 2 below highlight the cumulative waste plastic export and import by countries. As can be seen, between 1988 and 2016, High Income (HIC) countries are the leading exporters of plastic waste as they account for 87% of all exports valued at USD 71 billion. HIC and Upper Middle Income (UMI) countries have a balanced portion of 96% of the total imports valued at USD 106 billion.[44]

In 2017, China announced its plan to place a ban on the global import of plastic waste, which was part efforts to minimise the influx of contaminated waste materials that China considers hazardous and the risk they pose to the environment. The announcement of this new Chinese "National Sword" policy led to a slump in the burgeoning waste material trade and recycling with a significant drop in the price of plastic waste.[45] This policy was particularly important as China has handled almost 50% of all

[39] Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.

[40] Gourmelon, G. (2015). Global plastic production rises, recycling lags. New Worldwatch Institute analysis explores trends in global plastic consumption and recycling. Recuperado de http://www. worldwatch. org.

[41] UNEP-ISWA Global Waste Management Outlook 2015, p.84

[42] Costas Velis, Global Recycling Markets: Plastic Waste; A Story for One Player—China (Vienna: International Solid Waste Association, 2014).

[43] Hoornweg, D., & Bhada-Tata, P. (2012). What a waste: a global review of solid waste management (Vol. 15, p. 116). World Bank, Washington, DC.

[44] Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.

[45] https://www.ft.com/content/360e2524-d71a-11e8-a854-33d6f82e62f8

recyclable waste in the past 25 years.[46] For example, within the first half of 2017, China and Hong Kong's import of plastic waste from G7 countries dropped from 60% to 10%.[47]

The Chinese "National Sword" policy came into law on January 2018 and has resulted in a 99% drop in China's plastic waste imports. The consequence has been a decline in profitability from recycling as a result of the rise in the cost managing and recycling plastic waste. This rise in cost has led to the redirection of plastic waste that would have been recycled in China to landfills, incinerators or dumped in the natural environment.[48]

Approximately 22% to 43% of global plastic waste is dumped in landfills. Consequently, landfills occupy significant space and constitute a menace to the community at large.[49] A recent study revealed that 4.8 - 12.7 million tonnes of waste plastics enter the oceans annually.[50] The continuous dumping and accumulation of plastics in the ocean contribute to the global pollution challenges plaguing most coastal regions of the world.[51] The challenges posed by waste plastics in the oceans have received increasing attention with commitments for collective action to address this globally.[52] Marine debris – particularly plastic debris – poses a significant hazard for the ecology, economy and aesthetic appeal/ value of coastal areas. Furthermore, waste plastics in the ocean are hazardous to wildlife, [53] [54] with findings showing that approximately 700 under-water/aquatic species interact with anthropogenic debris.[55] This calls for significant action.[56]

1.2 International Environmental Regulations

The Basel, Rotterdam and Stockholm Conventions are multilateral environmental agreements that are focused on protecting humans and the environment from harmful chemicals and waste. These conventions have separate conferences of the relevant parties, where they meet to make decisions that

46 https://e360.yale.edu/features/piling-up-how-chinas-ban-on-importing-waste-has-stalled-global-recycling
47 https://www.ft.com/content/360e2524-d71a-11e8-a854-33d6f82e62f8
48 https://e360.yale.edu/features/piling-up-how-chinas-ban-on-importing-waste-has-stalled-global-recycling
49 U.N. Environment Programme (UNEP), Valuing Plastics: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry (Nairobi: 2014).
50 Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., ... & Law, K. L. (2015). Plastic waste inputs from land into the ocean. Science, 347(6223), 768-771.
51 Van Sebille, E., Wilcox, C., Lebreton, L., Maximenko, N., Hardesty, B. D., Van Franeker, J. A., ... & Law, K. L. (2015). A global inventory of small floating plastic debris. Environmental Research Letters, 10(12), 124006.
52 Jambeck, J., Hardesty, B. D., Brooks, A. L., Friend, T., Teleki, K., Fabres, J., ... & Baleta, T. (2018). Challenges and emerging solutions to the land-based plastic waste issue in Africa. Marine Policy, 96, 256-263.
53 Wilcox, C., Van Sebille, E., & Hardesty, B. D. (2015). Threat of plastic pollution to seabirds is global, pervasive, and increasing. Proceedings of the National Academy of Sciences, 112(38), 11899-11904.
54 Wilcox, C., Mallos, N. J., Leonard, G. H., Rodriguez, A., & Hardesty, B. D. (2016). Using expert elicitation to estimate the impacts of plastic pollution on marine wildlife. Marine Policy, 65, 107-114.
55 Gall, S. C., & Thompson, R. C. (2015). The impact of debris on marine life. Marine pollution bulletin, 92(1-2), 170-179.
56 Rochman, C. M., Browne, M. A., Underwood, A. J., Van Franeker, J. A., Thompson, R. C., & Amaral-Zettler, L. A. (2016). The ecological impacts of marine debris: unravelling the demonstrated evidence from what is perceived. Ecology, 97(2), 302-312.

are synchronised at multiple (national, regional and global) levels, for developing consistent policies to support the parties to the convention.

The rise in public resistance to waste disposal led to an increase in the disposal costs that subsequently pushed operators to seek cheaper alternatives for disposing of toxic substances. The weak environmental legislation and enforcement in developing countries of the world made them prime destinations for these toxic wastes. Public reactions and complaints in the 1980s to the deposit of hazardous waste in Africa and other developing countries led to the Basel Convention, adopted in March 22 1989, by the Conference of Plenipotentiaries in Basel, Switzerland, with a focus on limiting the trade of toxic substance to minimise their effects on human health and the environment. The convention entered into force in 1992 and focused on limiting the transboundary movements of toxic waste and the use of Environmentally Sound Management (ESM) for disposal. The Basel Convention has 186 parties, including the EU.[57] [58] It is the one international, binding treaty with the most application and vision for international management of plastic waste.[59]

The Basel Convention highlighted the key chemicals and substances it considers as toxic wastes to the environment, depending on their origin and composition. It captures toxic substances that are explosive, flammable, poisonous, infectious, corrosive, toxic, or eco-toxic, and also includes other waste substances from household and incinerator ash. [60] Article 4.2 of the Basel convention encouraged countries to minimise the production of plastic wastes and outlined measures for reducing the number of plastics and toxic substance at the waste phase of the lifecycle. There are two classifications of wastes under the Basel convention: "hazardous" for those deemed to be toxic and "other waste". Plastic wastes are classed as "other waste" unless they exhibit traits that are toxic. The Basel Convention requires parties to regulate the transboundary movement of "hazardous" and "other" plastic waste. The goal is that these wastes are managed in the country where they are produced or imported, in an environmentally sound manner.

The Basel convention allows parties to the convention to designate plastic wastes as hazardous in their national legislation, in which case such party will not be allowed to import or export plastic waste with other parties. The exporting countries are also expected to ensure the destination country (importer) can manage plastic wastes in an environmentally sound way. Trade with a non-party is prohibited except for cases where both parties have negotiated the transaction. Furthermore, the Basel Convention encourages plastic waste trade if the exporting party lacks the relevant capacity for efficient and

[57] https://pib.gov.in/newsite/PrintRelease.aspx?relid=161203
[58] Secretariat of the Basel Convention, Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. <http://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/4499/Default.aspx>, 2019 (accessed 12 October 2019).
[59] Raubenheimer, K., & McIlgorm, A. (2018). Can the Basel and Stockholm Conventions provide a global framework to reduce the impact of marine plastic litter?. Marine Policy, 96, 285-290.
[60] https://pib.gov.in/newsite/PrintRelease.aspx?relid=161203

environmentally sound disposal of plastic waste. Plastic waste export is also allowed if it is intended for recycling.[61]

The Rotterdam Convention is a multilateral environmental agreement that stipulates expectations from those involved in the global trade of certain toxic chemicals. It was adopted in 1998 and took effect in 2004. The Rotterdam convention primarily focuses on encouraging shared responsibility and collaboration between parties importing and exporting chemicals that are captured in the Rotterdam Convention to protect human health and the environment from toxic substances. In the Rotterdam convention, parties are encouraged to make informed decisions on the chemicals they wish to import. The Prior Informed Consent (PIC) procedure is a tool that is used for shared decisions on chemicals captured in Annex III that parties to the convention want to import. It is also used to confirm compliance by exporting parties. The Annex III of the Rotterdam Convention has 47 chemicals (33 are pesticides and 14 industrial chemicals).[62]

The Stockholm Convention is an international environmental treaty designed to protect human health and environment from a class of chemicals known as Persistent Organic Pollutants (POPs). It was agreed in 2001 and came into effect in 2004. The Stockholm Convention has 181 parties, including the EU.[63] The POP class of chemicals are dangerous to human health and harmful to the environment. It stays in the environment for a long time (persistent), distributed across multiple geographies (long-range transport) and retained in the fatty tissues of humans and animals (bioaccumulation). The Annex-A of the convention focused on the elimination of the chemical from production, use, export and import. Annex-B dealt with the restriction for chemicals to be produced and used for some specific purposes. Annex-C addressed accidental production. The Stockholm convention identifies 26 chemicals as POP. The convention expects parties to take active measures to stop or minimise the release of POP to the environment.[64]

The Stockholm Convention focused on the minimising or eliminating the production or release of POPs to the environment. POPs are chemical compounds that are toxic, persistent and bioaccumulate. The convention works closely with manufacturers at the design phase by restricting the use of some POPs for manufacturing. Manufacturers of POPs are expected to: 1) minimise the impact of products at all phases of the lifecycle and 2) provide details on hazardous chemicals they produced. Some POPs captured in Annex A of the Stockholm convention can be used for producing plastics. Current measures under the convention can be used to regulate the transboundary trade of POPs intended for use in plastics and plastic waste contaminated by POPs. In general, plastics are not classified as toxic wastes

[61] Raubenheimer, K., & McIlgorm, A. (2018). Can the Basel and Stockholm Conventions provide a global framework to reduce the impact of marine plastic litter?. Marine Policy, 96, 285-290.

[62] https://pib.gov.in/newsite/PrintRelease.aspx?relid=161203

[63] Secretariat of the Stockholm Convention, Status of ratification. <http://chm.pops.int/Countries/StatusofRatifications/PartiesandSignatoires/tabid/4500/Default.aspx>, 2019 (accessed 12 October 2019).

[64] https://pib.gov.in/newsite/PrintRelease.aspx?relid=161203

under current regimes unless they contaminated by POPs regulated under the Stockholm Convention on POP or if they meet other criteria specified in the Basel convention.[65]

The Basel and Stockholm conventions have the primary aim of protecting human health and the overall ecosystem through environmentally sound management of wastes (Basel) and elimination of POPs (Stockholm). Both conventions provide opportunities to manage the effects of plastics through their lifecycle by regulating the use of POPs and the import and export of plastics.

Barsalou & Picard (2018), however, argue that international environmental agreements, such as the Basel and Stockholm Conventions were not designed to protect the environment. They were designed to support effective administration and commodification of wastes. For example, the Basel Convention was a response to the internationalisation of waste trade.[66] The rising cost of waste disposal in the Global North due to their environmental legislation led to the shipment of waste from the Global North to dumping grounds in the Global South ("toxic colonialism"). The Basel convention did not eliminate or reduce waste generation and circulation. It created guidelines for efficient management and transboundary movement of hazardous waste. International waste trade became legal, economic activity under the Basel Convention and there is no restriction on the substance or quantity of waste to be exchanged as long as parties to the transaction agree. This makes it easy for some countries to use the import of waste (including hazardous substance) as legitimate economic activity. International waste trade is vital for countries such as Turkey, where it constitutes 1% of its GDP.[67]

The Basel convention lacks substance in the definition of what constitutes waste and non-waste, including the difference between hazardous and non-hazardous waste. This lack of clarity creates loopholes for the transboundary movement of some hazardous substance that the convention intends to control. For example, solid plastic wastes were captured as a non-hazardous substance under the Basel convention, which placed them outside the scope of the convention and could be considered non-waste.[68]

The Basel Convention was amended to include a globally binding framework to promote transparency in the international trade of specific streams of plastic waste. The amendment was seen as a step in the right direction. It shows the importance of the Basel convention and its capacity to respond to the growing environmental issues. The new amendments to the Basel convention adopted in May 2019 placed plastic waste into three categories: 1) "hazardous waste" (plastics listed under Annex VIII); 2) "other waste" requiring special consideration (plastics listed under Annex II); and 3) "non-hazardous

65 Raubenheimer, K., & McIlgorm, A. (2018). Can the Basel and Stockholm Conventions provide a global framework to reduce the impact of marine plastic litter?. Marine Policy, 96, 285-290.
66 Barsalou, O., & Picard, M. H. (2018). International environmental law in an era of globalized waste. Chinese Journal of International Law, 17(3), 887-906.
67 Barsalou, O., & Picard, M. H. (2018). International environmental law in an era of globalized waste. Chinese Journal of International Law, 17(3), 887-906.
68 https://www.asil.org/insights/volume/23/issue/7/basel-convention-parties-take-global-lead-mitigating-plastic-pollution

waste" (plastics listed under Annex IX).[69] The trade of plastic waste under Annex II and III are subject to stringent controls under the convention. The new amendments will take effect on January 1, 2021 and will affect all 187 Basel parties and their non-party trading partners including the United States of America.[70]

1.3 Global Recycling Policy, Standards

1.3.1 Impurities and Recycling Processes

Recycling is a sustainable approach to managing plastic waste. Recycling plastics is more complicated than recycling other waste materials, such as glass and metals[71] [72] because of its potential to be contaminated by impurities that could pose technical, economic and/or market barriers to substitution of virgin plastic.[73] [74]

There are three class of plastic waste impurities: non-plastic components (foreign materials), non-targeted plastic (different polymers than the one targeted for reprocessing, including multi-plastic products and polymer blends) and chemical impurities (bound to the plastic matrix, such as pigments, additives, stabilizers, etc.).[75] Impurities can impact mechanical recycling in different ways, including decreasing processing efficiency, reducing the mechanical performance of recyclates and the potential addition of unwanted (possibly hazardous) chemicals in the product matrix.

The quality and economic value of plastic waste recyclates are determined by its purity level (Institute of Scrap Recycling Industry (ISRI)),[76] which is affected by the type and number of sorting and reprocessing steps.[77] Impurities in plastic waste impact the cost of recycling both in terms of capital

[69] Proposal to Amend Annexes II, VIII and IX to the Basel Convention, U.N. Doc. UNEP/CHW.14/27 (Dec. 17, 2018).
[70] https://www.asil.org/insights/volume/23/issue/7/basel-convention-parties-take-global-lead-mitigating-plastic-pollution
[71] Alwaeli, M. (2010). The impact of product charges and EU directives on the level of packaging waste recycling in Poland. Resources, Conservation and Recycling, 54(10), 609-614.
[72] Rigamonti, L., Ferreira, S., Grosso, M., & Marques, R. C. (2015). Economic-financial analysis of the Italian packaging waste management system from a local authority's perspective. Journal of Cleaner Production, 87, 533-541.
[73] RDC, P. (2003). Evaluation of Costs and Benefits for the Achievement of Reuse and Recycling Targets for the Different Packaging Materials in the Frame of the Packaging and the Packaging Waste Directive 94/62/EC. Final Consolidated Report.
[74] Faraca, G., Martinez-Sanchez, V., & Astrup, T. F. (2019). Environmental life cycle cost assessment: Recycling of hard plastic waste collected at Danish recycling centres. Resources, Conservation and Recycling, 143, 299-309.
[75] Faraca, G., Martinez-Sanchez, V., & Astrup, T. F. (2019). Environmental life cycle cost assessment: Recycling of hard plastic waste collected at Danish recycling centres. Resources, Conservation and Recycling, 143, 299-309.
[76] Institute of Scrap Recycling Industry (ISRI), 2017. Scrap Specifications Circular. Guidelines for Non Ferrous Scrap, Ferrous Scrap, Glass Cullet, Paper Stock, Plastic Scrap, Electronics Scrap, Tire Scraps. Available at: http://www.scrap2.org/specs/files/assets/basic-html/page-1.html#
[77] Faraca, G., Martinez-Sanchez, V., & Astrup, T. F. (2019). Environmental life cycle cost assessment: Recycling of hard plastic waste collected at Danish recycling centres. Resources, Conservation and Recycling, 143, 299-309.

investments in sorting equipment and the revenue that can be generated from the sales of recycled materials. Low-quality end products attract lower revenues.[78]

The choice of plastic waste recycling route is mostly informed by factors, such as location, polymer type, product type, method of collection, presence of impurities, desired quality of the product and raw material prices offered by companies sorting or recycling the waste.[79] There are multiple approaches to recycling, which varies in terms of number, types and sequence of processes. Plastic waste recycling processes can be placed into four categories: 1) primary (re-extrusion); 2) secondary (mechanical recycling); 3) tertiary (feedstock or chemical recycling); and 4) quaternary (energy recovery) routes, depending on the technology used and the output produced by the process.[80] [81] [82] Mechanical recycling is the most common approach to recycling plastic waste.[83] It generally involves processes, such as collection, sorting, washing and grinding of waste plastics to produce regranulate. The collection, sorting and washing processes are applicable for post-consumer waste plastics (mixed plastics packaging waste) and do not apply to post-industry waste plastics (clean wastes with well-known composites).[84]

Chemical recycling describes technological processes that convert post-consumer waste plastics to valuable chemicals that can be used as feedstock by the chemical industry. Such technologies include pyrolysis, gasification, chemical depolymerization, catalytic cracking and reforming, and hydrogenation. Chemical recycling processes waste plastics to produce feedstock, such as monomers, oligomers and higher hydrocarbons that can be used to make virgin-like polymers for new plastic production. Chemical recycling captures fairly new technologies with numerous test plants across Europe exploring new processes for waste plastic recycling.[85] It exist for feedstocks like PET, PUR and nylon at low scale.[86] Chemical recycling mostly complements mechanical recycling. It should be used only when it is inefficient to use mechanical recycling for waste plastics that are not well sorted, multi-layered or significantly contaminated.[87]

78 Rigamonti, L., Ferreira, S., Grosso, M., & Marques, R. C. (2015). Economic-financial analysis of the Italian packaging waste management system from a local authority's perspective. Journal of Cleaner Production, 87, 533-541.
79 Faraca, G., Martinez-Sanchez, V., & Astrup, T. F. (2019). Environmental life cycle cost assessment: Recycling of hard plastic waste collected at Danish recycling centres. Resources, Conservation and Recycling, 143, 299-309.
80 ASTM Standard D5033, 2000. Standard Guide to Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics. ASTM International., West Conshohocken. https://doi.org/10.1520/D5033-00.
81 Brems, A., Baeyens, J., Dewil, R., 2012. Recycling and recovery of post-consumer plastic solid waste in a European context. Therm. Sci. 16, 669–685. https://doi.org/10.2298/TSCI120111121B.
82 Ignatyev, I.A., Thielemans, W., Vander Beke, B., 2014. Recycling of polymers: a review. Chem. Sus. Chem. 7, 1579–1593. https://doi.org/10.1002/cssc.201300898.
83 Al-Salem, S., Lettieri, P., Baeyens, J., 2009a. Recycling and recovery routes of plastic solid waste (PSW): a review. Waste Manage. 29, 2625–2643.
84 Ragaert, K., Delva, L., & Van Geem, K. (2017). Mechanical and chemical recycling of solid plastic waste. Waste Management, 69, 24-58.
85 https://www.plasticsrecyclers.eu/chemical-recycling
86 Ragaert, K., Delva, L., & Van Geem, K. (2017). Mechanical and chemical recycling of solid plastic waste. Waste Management, 69, 24-58.
87 https://www.plasticsrecyclers.eu/chemical-recycling

1.3.2 Recycling Standard: ISO 15270:2008

The ISO 15270:2008 is an international standard introduced by the International Organisation for Standardisation (ISO) for the plastic waste recovery and recycling industry. It stipulates guidelines for recovery and recycling of plastic waste emanating from pre-consumer and post-consumer sources. This new standard is designed to support actors in the plastic industry to have: 1) a sustainable global infrastructure for plastics recovery and recycling; 2) a sustainable market for recovered plastics materials and their derived manufactured products.[88] [89] The ISO 15270 standard has quality expectations for all phases of plastic waste recovery processes. It states that the decision on recycling approaches should be predicated on meeting these requirements: 1) the need to minimise adverse environmental impact; 2) prior demonstration of sustainable commercial viability; and 3) secure access to viable systems for collection and quality control.[90]

The focus on sustainable development and the need to minimise plastic waste should emphasise product life-cycle basis to: 1) general reduction of material and energy resource use; and 2) specific optimisation of the use of plastics raw materials. The approach to selecting methods and processes for managing plastic waste originating from pre-consumer and end of life products should consider all possible strategies, including conducting an initial analysis of possible recovery options. There are two general categories of plastics recovery technologies: 1) material recovery (mechanical recycling, chemical or feedstock recycling and biological or organic recycling); and 2) energy recovery in the form of heat, steam, or electricity generation using plastics waste as substitutes for primary fossil fuel resources. The ISO 15270 standard is designed to be a useful guide that can be adopted globally irrespective of the specific legal and regulatory framework underlying its application for plastic waste recovery and recycling.[91]

1.3.3 Biodegradable Standards

The EU standards EN 13432:2000 for compostable and biodegradable packaging were introduced in 2000 and adopted by national standard organisations of EU member states. The British Standard Institute adopted the standard as BS EN 13432.[92] The terms biodegradation, biodegradable materials and compostability are quite often misused. The European Standard EN 13432 (Requirements for packaging recoverable through composting and biodegradation – Test scheme and evaluation criteria for the final acceptance of packaging) attempts to resolve this problem by highlighting characteristics of a "compostable" material: material that can be degraded through organic processes (composting and anaerobic digestion). This standard applies to plastic packaging and lignocellulosic materials.[93] Biological

88 https://www.iso.org/standard/45089.html
89 https://www.sis.se/api/document/preview/909881/
90 https://www.recyclingtoday.com/article/iso-introduces-standards-for-plastics-recycling/
91 https://www.sis.se/api/document/preview/909881/
92 https://www.bpf.co.uk/topics/standards_for_compostability.aspx
93 https://biobagworld.com/environment/biodegradable-and-compostable/

treatment like composting or digestion is an essential recovery mechanism for managing biodegradable waste plastics.[94]

Biodegradable plastics are made of molecules that can naturally break down. There is no specific timeline for the degradation even though some can take many years depending on their condition. Biodegradable plastics can be "compostable". Compostable plastics must comply with strict standards. Polylactide (PLA) is an example of compostable plastics that are used in producing food packaging. Under the European Standard EN 13432, certified compostable plastics must break down in less than 12 weeks given industrial composting conditions.

Industrial composting plants are essential for providing relevant conditions (heat, moisture, air and microorganisms) for efficiently degrading compostable waste plastic such as PLA. Burying compostable waste plastic in the ground or compost heap cannot provide the 60C temperature required for degradation. Hence, the term biodegradable or compostable does not imply the ability of a substance to breakdown quickly within the natural environment.[95]

A degradable plastic can also be made from oxo-biodegradable plastic. Oxo-biodegradable plastics are traditional plastics with additives that allows the plastic to react with oxygen and break it down after a specific time interval. This accelerates the degradation process that would have taken hundreds of years.

Different countries have their respective versions of biodegradable plastics standards. The European Standard is EN 13432, the US Standard is ASTM D6400 and the Australian Standard is AS4736. There is very little differences between these different standards.[96] As with other standards, independent certification agencies provide product evaluation and certification services for BS EN 13432. The British Association for Organics Recycling operates a certification scheme for BS EN 13432 in collaboration with the German certification agency Din Certco.[97] The European Bioplastics Association suggests narrowing of claims of compostability that can be supported by appropriate standard references (ISO 17088, EN 13432 / 14995 or ASTM 6400 or 6868), a certification and label (Seedling label via TÜV AUSTRIA Belgium or DIN CERTCO, OK compost label via TÜV AUSTRIA Belgium). [98]

1.3.4 The EU Policy and Regulation

The capacity for recycling plastic waste in the EU is vastly unexploited. The EU generates approximately 25.8 million tonnes of plastic waste annually, out of which less than 30% is collected for recycling. A

[94] https://www.plasticseurope.org/application/files/9115/1708/0054/20170828fact_sheet_biodegradable_plastics_july_2017.pdf

[95] https://www.independent.co.uk/news/science/plastic-biodegradable-environment-pollution-a8908226.html

[96] https://biobagworld.com/environment/biodegradable-and-compostable/

[97] https://www.bpf.co.uk/topics/standards_for_compostability.aspx

[98] https://www.european-bioplastics.org/bioplastics/materials/biodegradable/

significant proportion of the collected waste plastic is exported out of the EU for treatment and recycling in third world countries with different environmental standards.[99] The EU economy loses about 95% of the worth of plastic packaging material (between EUR 70 and 105 billion) every year due to a short first-use cycle.[100]

The recycling business in the EU has been affected by low commodity prices and instability in the market, which has stalled decisions to invest in new plastic recycling capacity because of the prospects for low profits.[101] A recent study by ICIS in 2018 highlights the need for actions to accelerate the slowing growth rate of recycling in Europe to ensure the European recycling sector reaches its 2025 and 2029 targets of 77% and 90% respectively for recycling PET bottles. The PET collection rate in Western Europe grew from 58% in 2016 to 63% in 2018 with an estimate of 65% for 2019. This falls short of the 7% annual growth necessary to meet the 2029 target.[102]

The EU adopted a new policy agenda in 2018, targeting Single-Use Plastics, with the focus on recycling all plastic packaging in the EU market by 2030 as part of its transition to a more circular economy. It has a framework with 10 indicators for every stage in the cycle for measuring the EU and national level advancements to a circular economy.[103]

The EU Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation applies to all chemicals (except for few) separately, in mixture or articles. It controls the sales of chemicals through robust guidelines on registration, evaluation, authorisation and restriction. It also mandates the exchange of information amongst supply chain actors on the health and environmental risks associated with certain chemicals. Manufacturers using either virgin or recycled materials are required to obey these guidelines, which do not differentiate between the two materials.

De Römph & Van Calster (2018) argue that the absence of information on plastic waste destined for recycling facilities poses significant challenges for recyclers compliance with the REACH regulation. The primary tool in the REACH regulation is the requirement for all manufacturers (or importers) to register their substances, on their own (defined in Article 3(1)) or in a mixture (defined in Article 3(2)) of quantities equal or above 1 tonne per annum. The REACH regulation also has a measure to prohibit the use of risky substances, which should be replaced with less risky options.[104]

[99] https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf
[100] Ellen MacArthur Foundation, The new plastics economy, 2016 (https://www.ellenmacarthurfoundation.org/assets/downloads/EllenMacArthurFoundation_TheNewPlasticsEconomy_Pages.pdf)
[101] https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf
[102] https://www.recycling-magazine.com/2019/07/31/europe-faces-challenges-in-meeting-plastic-bottle-recovery-target/
[103] https://www.recyclingtoday.com/article/eu-commission-adopts-plastics-recycling-policy/
[104] de Römph, T. J., & Van Calster, G. (2018). REACH in a circular economy: The obstacles for plastics recyclers and regulators. Review of European, Comparative & International Environmental Law, 27(3), 267-277.

1.3.5 Chinese Government Policies

The "Green Fence" and "National Sword" policies, though national policies of the Chinese government, have had significant impacts on the global import and export of plastic waste. It was introduced in 2013 as a temporary ban to ensure the import of waste with less contamination. Its primary objective was to improve the quality of plastic waste imports and to minimise illegal foreign smuggling and trade.[105] This led to a decline in plastic waste destined to China as some shipments were returned to the exporting countries. The plastic waste industry witnessed a USD 446 million and USD 298 million drop in export and import trade values respectively for 2012 and 2013. The industry did not recover from this drop even though the trade of plastic waste plastics remained substantial in 2016. The Green Fence policy succeeded in reducing illegal smuggling and trade but did not entirely stop informal flows of plastic waste.[106]

The Chinese government announced a permanent ban on the import of non-industrial plastic waste in 2017.[107] This is known as the "National Sword" policy that came into force in January 2018. The National Sword policy focused on preventing the export of contaminated wastes that constituted significant problems for the Chinese waste processing infrastructure and created more environmental challenges.[108] The Chinese National Sword policy set the contamination standard for plastic waste import to 0.5%, which is lower than the industry standard range - between 1% to 5%.[109]

About 12 months after enacting the National Sword policy, the Chinese import of plastic waste significantly dropped by 99%, which led to a crash in the prices of plastic waste and its redirection to other Asian and African countries. This impacted the flow of plastic waste from G7 countries to China and Hong Kong, which dropped from 60% during the first 6 months of 2017 to less than 10% for the same period in 2018.[110] See figure 1.6 for details.

105 C.A. Velis, "Global recycling markets: plastic waste" (International Solid Waste Association, 2014); www.iswa.org/fileadmin/galleries/Task_Forces/TFGWM_Report_GRM_Plastic_China_LR.pdf.

106 Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.

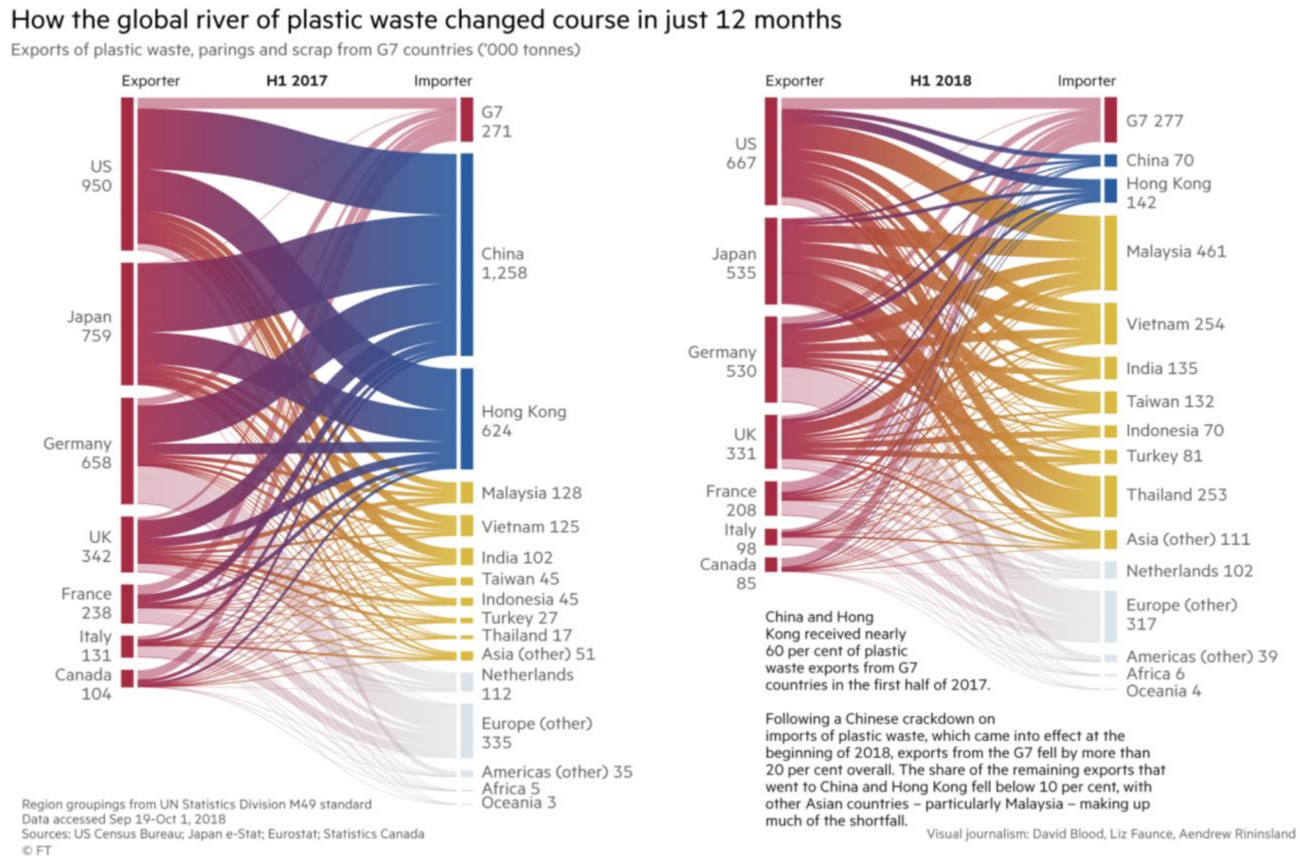
107 Chinese Ministry of Environmental Protection, "Announcement of releasing the Catalogues of Imported Wastes Management," (Announcement no. 39, 2017); www.mep.gov.cn/gkml/hbb/bgg/201708/t20170817_419811.htm?COLLCC=3069001657&

108 https://e360.yale.edu/features/piling-up-how-chinas-ban-on-importing-waste-has-stalled-global-recycling

109 https://www.washingtonpost.com/national/health-science/a-move-by-china-puts-us-small-town-recycling-programs-in-the-dumps/2019/01/18/6a043642-1825-11e9-8813-cb9dec761e73_story.html

110 https://www.ft.com/content/360e2524-d71a-11e8-a854-33d6f82e62f8

Figure 1. 6: How the Global River of Plastic Waste Changed Course in just 12 Months



Source:[111]

The Chinese National Sword policy is responsible for the increasing quantity of plastic waste being dumped in landfills, incinerated or ending up in the natural environment. Over 500,000 tonnes of plastics and other household wastes were burned in England in 2018. Australia is also struggling to manage 1.3 million tonnes stockpile of recyclable waste, it previously exported to China.[112]

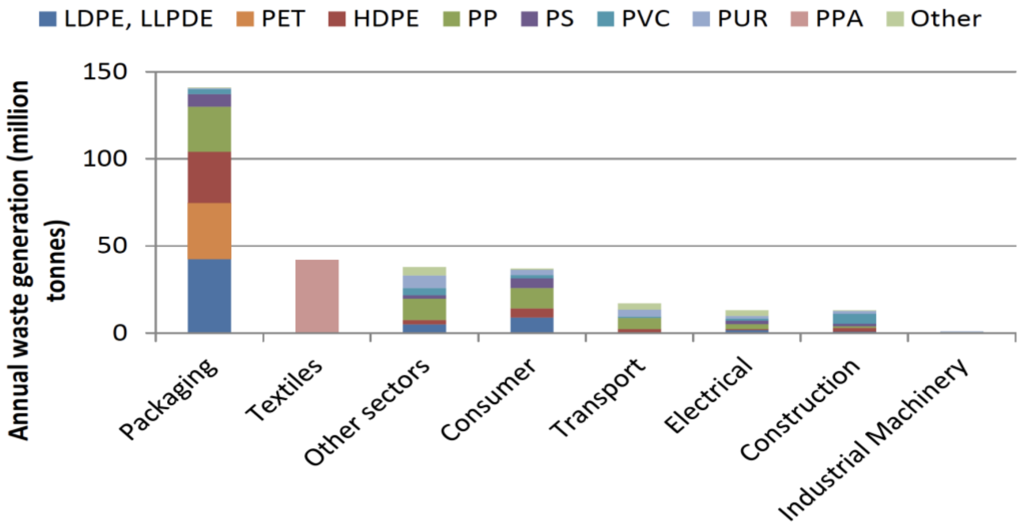
1.4 Global Distribution of Waste Plastics Recycling Capacity

Plastics are made of different materials that have specific physical and chemical properties. A minimum of 8 polymer types are commonly used for manufacturing plastics in combination with numerous chemical additives to reinforce polymer performance. The use of different polymer types and chemicals in plastics makes collection, sorting and recycling difficult across different polymers. Plastics are also used in most key product categories like packaging, textile, transport, electrical and construction. The figure 1.7 below shows the proportion of different polymer types that are used in different product categories. The product category with the highest application of plastics as a measure of weight is

[111] https://www.ft.com/content/360e2524-d71a-11e8-a854-33d6f82e62f8
[112] https://e360.yale.edu/features/piling-up-how-chinas-ban-on-importing-waste-has-stalled-global-recycling

packaging, followed by the textile, consumer goods, transport and construction sectors, respectively. The difference in polymer types that are used in the same product categories also complicates plastic waste sorting and recycling.[113]

Figure 1. 7: Global plastics use by polymer and sector



Note: The polymer breakdown for each product category has been translated on a proportional basis from 2015 production data. Polyester, polyamide, and acrylic (PPA) fibres are assigned exclusively to the textiles sector following Geyer, Jambeck, and Law (2017).

Source: [114]

Before 1980, the rate of plastic recycling and recovery was very low. The plastic recycling rate is economically marginal with the current global recycling rates estimated to be around 14% - 18%. The top recycling rates in 2014 were in Europe at 30% and China at 25%. The recycling rate in the US since 2012 has been consistently around 9%. The other plastic waste is either incinerated (24%) or dumped in landfills or the natural environment (58% - 62%).[115] Recycled plastics meet 10% of the global demands for plastics.[116] The rate of recycling plastic waste differs across countries, waste streams and polymer types. The recycling rate for the polymer type polyethylene terephthalate (PET) and high-density polyethylene (HDPE) are generally above 10%, while that for other polymer types like polystyrene (PS) and polypropylene (PP) is near zero.[117]

As at 2018, there were 144 HDPE and PP recyclers in all of Europe with Italy and Spain hosting the highest number of HDPE and PP facilities. Germany and the UK host the third and fourth number of

113 https://www.oecd.org/environment/waste/policy-highlights-improving-plastics-management.pdf
114 Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e1700782.
115 Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e1700782.
116 d'Ambrières, W. (2019). Plastics recycling worldwide: current overview and desirable changes. Field Actions Science Reports. The journal of field actions, (Special Issue 19), 12-21.
117 https://www.oecd.org/environment/waste/policy-highlights-improving-plastics-management.pdf

facilities respectively in Europe.[118] The recycling rate in the European Union (EU) was 30% in general, which is significantly higher in some EU member states.[119] The recycling rate in other High Income (HIC) countries is mostly in the order of 10%. This statistic is mostly unavailable for low to middle-income countries, though some data shows that recycling rates in some cities in low to middle-income countries range around 20% - 40%.[120]

Exporting plastic waste to countries with comparative cost advantages in sorting and recycling can simultaneously improve global recycling rates, generate more revenues and enhance the environment. The overall trade in plastic waste, however, is predominantly low in comparison to its production. For example, in 2015, only 14 million tonnes (or 4%) of the 300 million tonnes of plastic waste generated was exported outside the country of origin.[121] A handful of countries are responsible for the imports of plastic waste. In 2016, the People's Republic of China was the biggest market for plastic waste having imported about 60% (8 million tonnes) of the global imports.[122] China is followed by Hong Kong (2 million tonnes), Germany (0.5 million tonnes) and the United States (0.4 million tonnes).[123]

Since 1988, High Income (HIC) countries have remained the dominant exporters of plastic waste, having exported 87% of the total plastic waste exported, which is worth USD 71 billion. Whereas, the import of plastic waste is almost evenly distributed between HIC and Upper Middle Income (UMI) countries that together constitute 96% of global imports that is worth USD 106 billion. See tables 1.1 and 1.2 below for details. From a regional perspective, tables 1.1 and 1.2 below show EAP (East Asia and Pacific) countries as the top exporters of plastic waste, but this is primarily the result of the large flow of plastic waste destined for China through Hong Kong. Eliminating Hong Kong makes the ECA (Europe and Central Asia) countries (e.g. Germany, UK and Netherlands) the top exporters of plastic waste with 32% (USD 27.6 billion) of global exports and North American (NA) countries (e.g. United States and Canada) adding 14% (USD 14.3 billion) to the global exports of plastic waste.[124]

However, EAP (East Asia and Pacific) countries overwhelmingly lead in the import of waste plastics, having imported 75% (USD 83.3 billion) of the global import since 1988. See table 1.2 for details. The combined plastic waste exports from OECD member nations constitute 64% (USD 57.4 billion) of global exports, which suggests that plastic waste trade mostly occurs between OECD and EAP countries. This is important considering 33 of the 35 OECD member nations are classed as HIC, and

118 https://www.plasticsrecyclers.eu/recycling-capacity-rigid-polyolefins-europe-totals-17-m-tonnes
119 PlasticsEurope (2017), "Plastics – the Facts 2017",
https://www.plasticseurope.org/application/files/5715/1717/4180/Plastics_the_facts_2017_FINAL_for_website_one_page.pdf (accessed on 28 March 2018).
120 Wilson, D. et al. (2009), "Building recycling rates through the informal sector", Waste Management, Vol. 29/2, pp. 629-635, http://dx.doi.org/10.1016/J.WASMAN.2008.06.016.
121 https://www.oecd.org/environment/waste/policy-highlights-improving-plastics-management.pdf
122 UN COMTRADE (2018), United Nations Statistics Division - Commodity Trade Statistics Database (COMTRADE), https://comtrade.un.org/db/default.aspx (accessed on 21 March 2018).
123 https://www.oecd.org/environment/waste/policy-highlights-improving-plastics-management.pdf
124 Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.

90% of the top 10 exporters are members of OECD, while 23 of the 36 EAP countries are classed as low or middle-income countries.[125]

Table 1. 1: Cumulative Plastic Waste Export by Country (1988-2016)

Table 1. Cumulative plastic waste export and import by country (1988–2016) (*9–12*). MMT, million MT. SAR, Special Adminitrative Region.

Exporters (top 10)

Rank*	Reporter	Economic classification[†]	Region*	Cumulative trade value (billion USD)[‡]	Cumulative net weight (MMT)[§]	% of global exports
1[‖]	China, Hong Kong SAR	HIC	EAP	16.7	56.1	26.1
2	United States	HIC	NA (OECD)	12.3	26.7	12.4
3	Japan	HIC	EAP (OECD)	9.64	22.2	10.3
4	Germany	HIC	ECA (OECD)	6.95	17.6	8.22
5	Mexico	UMI	LAC (OECD)	4.55	10.5	4.90
6	UK	HIC	ECA (OECD)	3.32	9.26	4.31
7	Netherlands	HIC	ECA (OECD)	3.19	7.71	3.59
8	France	HIC	ECA (OECD)	3.49	7.55	3.52
9	Belgium	HIC	ECA (OECD)	2.55	6.41	2.99
10	Canada	HIC	NA (OECD)	1.93	3.89	1.81
		Total		64.7	168	78

Source:[126]

Table 1. 2: Cumulative Plastic Waste Import by Country (1988-2016)

Importers (top 10)

Rank	Country	Economic classification[†]	Region*	Cumulative trade value (billion USD)[‡]	Cumulative net weight (MMT)[§]	% of global imports
1	China	UMI	EAP	57.6	106	45.1
2	China, Hong Kong SAR	HIC	EAP	23.3	64.5	27.3
3[¶]	United States	HIC	NA (OECD)	5.18	8.49	3.60
4	Netherlands	HIC	ECA (OECD)	2.40	6.43	2.72
5	Germany	HIC	ECA (OECD)	2.30	5.36	2.27
6	Belgium	HIC	ECA (OECD)	1.81	4.15	1.76
7	Canada	HIC	NA (OECD)	1.76	3.83	1.62
8	Italy	HIC	ECA (OECD)	1.84	3.32	1.41
9	India	LMI	SA	1.20	3.10	1.31
10	Other Asia, nes[#]	Unspecified	Unspecified	0.97	2.38	1.01
		Total		98.3	208	88

Source:[127]

125 Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.
126 Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.
127 Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131.

D'Ambrières (2019) suggests that waste management capacity differs from one country to the other. They discuss four main categories of countries: 1) developed economies with regulations that encourage recycling, 2) developed economies that do not have such incentives, 3) developing economies with large industrial bases and 4) developing economies with little industrial activity.[128]

Developed economies with regulations that encourage recycling usually have established economies that are considered rich with modest economic growth rates. These economies tend to have the usual waste management infrastructures, such as landfills and energy recovery, which have relatively high costs of labour. Countries in this category include those in Western Europe and Japan, with varying regulations focused on improving recycling. They usually achieve a recycling rate that is close to 30%. The regulations adopted in countries in this category include setting up organisations to oversee recycling, green levies and measures to increase the costs of alternative waste processing (taxes on landfills and incineration).

Developed economies without regulatory incitement have traits associated with the first category but emphasise the use of traditional waste management methods, such as landfills and incineration. Examples of countries in this category are the United States and Australia. These countries have low local plastic waste recycle rate of less than 10% because of poor recycling and lack of regulation to promote recycling over other traditional waste processing methods.

Developing countries with a significant industrial base usually have insufficient waste processing infrastructures with unsystematic waste collection methods that see most household and industrial wastes discarded in unofficial or unregulated sites. Countries in this category have poor sorting infrastructures that are mostly replaced by informal networks. Recycling capacity and processing infrastructure in these countries improve in response to the value of waste as a result of local industry demands and volumes of available wastes. Good examples of countries in this category are China, India and Brazil. These countries achieve a recycling rate of about 20%.[129] The development of waste management infrastructure is ongoing in China. Approximately 1.3 to 3.5 million tonnes of plastic waste is estimated to enter the oceans from Chinese shorelines.[130]

The last category is developing countries with limited industrial activity. Countries in this category usually have minimal recycling capacity because of the insignificant value of waste in their local market. This leads to much of the waste ending up in informal or unregulated dumpsites and oceans or marine environments.

128 d'Ambrières, W. (2019). Plastics recycling worldwide: current overview and desirable changes. Field Actions Science Reports. The journal of field actions, (Special Issue 19), 12-21.
129 d'Ambrières, W. (2019). Plastics recycling worldwide: current overview and desirable changes. Field Actions Science Reports. The journal of field actions, (Special Issue 19), 12-21.
130 J. R. Jambeck, A. Andrady, R. Geyer, R. Narayan, M. Perryman, T. Siegler, C. Wilcox, K. L. Law, Plastic waste inputs from land into the ocean. Science 347, 768–771 (2015).

1.5 Key Challenges to Waste Plastics Trade Flows

The lack of sufficient stakeholder engagements is one of the primary challenges to plastic waste trade flows that underpin most of the other challenges. This is because a burgeoning recycling sector will require stakeholder alignment across every stage of the product lifecycle, which should involve plastic product manufacturers, petrochemical companies, retailers, consumers, waste managers, city authorities, government, regulators and NGOs.[131] Insufficient stakeholder alignment, for example, impacts plastic waste recycler's access to relevant information on the composition of waste plastics received for processing. Recyclers have two options for obtaining information on plastic waste: 1) requesting any available information on the composition collected elsewhere; and 2) undertaking their own (laboratory) analysis of the constituents. The first option in practice is mostly possible when recyclers have well-established relationship with the party supplying the waste. Such that the composition of the waste is established and consistent over time. The second option is significantly expensive as spot checks are insufficient and create uncertainty on the impact of impurities detected for shipped plastic waste.[132]

The flow of plastic waste in most regions of the world (including the EU) is not adequately monitored. The lack of transparency makes it difficult to uniformly determine the origin and quality of recyclates at later stages of the recycling process. Transparency and traceability would increase the confidence of plastic waste converters on the quality and reliability of their end products. The EuCertPlast certification scheme exists to promote transparency and traceability of the secondary raw materials market, amongst other objectives. Certified recycler projects the image of a recycler with good practices and delivers high quality recycled products.[133]

Informal trade flows have surged due to the absence of transparency and accountability in the international waste trade as well as inadequate law enforcement and customs inspections at international ports, which has promoted illegal flows of waste on the pretense of recycling.[134] Illegal trade flows is facilitated by widespread deceptive strategies like mislabeling of waste shipments as recyclable materials and the contamination of recyclable waste with other hazardous waste.[135] It is the rise in illegal flows of waste that informed the increasing waste trade restrictions by China and some other Asian countries.

Consequent to the Chinese National Sword policy, legal and illegal plastic trade flows to other Association of Southeast Asian Nations (ASEAN) countries have significantly increased, with Malaysia

131 d'Ambrières, W. (2019). Plastics recycling worldwide: current overview and desirable changes. Field Actions Science Reports. The journal of field actions, (Special Issue 19), 12-21.
132 de Römph, T. J., & Van Calster, G. (2018). REACH in a circular economy: The obstacles for plastics recyclers and regulators. Review of European, Comparative & International Environmental Law, 27(3), 267-277.
133 https://www.plasticsrecyclers.eu/challenges-and-opportunities
134 https://www.asil.org/insights/volume/23/issue/7/basel-convention-parties-take-global-lead-mitigating-plastic-pollution
135 UN Environment Programme, Global Chemicals Outlook II (2019), https://wedocs.unep.org/bitstream/handle/20.500.11822/28113/GCOII.pdf?sequence=1&isAllowed=y.

witnessing record-high number of illegal and unlicensed recycling activities.[136] [137] Following the Chinese ban on plastic waste, Malaysia, Thailand and Vietnam have also implemented restrictions on the import of plastic waste. However, illegal waste flow from Australia, the United States, Canada, Saudi Arabia, Japan and the EU continues.[138]

As countries continue to strengthen and implement plastic waste regulations and bans on imports, trade flows of plastic waste are diverted to other countries, especially those with weaker regulatory standards for plastic waste imports. However, the new international rules under Basel convention will make such diversion increasingly difficult.[139] One of the primary objectives of the Chinese Green Fence policy was the reduction in illegal trafficking of plastic waste to China. This temporary policy succeeded in reducing informal plastic waste flows but did not eliminate it even though the actual quantities are not known.

Trade restrictions are increasingly limiting the import and export of plastic waste. The Chinese National Sword policy has had significant impacts on the trade flows of plastic waste. The EU plastic waste exports to China declined from 100,000 tonnes in June 2017 to less than 10,000 tonnes in January 2018. A similar trend is reported for the United States, where export volume fell from 75 000 tonnes in January 2017 to 6 000 tonnes in December 2018.[140] The Chinese National Sword policy places a ban on legal or formal import of plastic waste, which could result in a rise in informal and illegal flows.[141]

The Chinese ban on waste plastic has led to decline in recycling rates for countries that predominantly shipped waste to China, increase in the incineration and landfilling of plastic waste, diversion of waste materials to other export markets and domestic waste stockpiles.[142] Hence, making recycling very cost-intensive and unprofitable. Australia is currently struggling to manage the 1.3 million tonnes of plastic waste it previously shipped to China, while England burnt 500,000 more tonnes of plastic and household waste.[143]

However, experts argue that the challenges posed by the Chinese National Sword policy could lead to the development of a sustainable solution for global waste management. It could lead to building more waste processing infrastructures in North America and Europe and encouraging manufacturers to make

136 Data from the Global Plastics Waste Trade 2016-2018 and the Offshore Impact of China's Foreign Waste Import Ban, Greenpeace (Apr. 23, 2019), http://www.greenpeace.org/eastasia/Global/eastasia/publications/campaigns/toxics/GPEA%20Plastic%20waste%20trade%20-%20research%20briefing-v1.pdf
137 https://www.asil.org/insights/volume/23/issue/7/basel-convention-parties-take-global-lead-mitigating-plastic-pollution
138 3000 Metric Tonnes of Plastic Waste from 60 Containers Are Expected to Be Shipped Back to Their Country of Origins, MESTECC (May 28, 2019), https://www.mestecc.gov.my/web/en/media-statement/3000-tan-metrik-sisa-plastik-daripada-60-buah-kontena-dijangka-dihantar-balik-ke-negara-asal/.
139 https://www.asil.org/insights/volume/23/issue/7/basel-convention-parties-take-global-lead-mitigating-plastic-pollution
140 ISRI (2018), 2017 Trade Flows, http://www.isri.org/2017-trade-flows (accessed on 06 April 2018)
141 Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science advances, 4(6), eaat0131
142 https://www.oecd.org/environment/waste/policy-highlights-improving-plastics-management.pdf
143 https://e360.yale.edu/features/piling-up-how-chinas-ban-on-importing-waste-has-stalled-global-recycling

products that can be easily recycled.[144] Improving domestic recycling capacity will take time but can make the market for recycling more attractive.[145]

1.6 Global and National Plastics Pact Initiatives

The challenges that waste plastics pose to human health and the environment are receiving increasing attention both from governments and the private sector. This has led to a significant rise in global and national plastics pacts and alliances focusing on solving the challenges of plastic waste in the environment and possibly a circular economy for plastic waste. These pacts and alliances include the New Plastics Economy Global Commitment, the Global Plastics Alliance (GPA) and Alliance to End Plastic Waste (AEPW). Plastic pollution can be addressed by eliminating plastic waste, which would require changing the current linear take-make-dispose model to a revolutionary model of design, use and reuse of plastics.[146]

The New Plastics Economy Global Commitment led by Ellen MacArthur Foundation in partnership with the UN Environment Programme has carved a vision for a circular economy for plastics. A circular economy for plastics is a vision for an international plastics system where plastics do not become waste by eliminating the design of problematic and irrelevant plastics. In such a system, new business models can be used to change the approach to using plastics to ensure that all plastics are carefully reused, recycled or composted into new packaging and products. The New Plastics Economy Global Commitment vision has been endorsed by over 400 organisations including government and companies responsible for approximately 20% of all globally produced plastic packaging (including some well-known global brands).[147] This vision necessitates global, national and regional collaborations to achieve solutions adapted for local needs. Such collaborations are beginning to gain significant traction across the globe. The Plastics Pact is an alliance programme designed to pull national and regional stakeholders together to design and implement solutions for the vision of a circular economy for plastics. Every pact is governed by a local organisation working with governments, businesses and the public towards a common goal with a specific set of local targets. Pioneering national initiatives involved in the Ellen MacArthur Foundation's Plastics Pact network include the UK's Plastics Pact, supported by WRAP, the Pacte National sur les emballages plastiques in France and Circula El Plástico in Chile.

The GPA is an international collaboration involving plastics industry associations and related industry associations. Its first Global Declaration exploring Solutions for Marine Litter was released in 2011 focusing on six areas: education, research, public policy, sharing best practices, plastics recycling or recovery and plastic pellet containment. The GPA has about 355 projects that are either planned, in progress or completed, as of December 2017, which represent a 3.5 folds increase in the number of projects since the release of the initial Global Declaration in 2011. Such projects range from beach

[144] https://e360.yale.edu/features/piling-up-how-chinas-ban-on-importing-waste-has-stalled-global-recycling
[145] https://www.oecd.org/environment/waste/policy-highlights-improving-plastics-management.pdf
[146] https://www.newplasticseconomy.org/projects/plastics-pact
[147] https://www.newplasticseconomy.org/projects/plastics-pact

clean-ups to expanding waste management capacities, and from international research to awareness campaign and education.[148]

The Alliance to End Plastic Waste (AEPW) is a pact of global firms from the plastics and consumer goods value chain. Membership of the alliance includes firms that make, use, sell, process, collect and recycle plastics, such as BASF, Clariant, Covestro, Dow, DSM, ExxonMobil, Henkel, LyondellBasell, NOVA Chemicals, PolyOne, Procter & Gamble, Reliance Industries, SABIC, Total and Veolia. The AEPW current has approximately 30 member firms and has a goal of spending USD1.5 billion over the next 5years to eliminate plastic waste in the environment. It has already committed USD1.0 billion to its cause.[149] The AEPW is also collaborating with World Business Council for Sustainable Development (founding strategic partner), cities, Incubator Network of Circulate Capital and intergovernmental organisations, including the United Nations.

1.7 Case Studies

1.7.1 The UK

The UK is part of the EU and has committed to the European Strategy for Plastics in a Circular Economy, which includes an agreement on the Single Use Plastic Directive that will take effect from 2021. The directive will ban specific types of single use plastics.[150] The EU Waste Framework Directive (2008/98/EC) currently drives UK recycling policies. It gives guidelines for implementing the waste management policy throughout the EU. The EU Waste Framework Directive requires members to implement the waste management hierarchy. The waste management hierarchy outlines the order of priority to implement for products and waste. It promotes prevention and re-use over recycling, which is consistent with the drive for a circular economy.[151]

In 2016, the UK produced 1.53 million tonnes of plastic waste across all producing sectors and household. This figure represents a 24% rise from the 2010 figure and a 13% rise for 2014. The services sector contributed about 53% of the total plastic waste in the UK, which is the highest for any single contributor.[152] [153] [154] About 91% of plastic waste collected for treatment in the UK were sent for recovery and recycling, and the remainder 9% were sent to landfills. The amount of plastic waste in the

148 https://www.plasticseurope.org/en/newsroom/press-releases/archive-press-releases-2018/global-plastics-alliance-activities-prevent-marine-litter-grow-355-projects-worldwide

149 https://www.britishplastics.co.uk/News/alliance-to-end-plastic-waste-launched-as-largest-plastic-in/

150 http://researchbriefings.files.parliament.uk/documents/CBP-8515/CBP-8515.pdf

151 EU Waste Framework Directive, Article 4

152 UK statistics on waste 2019 update, Defra (Table 5.2): https://www.gov.uk/government/statistical-data-sets/env23-uk-waste-data-and-management

153 The coverage of UK data on plastic waste has been questioned by some organisations. A report for WWF calculated that total plastic waste generation in the UK in 2014 was around 4.9 million tonnes and could increase to around 6.3 million tonnes by 2030.

154 WWF, A Plastic Future – Plastics Consumption and Waste Management in the UK March 2018: http://www.eunomia.co.uk/reports-tools/a-plastic-future-plastics-consumption-and-waste-management-in-the-uk/

UK sent to landfills declined from 122,400 tonnes in 2012 to 53,400 tonnes in 2016.[155] The UK exported 0.6 million tonnes of plastic waste in 2018. Plastic waste export by the UK was the highest in 2011, but the 2018 figures represent the lowest export in the past ten years.[156] Following the Chinese ban on the import of plastic waste, the UK's plastic waste export to China dropped by 90% in 2018. The UK plastic waste in 2018 was mostly exported to Malaysia (17%), Turkey (13%), Indonesia (12%) and China/Hong Kong (9%).[157]

The UK Plastics Pact is an alliance that was founded by 42 businesses committed to eliminating unnecessary use of single-use plastic packaging. It was founded in April 2018 with the support of the UK's Waste and Resources Action Programme (WRAP). The UK Plastics Pact led by WRAP was set up to develop a solution to the challenges posed by plastic pollution without losing the benefits of plastic for society. It published the Pact's roadmap for 2025 in November 2018 outlining four main targets: eliminate problematic or unnecessary single-use plastic packaging through redesign, innovation or alternative re-use delivery models; 100% of plastic packaging to be reusable, recyclable or compostable; 70% of plastic packaging to be effectively recycled or composted, and a 30% average recycled content across all plastic packaging by 2025.[158] As at the time of the founding of the pact, the 42 pioneering members, including Nestlé, Marks & Spencer (M&S), Unilever, Procter & Gamble (P&G) and PepsiCo accounted for over 80% of the plastic packaging on UK supermarket products. The pact has now grown to 127 members with supports from waste management firms, local authorities, universities and SMEs. [159]

1.7.2 Egypt

Egypt is a country in northern Africa with a population estimate of 98 million. It is the highest importer of plastics in Africa having imported 43 Million tonnes (18.7%) of a total of 230 million tonnes of plastics that entered Africa between 1990 and 2017.[160] Environmentally Sound Management (ESM) of plastic waste in Africa is still at its early stages as some African countries have started recovery and recycling of plastic waste. Waste plastics constitute 13% of solid waste generated in Egypt. Egypt has no specific solid waste management law. However, the legal structure for managing solid waste is embedded in different pieces of legislation.[161] Egypt is the seventh-highest marine plastic polluter in the world. Approximately 0.15 to 0.39 million tonnes of plastic wastes from Egypt are dumped in the marine

155 UK statistics on waste 2019 update, Defra (Table 5.4): https://www.gov.uk/government/statistical-data-sets/env23-uk-waste-data-and-management

156 http://researchbriefings.files.parliament.uk/documents/CBP-8515/CBP-8515.pdf

157 HMRC Build your own table webpage: [downloaded on 27 February 2019] https://www.uktradeinfo.com/Statistics/BuildYourOwnTables/Pages/Home.aspx:

158 https://www.ukcpn.co.uk/news/uk-plastics-pact-1-year-on/

159 https://www.edie.net/news/5/One-year-on--How-has-WRAP-s-Plastic-Pact-changed-business-s-approach-to-single-use-plastics-/

160 https://enveurope.springeropen.com/articles/10.1186/s12302-019-0254-5

161 Ibrahim, M. I. M., & Mohamed, N. A. E. M. (2016). Towards sustainable management of solid waste in Egypt. Procedia Environmental Sciences, 34, 336-347.

environment every year.[162] A growing understanding of the many risks plastic waste pose for the wellbeing of the society and environment has led to the creation of various youth programmes focusing on plastic pollution in Egypt, including Banlastic, Bekia and Verynile.[163]

1.7.3 Malaysia

Malaysia is a Southeast Asian country with an estimated population of about 32 million people with a national recycling target of 22% by the year 2020. Waste plastics constitute about 24% of all solid waste generated in Malaysia. Plastic waste import to Malaysia tripled to 870,000 tonnes between 2016 and 2018.[164] The surge in plastic waste entering Malaysia led to a rise in illegal recycling plants and activities with limited attention to environmental standards. Malaysia is facing significant plastic waste management challenges. Its government plans to return containers with almost 3,000 tonnes of contaminated plastic waste to their originating countries.[165] Malaysia ranks 8th amongst the top 10 countries mismanaging plastic waste globally.[166] It has generated 0.94 million tonnes of mismanaged plastic waste, of which about 0.14 – 0.37 million tonnes are suspected to have been displaced in the marine environment.[167] Following the Chinese National Sword policy, plastic waste from countries like the US, UK and Australia was diverted to Malaysia where illegal recycling facilities in cities like Jenjarom tried to take advantage of the plastic waste recycling opportunity by burying or burning wastes. Approximately 19,000 tonnes of plastic waste is dumped in the small town of Jenjarom in Malaysia, transforming the town into a massive landfill.[168]

162 https://www.scientificamerican.com/arabic/articles/news/the-first-assessment-of-micro-plastic-waste-in-egyptian-marine-environment/

163 https://fanack.com/pollution/egypt-verynile-youth-initiative-tackles-plastic-pollution/

164 https://egyptindependent.com/malaysia-to-ship-back-hundreds-of-tonnes-of-plastic-waste/

165 https://www.reuters.com/article/us-malaysia-waste/malaysia-to-send-3000-tonnes-of-plastic-waste-back-to-countries-of-origin-idUSKCN1SY0M7

166 https://www.mestecc.gov.my/web/wp-content/uploads/2019/03/Malaysia-Roadmap-Towards-Zero-Single-Use-Plastics-2018-20302.pdf

167 Estimation of mismanaged plastic waste in Malaysia in 2010 (Jenna R. Jambeck et al. 2015)

168 https://www.businessinsider.com/malaysia-town-plastic-waste-china-photos-2019-2?r=US&IR=T