ZERO WASTE EUROPE

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Changing trends in plastic waste trade

Plastic Waste shipments report

November 2018

Contents

Executive summary

Plastics, especially single-use ones, are becoming an increasing environmental threat worldwide. Having been in use at large scale for a relatively short period of time, they have managed to colonise not only our daily lives but the environment as well.

Plastics production has grown at a very fast pace, from 2 million tonnes in 1950 to 381 million tonnes in 2015. The rate of production has sped up in the last decade. The plastic industry projects further increases: by 2050, it is estimated that total plastics ever produced will reach 34,000 million tonnes (Mt); that is four times what has been produced so far.

Despite the comfortable idea that we can use all the plastics we want as they will be recycled if we place them in the right bin, recent data shows that only 9% of all plastics ever discarded since 1950 have been recycled. 12% have been incinerated, and the rest is still present in the environment, whether in landfills, dumpsites, oceans, as incinerator residues, etc. and will most likely remain there for millennia.

As stated by the European Union (EU), recycling "serves the objective of generating a material which is used for the original or for other purposes, and thus of closing the economic material circle." The use of plastics as fuel is not reprocessing but replacing another energy source, does not close any material circle, and shortens materials cycles. Waste hierarchies tend to separate recycling from energy recovery, placing the first higher up in the scale. Producing with recycled plastics instead of virgin plastics has more environmental benefits. Lower emissions, including GHGs, by avoiding extraction and processing of fossil fuels, lower energy consumption and a reduced burden on finite resources are some examples of benefits.

Domestic recycling processing in EU tends to focus on those post-consumer plastics that are easier to separate and process, like PET and HDPE bottles, which represent a minimum amount of total plastic use. Resins that are more difficult to separate tend to be exported.

Global trade of plastic waste accounted for over 15 million tonnes in 2016. China is the top importer and main consumer worldwide, receiving 51% of all plastic scrap traded (including re-exports from Hong Kong). United States is the national largest plastic scrap exporter in the world, and the 2nd largest plastics consumer. If taken collectively, the European Union is the largest exporter worldwide.

Dependence on global trade has drawbacks. Trade imbalances often make shipping scrap to global markets cheaper than recycling in the EU. Also, there are many transparency problems around global scrap trade, with inconsistent data, illegal traffic and uncertainties of real fate of exported materials.

Collection and processing for recycling in importing countries tends to rely heavily on the informal sector, without support or recognition from governments. The informal sector works under precarious conditions, and is exposed to releases of toxic additives and chemicals during plastics processing.

China's restrictions and ban on plastic scrap import is shaking recycling systems globally. China is conducting strict controls on plastic scrap containers, import quota, and inspecting and closing many local recycling facilities, and implemented a post-consumer plastic import ban in December 2017, "with an entry into force" in March 2018. Alleged reasons are to reduce waste smuggling and strengthening recycling of domestic waste.

There are great uncertainties as to the impact that this ban is having, but recycling exports to China have certainly diminished. A good number of exports are migrating to other countries in Asia. A desirable scenario for the EU is to reduce plastics use, expand domestic recycling capacity and increase collection rates in order to reduce export dependency and reduce the reliance on incineration and landfilling in Europe and beyond.

Key findings

- **The impacts of plastics are out of control.** The overproduction of plastics and the diversity of plastics produced and consumed mean plastics are found in marine and other environments at an alarming scale.

- **Recycling rates are very low worldwide**. Highest collection rate of plastic for recycling in the world is 29.7% in the European Union, while U.S. only collects for recycling 9.5% of post-consumer plastic, considering records from the formal systems, and due to lack of registers from the recovery rates in the informal sector. In turn, China's plastic recycling rate is 22.8%. **In the best case scenario over two thirds of the plastics we discard fall out of the so called Circular Economy. But the average scenario is a lot worse.**

- **Plastic recycling rates are limited**. Most plastic resins are not economically recyclable. Low oil and gas prices make virgin plastic cheap, which severely undermines recycling markets. Current trends to shift from rigid to multi-laminated, multi-composite flexible plastics reduce recycling options even more.

- There has a global dependence on global plastic scrap trade for recycling systems; the largest exporters are the United States and countries in the European Union but the new ban from China is changing the situation.

- **Global trade of plastic scrap implies severe environmental injustices.** Many plastics exported are mixed plastics, of low grade, with no local markets. The lack of transparency also enables illegal waste trade.

- As the leading importer of plastic scrap, **China's announced ban on post-consumer plastic import is shaking local recycling systems worldwide.** This change is driving innovative thinking to improve recycling quality and standards in the regions that export the most plastic but also threatens to increase plastic incineration, as well as to shift the burden of plastic waste processing to countries in Southeast Asia, including Indonesia and Malaysia, and potentially India.

- **Recycling processing in importing countries tends to rely heavily on the informal sector and small operations**, without support or recognition. Such operations often fall well below standards in exporting countries, meaning that exporting countries are externalising costs and environmental impacts abroad.

- Using plastics as fuel is occasionally proposed to manage plastic waste, which is not recycling but a form of incineration with fossil fuel emissions, thus lower on the waste management hierarchy.

- Current standards are not proving effective to drive the recycling markets to absorb all plastics. They are voluntary, managerial, and largely influenced by industry.

- **Existing international frameworks are not sufficient to address current problems with plastics.** They are voluntary and only focus on preventing ocean leakage of the plastics. These global instruments are not addressing the root-causes of plastic pollution, and in consequence they will fall short in prompting real change.

- While there is evidence that some regions can increase recycling rates with current capacity by proven policy tools and even expand local recycling capacity in proper conditions, data from this research suggest that increasing recycling will not be enough to absorb all plastics in use. Therefore, other upstream approaches are necessary.

1. Introduction

1.1 Objectives

Increasing presence of plastics in land and alarmingly in oceans globally is a symptom that the use of plastics in our modern world has gotten out of control. The challenge becomes bigger as industry's projections are to increase production, in part, due to low oil and gas prices.

Fortunately, the scale of the problem is gaining recognition worldwide and a global conversation around potential solutions has begun. A variety of measures have been proposed in the many venues where plastic pollution is discussed. Expanding recycling systems is one of them, and it

is believed this expansion will be able to prevent plastics entering water courses and polluting the environment while providing green jobs and strengthening local waste management systems.

However, while recycling is part of the solution at this scale of the problem, it is a very limited one. In this report we will examine current state of plastic recycling practices, understand the global trade circuit around them, look into types of plastics and recycling standards and explore what actually happens with the plastics that are bound for recycling.

This report is a result of a collaborative analysis of data gathered collectively from primary and secondary sources. Primary sources include interviews with representatives from recycling companies, government bodies, research through databases and official registers, site visits, among others. Secondary sources include reports from the plastics and recycling industries, international, regional and local governmental and non-governmental entities.

This report focuses on some of the major plastics importer and exporter countries, as they are the biggest players in plastic production, consumption, and plastic scrap processing worldwide; namely China, United States, European Union, India, Indonesia, and Malaysia.

1.2 General overview on plastic manufacturing and consumption

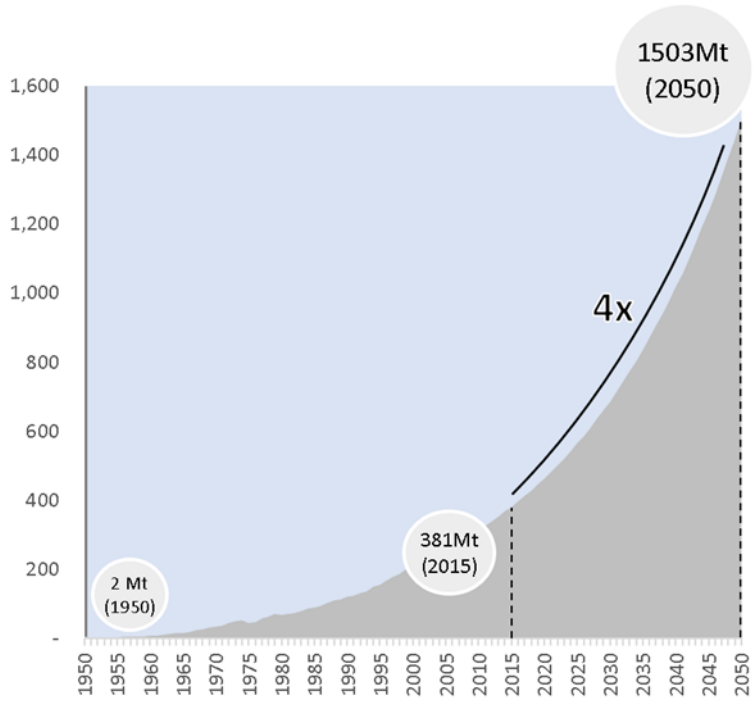
Plastic's production trend

As difficult as it seems to imagine a world without plastics, this peculiar material has only been in use at a large scale since 1950[1]. But ever since, it has been conquering our daily lives at an impressive pace. According to a global research, the total amount of plastic resins and fibres manufactured from 1950 through 2015 sums 7,800 million metric tonnes[2]. Including additives (which provide the properties that make plastics so versatile, such as flexibility and stability) the number scales up to 8,300 million tonnes.[3]

Plastics production has been growing at a very fast pace, particularly since the last decade. **Global annual production increased from 2 million tonnes in 1950 to 381 million tonnes in 2015**: 2.5 times the compound annual growth rate of the global gross domestic product for that period.[4] Projections are to further increase the growth rate: if current trend continues, by 2050, it is estimated that total plastics ever produced will reach 34,000 million tonnes (Mt); that is over four times what has been produced so far.[5]

[1] Geyer, R., Jambeck, J. and Lavender, K. 2017. Production, use, and fate of all plastics ever made. *Science Advances* 3:7. [DOI: 10.1126/sciadv.1700782].
[2] Unless otherwise specified, all data in tonnes in this report refer to metric tonnes.
[3] Geyer, R., Jambeck, J. and Lavender, K. 2017.
[4] *Ibid*
[5] *Ibid.*

Figure 1: Evolution of annual global polymer resin and fibre production and projections 1950-2050



Source: Geyer, R., Jambeck, J. and Lavender, K. 2017. Note: projections from 2015 onwards are of own elaboration, calculated on the basis of 4% growth rate, average growth rate in the past ten years. 2050 estimate from Geyer et al.

Plastics and the fossil fuel economy

Plastics are at the heart of the fossil fuel economy. Virtually all plastics are made of chemicals resulting from oil and gas processing.[6] **Currently, 6% of total oil production is used by the plastic sector**, and it is estimated that it will represent 20% use by 2050. Half of it is used as feedstock to make plastics and the rest as fuel in the production process. According to the same source, this would drive the global plastics sector to account for 15% of global annual carbon budget by 2050, compared with the 1% today.[7]

Oil and gas and plastic industries tend to be vertically integrated: many plastic companies are chemical divisions of oil and gas companies, or own oil and gas companies.[8] Largest plastics producer worldwide is **DowDupont**, with headquarters in U.S., which resulted from the recent merge of Dow and Dupont. Second largest plastics producer worldwide is **LyondellBasell**, with headquarters in The Netherlands.[9]

[6] Exceptions are those manufactured out of vegetable sources, such as bio-based PLA. Center for International Environmental Law. 2017. *Fossils, Plastics & Petrochemical Feedstocks.*

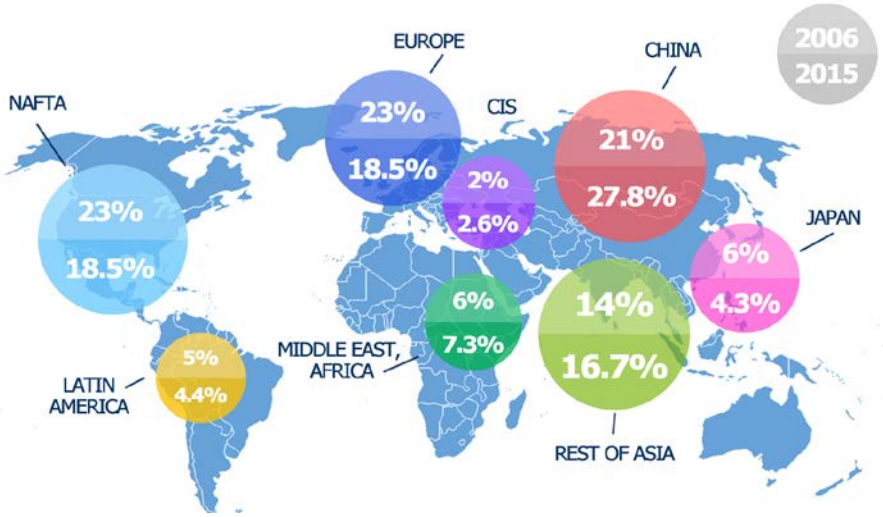
[7] The carbon budget refers to the amount of greenhouse gases admissible to emit in order to maintain the global temperature increase up to 2°C by 2100. Source: World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company. 2016. *The New Plastics Economy — Rethinking the future of plastics.*

[8] Center for International Environmental Law. 2017. *Fossils, Plastics & Petrochemical Feedstocks.*

[9] *Ibid.*

In terms of countries, **China** is the largest producer of plastics (27.8%) worldwide, followed by the **U.S.** and **Europe**.[10] Production of plastics is migrating from western countries to Asia, especially China. However, as mentioned before, chemical companies in Europe and the U.S. are planning expansions.[11]

Figure 2: Relative plastic production by country/region – 2006-2015



Note: includes only thermoplastics and polyurethanes, with a 2015 global production of 269 Mt.
Source: Adapted from Plastics Europe Market Research Group/Consultic Marketing & Industrieberatung GmbH

[10] Plastics Europe and EPRO. 2016. *Plastics - the Facts.*
[11] Center for International Environmental Law. 2017. *Fossils, Plastics & Petrochemical Feedstocks.*

Figure 3: Types of plastics, products and uses after recycling

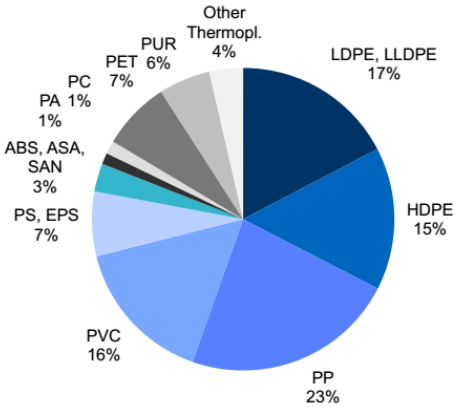
Resin		Common products		Uses after recycling
1 PETE	Polyethylene Terephthalate (PET, PETE)		Soda & water bottles, cups, jars, trays, clamshells	Clothing, carpet, clamshells, soda & water bottles
2 HDPE	High Density Polyethylene (HDPE)		Milk jugs, detergent & shampoo bottles, flower pots, grocery bags	Detergent bottles, flower pots, crates, pipe, decking
3 V	Polyvinyl Chloride (PVC, V)		Cleaning supply jugs, pool liners, twine, sheeting, automotive product bottles, food foils	Pipe, wall siding, binders, carpet backing, flooring
4 LDPE	Low Density Polyethylene (LDPE)		Bread bags, paper towers & tissue overwrap, squeeze bottles, trash bags, six-pack rings	Trash bags, plastic lumber, furniture, shipping envelopes, compost bins
5 PP	Polypropylene (PP)		Yogurt tubs, cubs, juice bottles, straws, hangers, sand & shipping bags	Paint cans, speed bumps, auto parts, food containers, hangers, plant pots, razor handles
6 PS	Polystyrene (PS)		To-go containers & flatware, hot cups, razors, CD cases, shipping cushion, cartons, trays	Picture frames, crown molding, rulers, flower pots, hangers, toys, tape dispensers
7 Other	Other		Polycarbonate, nylon, ABS, acrylic, PLA; bottles, safety glasses, CDs, headlight lenses	Electronic housing , auto parts

The Source: The Association of Plastic Recyclers

The most used plastic globally is PE (which includes HDPE, LDPE and LLDPE or linear LDPE). **Five types of plastics –PE, PP, PVC, PS and PET- account for 85% of total plastics demand worldwide**.[12] The world of fibres is dominated with polyester, based on PET, with 70% of total production.[13]

[12] Plastics Europe. 2016. *The Plastics Industry.* Powerpoint presentation.
[13] Geyer, R., Jambeck, J. and Lavender, K. 2017. Production, use, and fate of all plastics ever made. *Science Advances* 3:7. [DOI: 10.1126/sciadv.1700782].

Figure 4: Global plastic material demand by type - 2015



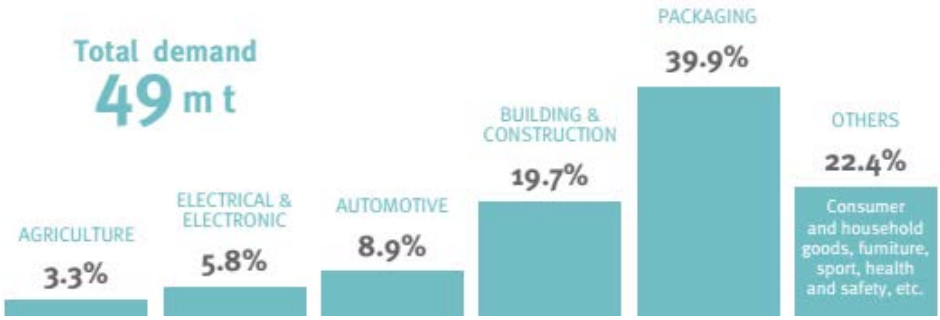
Source: Plastics Europe. 2016. The Plastics Industry. PowerPoint presentation.

The complex mixture of plastics we use and discard daily is a challenge for recycling.

Plastic packaging increase

Plastics largest application by far is packaging. Following uses are building and construction and automotive.

Figure 5: Uses of Plastics in Europe (EU+28) by segment, in 2015



Source: Plastics Europe and EPRO. 2016. *Plastics - the Facts.*

Since packaging has an ephemeral life -most packaging is discarded within the year it was bought- an increase in its production is quickly reflected in the amount of waste. Other uses of plastics such as building and construction and automotive have longer use lives, therefore the impact on waste accumulation is delayed.[14]

Largest plastic packaging manufacturers worldwide are **Amcor** (Australia), **Sealed Air** (U.S.), **Berry Plastics** (U.S.), **Bemis** (U.S.), **Alpla** (Austria) and **Coveris** (U.S.), based on their 2015 sales.

[14] Geyer, R., Jambeck, J. and Lavender, K. 2017. Production, use, and fate of all plastics ever made. *Science Advances* 3:7. [DOI: 10.1126/sciadv.1700782].

In turn, the leading sectors in packaging use are **fast moving consumer good** and **pharmaceutical**, top companies being **Nestlé**, **Procter & Gamble**, **PepsiCo**, **Unilever** and **JBS**.[15]

Plastic waste

According to a global research on plastic trends,[16] 6,300 million tonnes of plastic have become waste since 1950, including primary and secondary (recycled) plastics. **Only 9% of all plastics ever discarded since 1950 have been recycled**. 12% have been incinerated, and the rest is still present in the environment, whether in landfills, dumpsites, oceans, as incinerator residues, etc. **and will most likely remain there for millennia.** Plastic pollution in marine areas is getting increased attention worldwide, as there is growing evidence of the presence of plastic debris and microplastics in oceans and coasts around the globe. It is estimated that at least 8 million tonnes of plastic enter the oceans annually, and if this trend continues by 2050 there will be more plastic than fish in the ocean (by weight).[17]

Waste can tell us a lot about of our societies. So much so that the **share of plastics in municipal solid waste has increased from less than 1% in 1960 to 10% in 2015** in middle and high-income countries.[18] Back in the 1960 products did last longer, consumption of single-use items was low, supply chains were shorter and people used to consume more fresh and home-made food and locally produced items. This has changed dramatically ever since.

In brief, the fossil fuel economy has developed many types of plastics, which have been taking up consumer good stores quickly. The growth rate of plastic production and overall consumption, the fast and constant replacement of reusable products and packaging for single use ones, the intrinsic characteristics of plastics and the lack of structural responses to these issues have been building up this plastic soup our environment has turned into. As we will see in this report, recycling, while being part of the solution it is a very limited one and cannot by itself get anywhere near the core of the problem.

2. Plastic recycling trends

2.1 What is recycling?

The European Union defines recycling of waste as "any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include

[15] Ponder, Megan. 2016. *An Overview of the Plastics Industry and the Global Plastics Waste Trade.* Plastics Movement Alignment Project.
[16] Geyer, R., Jambeck, J. and Lavender, K. 2017.
[17] World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company. 2016. *The New Plastics Economy — Rethinking the future of plastics.* For more information on marine pollution, visit http://www.unep.org/gpa/what-we-do/global-partnership-marine-litter
[18] Geyer, R., Jambeck, J. and Lavender, K. 2017.
United Nations Environmental Programme and International Solid Waste Association. 2015. *Global waste management outlook.*

energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations."[19]
Recycling implies a transformation of the original material into a new one (in the case of plastic, it is basically melted and then reshaped). Recycling differs from reuse, where an object is used again for the same or other purpose without altering its basic structure (like refilling a bottle, or using a jar as a pen holder).

Recycling approaches can be classified into **mechanical recycling** when recycling is done through physical processes like grinding, shredding, heating, etc. but does not alter polymers' molecular structure. Real recycling is **primary recycling**, which happens when the product or packaging is reprocessed into the same use (like a bottle recycled into a bottle). This type of recycling replaces virgin materials of the original product and maximizes material cycles. When the material is processed into a lower quality product or packaging, it is called "downcycling", "open loop recycling," or **secondary recycling** (for instance a bottle turned into a bucket). In this case, the recycling downgrades the material reducing its quality and makes another round of recycling more difficult, thus economically unfeasible.

So called **chemical recycling** is done by chemically transforming plastics into their basic components (monomers in the case of depolymerization or pure polymers in the case of chemical purification), altering their molecular structure, and using them back to reproduce the same plastic again. Some new initiatives are attempting chemical recycling, and evaluation of such initiatives will need to include fugitive emissions from high temperature treatment, management of solvents, veracity of claims about how the outputs are used to ensure these processes are not combusted for fuel, whether processes are tested in countries were adequate monitoring could be achieved, and overall transparency of the process. However, the term "chemical recycling" also refers to transforming plastics in chemicals or other materials to be later used for different purposes than the original material. This process is also called "feedstock recycling". The outputs can be used as feedstock in chemical processes, but in the past, and still today, these other purposes meant using outputs as fuel.[20] **If feedstock recycling implies the use of plastics as fuels, that is clearly incineration instead of recycling.** Not surprisingly, this option is often proposed as a solution to multi-layer, multi-component and mixed plastics, and expanded polystyrene.

[19] Eurostat http://ec.europa.eu/eurostat/statisticsexplained/index.php/Glossary:Recycling_of_waste
[20] Tukker, A. 2002. *Plastics Waste - Feedstock Recycling, Chemical Recycling and Incineration.* Rapra. UK.

Burning plastics in cement kiln co-incineration, standard waste to energy incinerators, and plastics to fuel are NOT recycling

Using plastics as fuel is not recycling, because recycling refers to reprocessing materials into new materials. As stated by the European Union, recycling "serves the objective of generating a material which is used for the original or for other purposes, and thus of closing the economic material circle."[21] The use of plastics as fuel is not reprocessing but replacing another energy source, does not close any material circle, and shortens materials cycles. Waste hierarchies tend to separate recycling from energy recovery, placing the first higher up in the scale. Some consider waste-to-energy an energy recovery option[22] and some go even further by understanding that it is a waste disposal option; not a waste diversion one.[23] In addition, burning plastics means burning fossil fuels, thus increasing greenhouse gas emissions, in contradiction to worldwide efforts to halt global warming.

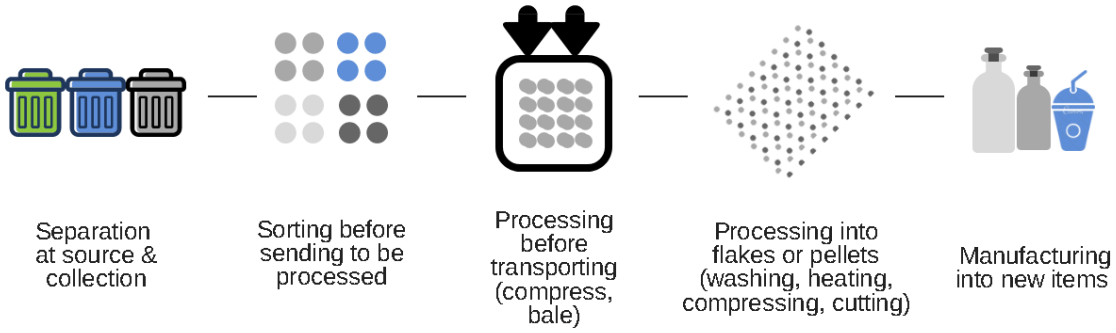
Despite these consequences, the incinerator industry, cement industry, plastic industry and other players attempt to disguise incineration of plastics as recycling, or to simply incinerate plastics without fanfare. Sometimes plastic collected for recycling ends up in cement kilns or incinerators when plastic recycling markets are insufficient.[24] This practice may be more widespread, given the lack of transparency in the plastic recycling market. In the U.S., Dow Chemical and partners are promoting a pilot program to collect plastics to burn in cement kilns and are labelling the program "recycling" and part of the "circular economy." The program has been widely condemned by the National Recycling Coalition and others. [25]

Other techniques promoted include the use of plastics to manufacture bricks and build roads. For them, further and independent assessment is needed on: potential leakage of microplastics and additives when the plastics break down, flammability and related-additives required, after-life use, displacement of more durable or renewable materials such as wood, among others. In the same line, some new initiatives to recycle multi-layered sachets need to be further analysed, assessing costs, outputs, compatibility with operating recycling and waste management systems.

[21] European Commission. 2012. *Guidelines on the interpretation of key provisions of Directive 2008/98/EC on waste.*
[22] The energy that can be recovered in incinerators does not equal the amount consumed in producing those plastics, so burning plastics in incinerators, waste to energy plants, co-incineration, gasification, pyrolysis, or using plastics as fuel are actually a waste-of-energy.
[23] Hoornweg, D. and Bhada-Tata, P. 2012. *What a waste: a global review of solid waste management.* World Bank.
[24] In the wake of China's import restrictions and ban, Honolulu,U.S. is currently considering sending plastics to the local waste to energy incinerator.
[25] For more information see no-burn.org/dirtyenergybag

For mechanical recycling to take place, the following stages need to happen:

Figure 6: Steps for mechanical recycling



Each stage makes recycling possible. Frequently, people use the term "recycling" to describe any of the different steps of this process: separating recyclables at home or work, sorting recyclables at a materials recovery facility or informal marketplace, and the other steps in the chart above. While all of these steps are part of the recycling system, recycling requires the final step: the material must actually be made into a new item.

Producing out of recycled plastics, instead of virgin plastics, has many environmental benefits. It reduces the burden on nature as it avoids the need to extract more finite natural resources; it consumes less energy, and yields lower emissions, including greenhouse gas emissions, by avoiding extraction and processing of fossil fuels.

Plastics recycling rate is still low worldwide compared to other materials like metals and paper. **The highest average rates of collection of plastics for recycling in the world is 29.7% in Europe**.[26] The U.S. only collects for recycling 9.5% of its post-consumer plastic.[27] China's plastic recycling rate is 22.8%.[28] This means that **in the best case scenario over two thirds of the plastics we discard fall out of the so called Circular Economy**, ending up in incinerators, landfills, dumpsites, oceans or the environment. **And the average scenario is a lot worse.**

Still, recycling rates are only estimates, for at least three reasons. First, **a big portion of the plastics deemed to be recycled are exported and there are uncertainties about the real figures of traded plastics and what happens to them in importing countries** (discussed below). Secondly, official statistics often fall short by failing to include the informal recycling sector, so a big portion of the process is ignored. An estimated 15 million waste pickers worldwide collect, process and

[26] Plastics Europe and EPRO. 2016. *Plastics - the Facts.*
[27] US: Environmental Protection Agency. 2016. *Advancing Sustainable Materials Management: 2014 Tables and Figures Assessing Trends in Material Generation, Recycling, Composting, Combustion with Energy Recovery and Landfilling in the United States.*
[28] Plastic recycling rate in China is calculated as the percentage of plastic waste that gets recycled out of the total plastic produced in the same year, due to lack of statistics about total waste production. Using calculations made by public officials about plastic waste produced in 2015 and comparing with recycling figures for that same year, plastic recycling rate would be in the range of 45-48%. Data source: http://www.sohu.com/a/138163695_270404 http://www.chyxx.com/industry/201511/358086.html

sell recyclable materials.[29] Thirdly, it is important to understand how these figures are measured. In the EU and U.S., for instance, recycling rates indicate what is collected for recycling and not what is finally recycled into a new item.

Talking about "plastic recycling rates" does not reflect the whole picture, given the diversity of plastics. As we will see below, some resins are easier to recycle, and others are simply non-recyclable. The most profitable resins to recycle are numbers #1-PET and #2-HDPE. The problematic ones, worldwide, are the #3 to #7 and multiple layers of plastic and other materials. For instance, in the U.S., recycling rates of plastic bottles made of HDPE and PET were 34% and 30% respectively in 2015, while bottles made of other plastic resins had much lower recycling rates, like LDPE (4%) and PVC (3%). Also, frequently resins are mixed with additives to provide versatile qualities, but this also affects recycling possibilities and safety. So **when a goal to "increase recycling rates" is set, it becomes necessary to look into the real possibilities of each type of plastic to accomplish this.**

2.2 Looking deeper into plastic recycling

A number of problems come to light when digging into the possibilities to recycle plastics. Notably there are two main problems:

- The demand of recycle plastics from the industry is very low. Being at the heart of the fossil fuel economy, oil prices influence plastics. When these are low, virgin materials become cheap, hence demand for used plastics falls. This makes the market for recycled plastics very weak, subject to constant fluctuations attached to changes in oil prices. The current increase of shale oil and gas extraction is taking oil prices down, thus making plastic recycling less attractive.

- Dependence of global market fluctuations. When recycling depends on external factors, it becomes more vulnerable. For instance, estimates are that 38% of recycling companies in China halted operations during the economic crisis of 2008-2009, affecting worldwide recycling.[30] Global trading of scrap plastics during that period was notoriously altered.

2.2.1 Recyclability of plastics

In addition to the #1-7 resin code classification, plastics can be broadly classified by their malleability when heated, into thermoplastics and thermosets.

[29] ILO, WIEGO (2017), Cooperation among Workers in the Informal Economy: A Focus on Home-based Workers and Waste Pickers, p. 22, retrived from http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---coop/documents/publication/wcms_567507.pdf

[30] Costas Velis. 2014. *Global recycling markets: plastic waste. A story for one player – China.* International Solid Waste Association.

Thermoplastics melt when exposed to heat, and can return to their original condition when cooled down. Examples include polyethylene (PE), polyvinyl chloride (PVC), polyethylene terephthalate (PET), polystyrene (PS) and polypropylene (PP). By their physical properties, thermoplastics like PET, PE and PP have high potential to be mechanically recycled.[31]

Thermoset plastics solidify when heated, and cannot return to their original condition afterwards, therefore they cannot be mechanically recycled. Examples are polyurethane (PUR), polyester, acrylic resins, phenolic resins, and silicone and epoxide resins. While new developments have been announced of thermoset plastics that can be recycled[32], the fact is that the resins used today cannot be mechanically recycled.

As mentioned before, some thermoplastic resins and types of products and packaging are easier or more economically convenient to recycle than others. It is important to note that **most plastics in use are difficult and/or too expensive to recycle.** This difficulty is not the exception, but the rule. Local recycling systems tend to focus on those post-consumer plastics that are easier to separate and process, like PET and HDPE bottles, which represent a minimum amount of total plastic use.[33] Resins that are more difficult to separate tend to be exported to Asian countries. Furthermore, even for those actually recycled, most of the process is actually downcycling. For instance, 80% of PET bottles "recycled" are actually converted into fibres and other non-packaging products.[34]

Chemical properties of resins provide each type of plastic unique properties, but also complicate the recycling process. Most resins are not compatible with each other because they melt at different temperatures, so they must be separated. This is difficult to do, especially for post-consumer plastics, considering the variety of types we use and discard, and even more given that a single packaging can have multiple resins; for instance, **water bottles are usually made of PET, but the caps can be made of PP or HDPE, the linings inside the caps are made of PVC, as well as the labels.**

Furthermore, recycling only reduces the amount of plastics that enter the market when replacing virgin materials, and that does not typically happen and it is difficult to do, given the intrinsic properties of plastics. Recycling PET bottles into fibres does not reduce the amount of plastics used from raw materials, but rather displaces natural fibres like cotton or wool. In the case of bottles it displaces materials like glass, which traditionally used to be associated with return and refilling schemes, or metals, which can be recycled many more times than plastic.

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[31] Hopewell, J., Dvorak, R. and Kosior, E. 2009. Plastics recycling: challenges and opportunities. Philos Trans R Soc Lond B Biol Sci. 364 (1526): 2115–2126. [doi: 10.1098/rstb.2008.0311] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2873020/

[32] *New Opportunities to Recycle Thermoset Plastics*. Northstar Recycling. August 21, 2015. http://www.northstarrecycling.com/new-opportunities-to-recycle-thermoset-plastics/ Retrieved September 28th, 2017.

[33] Hopewell, J., Dvorak, R. and Kosior, E. 2009. Plastics recycling: challenges and opportunities. Philos Trans R Soc Lond B Biol Sci. 364 (1526): 2115–2126. [doi: 10.1098/rstb.2008.0311] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2873020/

[34] World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company. 2016. *The New Plastics Economy — Rethinking the future of plastics.*

Packaging represents 26% of plastics use worldwide[35] and its use is growing, as a proven marketing tool.

In terms of waste management, the shift from reusable to single-use packaging meant that companies who used to take care of reclaiming and reusing their products and packaging then externalized their costs onto local governments when making their products and packaging disposable. After this shift, it is local governments' role to manage the discarded waste. With all these factors running at the same time, governments' challenge has become immense. According to some sources, **14% of plastic packaging is collected for recycling worldwide, but only 5% is actually recycled.**[36]

2.2.2 Environmental health problems associated with plastics recycling

Additives are an environmental health problem all along the lifecycle of plastics, yet tend to be underestimated. Thousands of substances are added to plastics to deliver different characteristics, such as stability, flexibility, anti-oxidants, UV-filter, and so on. Some of them are known toxics, and they are also known to leach, sometimes during plastics use or after.

For instance, pigments can contain heavy metals; phthalates are added mainly to PVC as plasticizer; brominated flame retardants and lead are added to plastics to provide stability when heated, and the list goes on and on. Also, some toxics can be present in plastics as by-products or residues from the production process. For example, polycyclic aromatic hydrocarbons can be formed during the production of polystyrene.

This is a problem all along the plastic life cycle: during production, use, recycling and disposal additives can be released. Hence, exposure to these additives can take place for workers in chemical plants and plastics manufacturing, users, and recycling workers.

Moreover, it is a long-term problem. Even those substances that are banned or regulated will still remain in the environment in the long term, in discarded plastics used for recycling, polluting recycled products, or in waste plastics in dumps, the oceans or elsewhere. For instance, a study to determine if children's toys made of recycled plastics contained some of the most toxic chemicals known to science (DecaBDE and OctaBDE) found that 90% of analysed toys from 26 countries contained them. Both substances are additives that serve as flame retardants for different products, such as electric and electronic equipment. Since toys do not typically require flame retardants, it is most likely that those toxic chemicals got there in the recycling of plastics

[35] *Ibid.*
[36] World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company. 2016. *The New Plastics Economy — Rethinking the future of plastics.*

that did have them.

During plastic melting for recycling, these toxic substances can be released, exposing workers, especially when these practices take place in areas without proper ventilation. Other frequent situations in some countries, such as draining plastics wash basins into surface water used for domestic purposes, or open burning or dumping of worthless materials, pose environmental health risk for workers and local populations. The **processing of plastics for recycling is carried out largely by the informal sector in less industrialised countries.**

3. Situation of plastic trade and management in Europe

3.1 State of play of plastics in Europe – production, demand, applications and waste generation

Production of plastics in Europe – globally, the production of plastics has increased in the past decade from 230 million tonnes in 2005 to 381 million tonnes in 2015. Production in Europe has remained relatively stable (going from 61 to 58 million tonnes), however Europe remains the joint second largest regional producer of plastic materials, at 18.5% of total global production, with China being the leader at 27.8%. At European level, 4 to 6% of the oil and gas is used to produce plastic materials. Short-term estimates (carried out in 2015) show a moderate upward trend in European plastics production, increasing +1.5% in both 2016 and 2017.

Consumption of plastics in Europe – in 2015, plastics demand totalled 49 million tonnes in Europe. 70% of the demand is concentrated in six countries – Germany, Italy, France, Spain, the United Kingdom and Poland. Demand has increased in almost all European countries in the past few years. Per capita plastic consumption in Western Europe is approximately 100 kg/year (compared to Asia at 20 kg/year).

Applications of plastics in Europe – post-consumer plastic waste is subdivided into waste streams from private households and commerce, as well as generated by economic activities such as the manufacturing industry, construction and agriculture. In Europe, the following are the main application groups of plastics: Packaging 39.9%; Building & Constructions 19.4%; Automotive 8.9%; Electrical/Electronics WEEE 5.8%; Agriculture 3.3%. Other applications represent 22.4%. As is clear, plastic packaging represents the largest consumer plastic application in Europe at 40%. A recent study also found that 95% of this material is disposed of after a single use.[37]

37 https://www.ellenmacarthurfoundation.org/assets/downloads/EllenMacArthurFoundation_TheNewPlasticsEconomy_Pages.pdf

Plastic waste generation in Europe – in 2014, 25.8 million tonnes of post-consumer plastic waste ended up in the official waste streams (more detailed breakdown further below). This has risen in the past decade – we are creating more plastic waste.

3.2 Plastics recycling in Europe

Waste collection: Under EU law (Waste Framework Directive 2008),[38] Member States are mandated to separately collect several waste streams, including plastic. However due to the inclusion "shall set up separate collections of waste where technically, environmentally and economically practicable and appropriate", to allow exemptions, for example, for remote areas, the separate collection of plastics does not happen in all over the EU and this clause is often overexploited. There are overall targets for municipal waste recycling which each country must meet, as well as separate targets for plastic packaging waste (see more information below). There are no specifications in the Directives on the type of plastic that must be collected for recycling – recycling capabilities differ per region with some regions only having infrastructure to recycle PET for example.

Where household curbside waste collection schemes exist in Europe, plastics are either captured alone or together with other materials. Collection schemes are aligned with downstream infrastructure for pre-treatment, sorting, and recovery. While packaging producer responsibility schemes often fund partially or totally the collection and the treatment of plastic packaging, the responsibility remains largely financial and not operational. In this sense, collection schemes can be either private (private waste management companies) or public (government-owned) – for example in Ireland there are more than 50 different private household waste collection companies, whilst in Slovenia waste collection services are largely publicly run. Various collection means exist including:

- Commingled collection – in most places, plastics are collected through dedicated commingled collection of dry recyclables – plastics are most often collected with metals and cartons, but can also be collected commingled with glass and/or paper.[39] However, this sorting system can seem to restrict the plastic types collected for recycling to high quality packaging such as PET bottles.
- Recycling points – despite the legal obligation to separately collect plastic waste, in some countries no curbside collection exists and recycling collection points are placed at central areas such as supermarkets.
- Deposit return schemes – nine European countries (two outside of the EU) have in place deposit return schemes on plastic beverage bottles[40] and two countries are set to introduce soon.

[38] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098
[39] Assessment of separate collection schemes in the 28 capitals of the EU, 2015 http://ec.europa.eu/environment/waste/studies/pdf/Separate%20collection_Final%20Report.pdf
[40] http://www.cmconsultinginc.com/wp-content/uploads/2017/05/BOOK-Deposit-Global-24May2017-for-Website.pdf

- Informal waste collection sector – many European cities have active informal systems. A key network, the Roma Informal Recyclers, are said to make up approximately 0.7% of the total population of Europe.[41] However, due to EU policies, legalisation is a pre-condition to formalisation and integration in the waste sector, which means there has been a landscape of growing conflicts and competition between the informal sector and actors all along the waste management chain.

Pre-treatment, sorting and mechanical recycling: A wide range of technologies are currently used for waste pre-treatment and sorting in Europe. These range from manual dismantling and picking to automated processes such as shredding, sieving, air or liquid density separation, magnetic separation and highly sophisticated spectrophotometric sorting technologies, e.g. UV/VIS, NIR, Laser, etc. Modern sorting plants are often complex infrastructures applying several of these technologies that have been adapted to specific waste streams in order to reach an optimal output and cost performance.

However, despite many advanced technological capabilities existing (and more being developed) and operating in some places in Europe, even if deployed fully all over Europe today, a recent study on plastic packaging shows the maximum eco-efficient recycling level would only be somewhere between 36% and 53%.[42] The study details that recycling beyond this limit will either be low quality recycling (no environmental benefits) or will not be eco-efficient due to very high costs.

One reason for this is the fact that the development and introduction of new plastic packaging materials and formats is happening far faster than, and is largely disconnected from, the development and deployment of corresponding after-use systems and infrastructure. This includes multi-layer or multi-element plastic packaging (different polymers are generally non-miscible or compatible with each other in mechanical recycling), full-body labels and coloured plastics.[43]
All these issues point to the need to redesign plastics as well as to improve and scale-up recycling infrastructure.

Chemical or feedstock recycling: This is increasingly seen as an option in Europe for difficult to recycle plastics such as laminated and composite plastics, low quality mixed plastics streams and plastics contaminated with food, soil, etc. Several technologies have been or are being developed by major chemical companies, however there are few commercially operating chemical recycling plants in Europe currently, and most of them do not yield monomers to create new plastics, but rather use plastics as an indirect fuel or as reducing agents for other

[41] https://drive.google.com/file/d/0B5BGPxldIBEcUkZxWUs1MUhGZWM/view
[42] Denkstatt, The potential for plastic packaging to contribute to a circular and resource-efficient economy (Identiplast, 2015). http://denkstatt.at/wp-content/uploads/2016/06/presentation_the-potential-for-plastic-packaging-to-contribute-to-a-circular-and-resource-efficient-economy.pdf
[43] https://www.ellenmacarthurfoundation.org/assets/downloads/EllenMacArthurFoundation_TheNewPlasticsEconomy_Pages.pdf

processes.[44] In general, investment levels and energy consumption are such that only very large-scale plants are expected to be economically viable, so it remains to be seen how this will develop as always reduction, redesign and replacement should come first. Furthermore, it is not clear if "chemical recycling" could count towards recycling targets in the EU, or how this would be measured, given that the plastics are not always reprocessed back into products, materials or substances but also used as fuel.

Standards and certification schemes for the collection, sorting and output of plastics recycling: There are numerous European standards, certification schemes and technical specifications related to mechanical recycling, the delivery conditions for various recyclates for use in finished or semi-finished products (including on quality and traceability) and organic recycling for bioplastics. They are not mandatory but are popular and mainstream and often inspiration for legislation.

Relevant for mechanical recycling generally there is:

- EN 15343 'Plastics - Recycled Plastics - Plastics recycling traceability and assessment of conformity and recycled content' which specifies the procedures needed for the traceability of recycled plastics. Should also provide a basis for calculating recycled content. This standard is applicable without prejudice to any existing legislation. The procedures are needed to formulate or describe the traceability, while the traceability can be used as a basis for calculating the recycled content. Associated to this standard is a certification scheme called EuCertPlast which was developed under an EU-funded project and which uses EN 15343 as a basis for environmentally friendly recycling of plastics.
- EN 15347 'Plastics - Recycled Plastics - Characterisation of plastics wastes' which provides tests and guidelines to lay out plastic waste properties (for the purchaser of the waste to be able to assess what it will do with it).
- European Technical Specification CEN/TS 16010 which provides sampling procedures for testing plastics waste and recyclates throughout the whole plastics recycling process.
- European Technical Specification CEN/TS 16861 which is a test for food grade recycled PET identifying and quantifying certain contaminants (marker compounds).

There are also relevant standards specifying the delivery conditions for various recyclates for use in finished or semi-finished products:

- EN 15342 'Plastics - Recycled Plastics - Characterization of polystyrene (PS) recyclates'
- EN 15344 'Plastics - Recycled Plastics - Characterisation of Polyethylene (PE) recyclates'
- EN 15345 'Plastics - Recycled Plastics - Characterisation of Polypropylene (PP) recyclates'
- EN 15346 'Plastics - Recycled plastics - Characterization of poly(vinyl chloride) (PVC) recyclates'
- EN 15348 'Plastics - Recycled plastics - Characterization of poly(ethylene terephthalate) (PET) recyclates'

[44] http://www.plasticseurope.org/plastics-sustainability-14017/zero-plastics-to-landfill/feedstock-recycling.aspx

As regards organic recycling for biodegradable plastics, there are standards for managed end of life options:

- Industrial compostability: Harmonised standard EN 13432 'Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging' which provides presumption of conformity with the packaging directive
- Industrial compostability: EN 14995 'Plastics - Evaluation of compostability - Test scheme and specifications' which establishes pass levels to determine the compostability or anaerobic treatability of plastic materials
- Home compostability: A standard on the home compostability of plastic carrier bags is currently being requested by the European Commission

Extended Producer Responsibility (EPR) in Europe – Green Dot and take-back systems: Producer responsibility schemes are a common way to internalise waste management costs associated with products and product categories in Europe. Several EPR schemes are mandated by EU legislation, mainly on Waste Electrical and Electronic Equipment (WEEE) and End-of-Life Vehicles (ELV). In the case of packaging, it is not compulsory under EU law, yet most of EU countries have producer responsibility schemes for packaging waste and the European Parliament has proposed within the revision of the Packaging and Packaging Waste Directive to extend the obligation on EPR for packaging waste.[45]

Two main forms of producer responsibility are present in Europe for packaging waste: Green Dot systems and take-back systems. Some European countries (including Iceland and Norway) have the two systems in place at the same, with a deposit scheme on certain beverage containers and a Green Dot system for the rest of the packaging waste. The remaining European countries internalise some of the post-consumer costs through Green Dot systems.

While Green Dot systems in Europe have served to financially support the introduction of separate collection schemes for packaging waste, recycling rates for plastic packaging remain below 40%. Additionally, recent research shows that lack of proper internalisation of associated costs of residual waste management or anti-litter measures, along with flat weight-based fees for producers have prevented Green Dot systems from driving eco-design.[46] The on-going revision of the Waste Framework Directive will likely introduce modulation of EPR fees on the basis of circularity of products, as well as to better internalise the costs of disposal and anti-litter campaigns.

How much plastic does Europe recycle?

[45] http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P8-TA-2017-0070+0+DOC+XML+V0//EN&language=EN
[46] https://www.zerowasteeurope.eu/downloads/redesigning-producer-responsibility-a-new-epr-is-needed-for-a-circular-economy/

According to the most recent data,[47] in 2014 the EU generated 25.8 million tonnes of post-consumer plastic waste. Of this (by weight) approximately 30% was collected for recycling, 40% sent for energy recovery and 30% landfilled. Energy recovery and landfill rates for plastics are significantly higher than those for overall municipal waste in the EU:

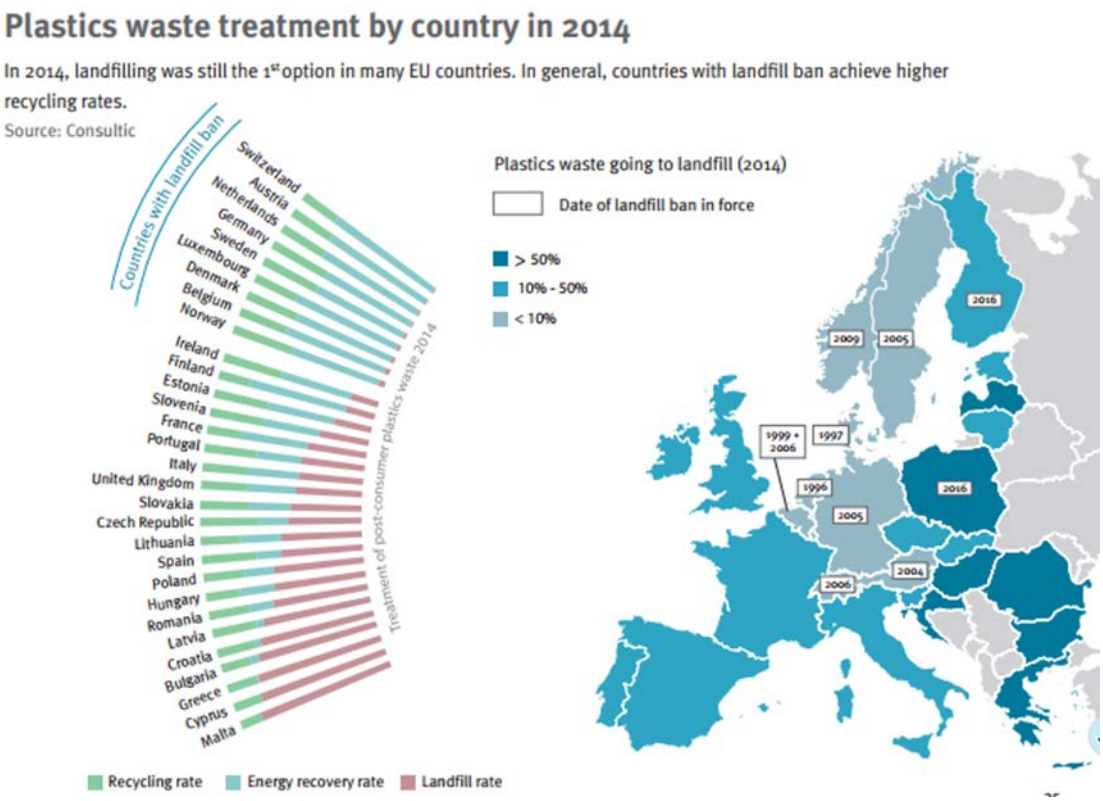
- Overall municipal waste: energy recovery = 26%; landfill = 25%[48]
- Plastic waste: energy recovery = 40%; landfill = 30%

Regarding in particular the high energy recovery rate for plastics, this has seen an increasing trend in the past decade (46% increase between 2006 and 2014, compared to a decrease of 38% for landfilling of plastics thanks to widespread taxes and bans). This growing trend goes against the waste hierarchy, enshrined in EU law. Part of this is due to subsidies given to waste-to-energy plants as part of the EU's promotion of renewable energy. The Renewable Energy Directive states that only the biomass fraction of mixed waste should be eligible for the subsidies.
Furthermore, despite trends also indicating that rate of plastics collected for recycling has also increased by 69% between 2006 and 2014, a key point to note is that the figures indicate what is collected for recycling, and not what is finally recycled. As noted in the section above, it is likely that up to 40% of plastics collected for recycling are discarded during the mechanical recycling process.

Recycling rates also vary greatly between EU countries, as seen in Figure 7. If assuming plastics follow largely the same consumption and waste generation trends per country as overall municipal waste, we can say that in general, countries that recycle more also tend to have higher consumption rates and waste generation per capita, meaning they often still generate large volumes of residual waste. For example, municipal waste generation was 618 kg per capita in Germany compared to 254 kg per capita in Romania. So despite Romania's low recycling (5%) and Germany's high recycling rates (47%), the residual waste volumes are in fact lower per capita in Romania (213 kg compared to Germany's 222 kg).[49]

[47] http://www.plasticseurope.org/documents/document/20161014113313-plastics_the_facts_2016_final_version.pdf
[48] http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Municipal_waste_landfilled,_incinerated,_recycled_and_composted_in_the_EU-27,_1995_to_2015_update.png
[49] http://ec.europa.eu/eurostat/documents/2995521/7214320/8-22032016-AP-EN.pdf/eea3c8df-ce89-41e0-a958-5cc7290825c3

Figure 7: Plastic waste treatment by country



Source: Plastics Europe and EPRO. 2016. Plastics - the facts.

Calculation methodology for determining recycling rates: For the last ten years calculation methodology of recycling rates in the EU has been defined by two main elements: firstly, EU legislation allowing four differing definitions of municipal waste, which means recycling rates have been overestimated in at least 20 EU Member States by reducing the scope of municipal waste[50], making rates incomparable between countries. The second of the elements defining the calculation methodology has been the point of measurement for recycling – which could be either the output from the sorting facility or the input to the recycling facility. In any case, recycling rates are calculated by weight. The approval of the new Waste Framework Directive has harmonised the calculation methodology for recycling across the EU, along with a common definition of municipal waste. The new point of measurement will be the input to the recycling operation and all household and similar waste in nature and composition will be considered to be municipal waste. Whenever the input to the recycling operation cannot be used, Member States can measure recycling at the output of any sorting operation, provided that the output material is effectively recycled and the subsequent losses are deducted.

[50] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014SC0207

Plastic recycling targets: Targets currently exist only for plastic packaging waste. In the EU Packaging and Packaging Waste Directive,[51] a minimum rate of 22.5% of all plastic packaging must be recycled by 2020 – this is a public policy target which all national governments must meet through implementation of tools to increase recycling (this could include EPR schemes as detailed above). This target is set to increase under current Directive revisions to 55% by 2030.[52] Plastics Europe reports that the current rate of collection of plastic packaging for recycling across the EU stands at almost 40%,[53] however, it is likely that the final output of recycling processes is far less when taking into account the discards during the recycling process.

Capacity of recycling facilities in Europe: The EU collects and sends more plastics to recycling than there is capacity to recycle in the EU itself.[54] Some countries, mainly Austria, are net recyclers of plastics – they recycle more plastic waste than is domestically collected for recycling (importing from other countries). Others, for example Belgium, the Netherlands and Italy, are intermediaries – they import plastic waste from other countries and re-export, mainly to countries outside of the EU from their large ports. The UK and Germany are the big plastic waste exporters. The overall under-capacity of infrastructure represents around 60% of the total plastic waste collected for recycling in the EU, while the other 40% is exported for recycling overseas.[55]

3.3 European exports of plastic waste

In the EU, post-consumer plastic waste is categorized as a non-hazardous (green listed) waste, thus it can be exported to non-OECD countries following the procedure of the EU Waste Shipment Regulation and provided the import is not prohibited by the country of destination (intermittently, the European Commission requested an update from non-OECD countries on waste types they do not want exported to them anymore, waste types they want limited and/or waste types to be continued). Exports for incineration, energy recovery or landfilling are prohibited to non-OECD countries. Each Member State lays down the rules on penalties applicable for infringement of the provisions of the Regulation.

Green listed waste exported for recycling is managed by the relevant customs authorities. No notifications to the relevant national governments or EU bodies are required. Customs data is available publicly (on request) on the type of plastic waste, its country of origin and country of destination, but there is no information available on the quality or the juridical status of the materials, and neither on what will happen to the material once it reaches its destination.

[51] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01994L0062-20150526
[52] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015PC0596
[53] http://www.plasticseurope.org/documents/document/20161014113313-plastics_the_facts_2016_final_version.pdf
[54] http://www.plasticsrecyclers.eu/sites/default/files/BIO_Deloitte_PRE_Plastics%20Recycling%20Impact_Assesment_Final%20Report.pdf
[55] http://www.plasticseurope.org/documents/document/20161014113313-plastics_the_facts_2016_final_version.pdf and UN Comtrade data for plastic scraps 2015

Regulations and reporting of exports: The regulatory framework concerning the reporting of plastic waste exports in relation to EU recycling targets is currently unclear despite several guidance documents by Eurostat. This is because, as noted above, Member States do not follow a uniform recycling calculation methodology.

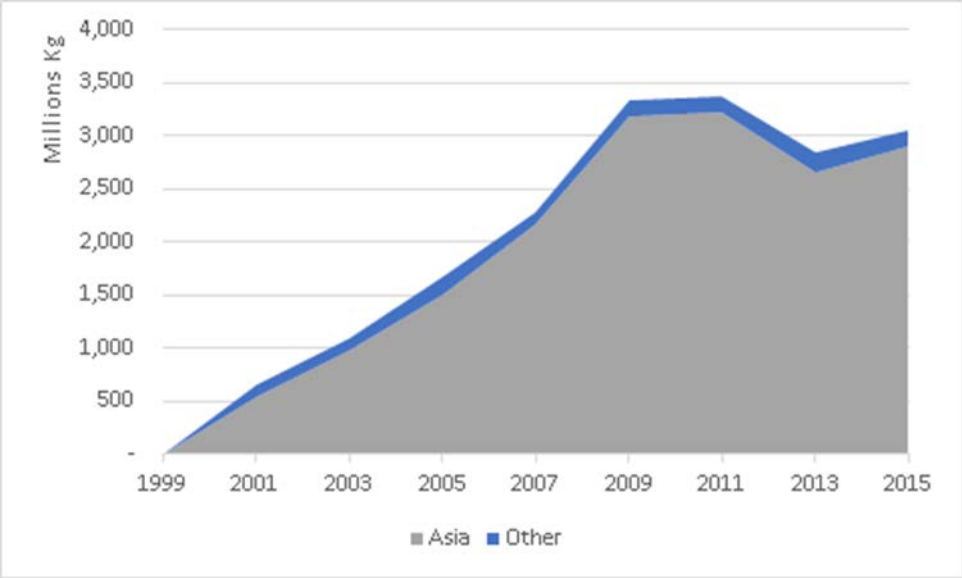
- EU Waste Shipments Regulation (WSR):[56] under this regulation, recycling conditions should be the same as EU standards when shipped outside EU, but there is an overall lack of transparency and accountability in ensuring this happens, leading to equivalent recycling standards often not being applied in practice (and being extremely difficult to track the chain of movements). Article 18 of the WSR states that waste exported is to be accompanied by certain information including a contract document which should be signed by the person who arranges the shipment before the shipment takes place and signed by the recovery facility or the laboratory and the consignee when the waste in question is received. The person who arranges the shipment or the consignee should provide a copy of the contract upon request by the competent authority concerned.
- EU Waste Framework Directive (WFD):[57] the only reference to exported waste in the current WFD is that "Member States may also limit outgoing shipments of waste on environmental grounds as set out in Regulation (EC) No 1013/2006" (i.e. the WSR). However, more detail is likely to be inserted under the current review of the WFD so that exported waste must be proven to follow equivalent recycling requirements as if recycled in the EU. Given that the review will also harmonise the calculation of recycling rates to one single methodology, this may also bring further complexities in measuring exported waste recycled.
- EU Packaging and Packaging Waste Directive (PPWD):[58] the current PPWD states that "packaging waste exported out of the EU shall only count for the achievement of the obligations and targets if there is sound evidence that the recovery and/or recycling operation took place under conditions that are broadly equivalent to those prescribed by the EU legislation on the matter." Under its current review, there are proposals to replace this with similar wording to the WFD revision (coming with the same concerns around its measurement).

Trends for extra and intra EU plastic waste trade: The EU collectively exported 40% of the plastics collected for recycling in 2015, corresponding to 12% of the entire post-consumer plastic waste arisings. The extra EU exports rose from 736,908 tonnes in 2002 to approximately 3.05 million tonnes in 2015, an increase of approximately 413%.[59]

[56] http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1454069470717&uri=CELEX:02006R1013-20160101
[57] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098
[58] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01994L0062-20150526
[59] Based on calculations from UN Comtrade data

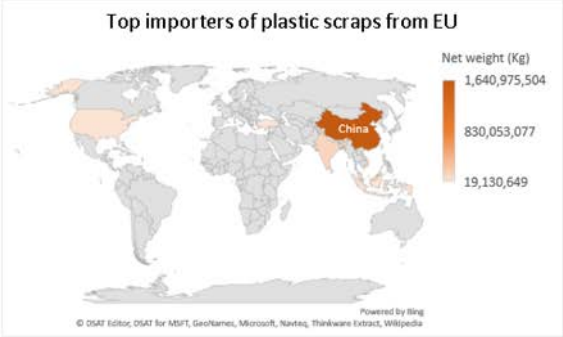
In comparison, intra EU trade was approximately 710,000 tonnes in 2002 and increased to approximately 2.3 million tonnes in 2015 and extra EU imports amounted to approximately 97,000 tonnes in the year 2002 and rose to a maximum of 437,000 tonnes in 2010 and were stable for the period 2011 to 2015 between 385,000 to 415,000 tonnes per year.

Figure 8: Plastic scraps exported from EU to Asia and elsewhere



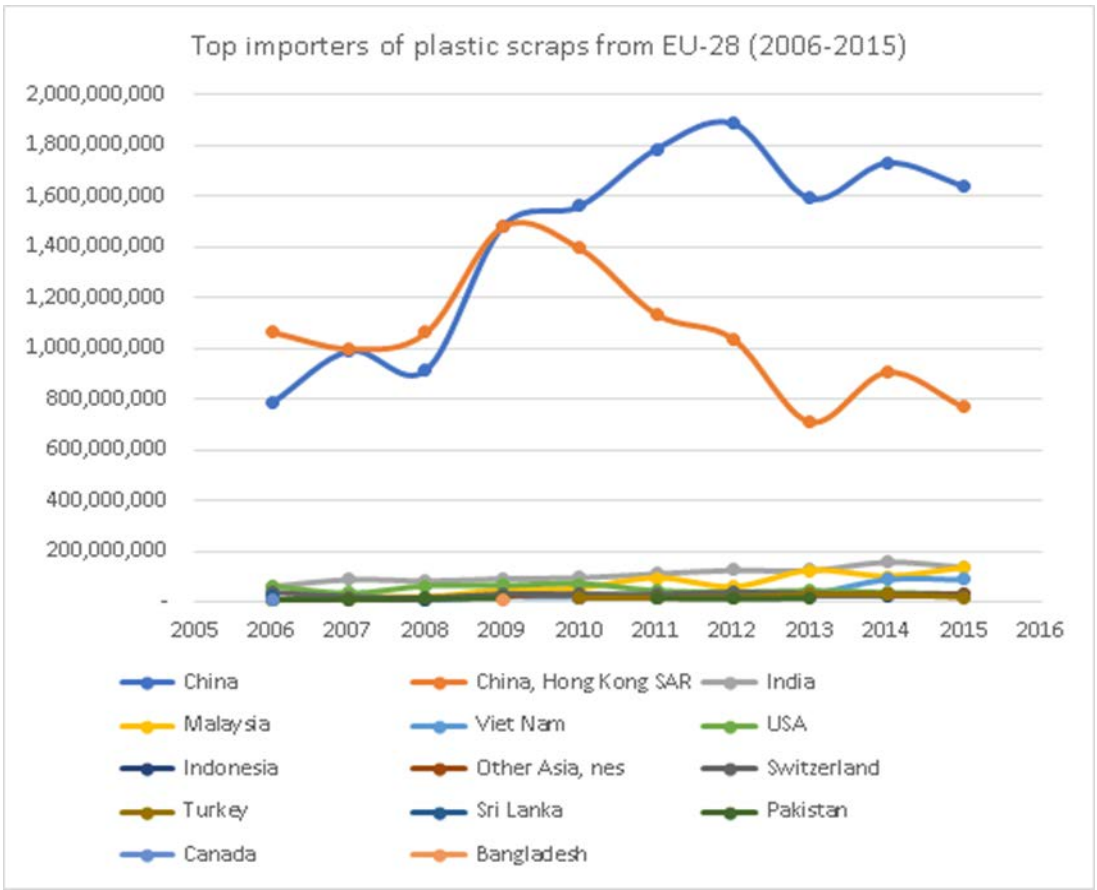
Major exporting countries and destinations: In 2015, the EU exported mainly to Asian countries: China, Hong Kong imported the majority of the scraps followed by India, Malaysia, Vietnam.

Graph: Top 10 exporters in EU and importers of plastic scraps exported from EU (2016)



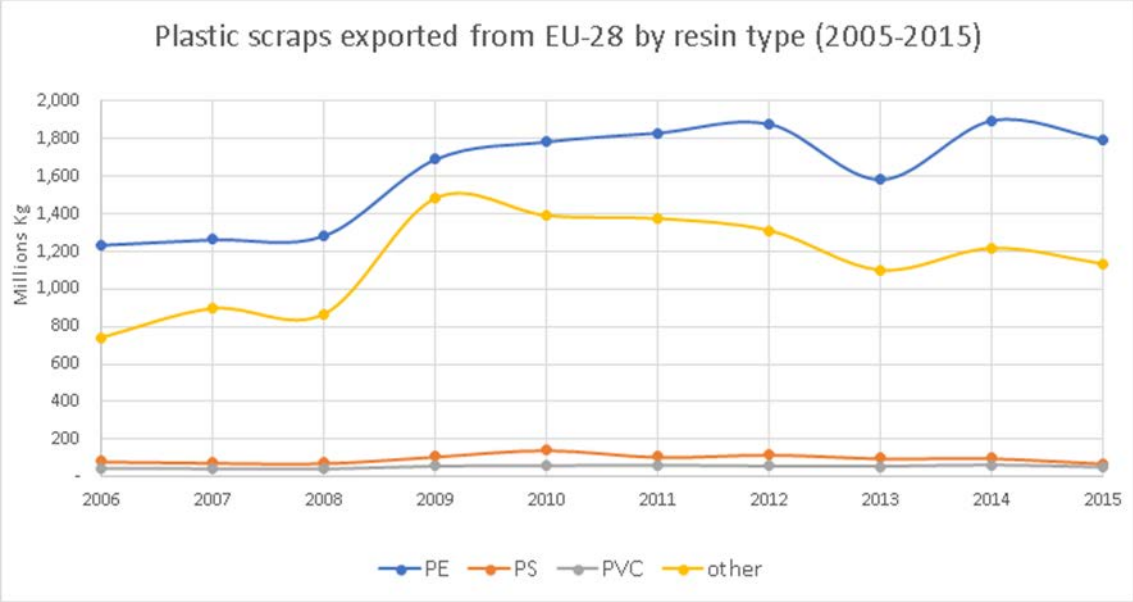
	Top exporters in EU	Net weight(Kg)	Top importers of plastic scraps from EU	Net weight (Kg)
1	Germany	1,445,155,174	China	1,640,975,504
2	United Kingdom	805,071,838	China, Hong Kong SAR	770,024,169
3	France	483,957,226	India	139,310,567
4	Netherlands	481,088,217	Malaysia	135,701,701
5	Belgium	440,848,567	Viet Nam	88,175,682
6	Spain	318,926,161	USA	33,551,828
7	Italy	234,261,882	Indonesia	32,518,950
8	Poland	192,224,235	Other Asia, nes	31,509,707
9	Sweden	99,012,668	Switzerland	24,622,438
10	Denmark	96,928,282	Turkey	19,130,649

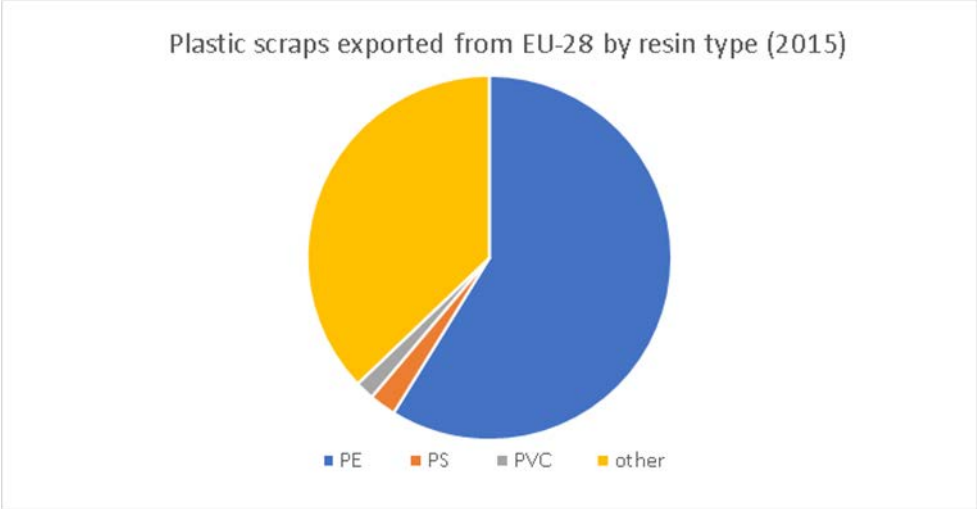
Source: UN Comtrade (2016)



Source: UN Comtrade

Graph: all Plastics waste export from EU28, per plastic waste type (yearly, tonnes)





Case example – France: More than 1 million tonnes of plastic is estimated to be collected for recycling in France, with half recycled in France. Of this recycled material, only half again is used domestically to manufacture new products (meaning half of the recycled plastics pellets are then again exported).[60] By 2022, all type of plastic packaging waste should be collected separately for recycling in France. This means new types of plastics might be exported because no industry exists in France for most types of plastic yet (currently recycling companies are mostly dedicated to recycling PET and HDPE/LDPE). The recycling companies are private. For the plastic sectors they are rather small, numerous companies. This is often pointed out as a problem for innovation and economic competitiveness, in comparison for example to the size of German plastic recycling companies.

[60] https://www2.deloitte.com/fr/fr/pages/sustainability-services/articles/chaine-valeur-plastiques-2015.html

Case example – Antwerp Port: The following tables indicate plastic waste exports from Antwerp Port in Belgium, one of the largest European exporting ports, for the years 2014, 2015 and 2016.

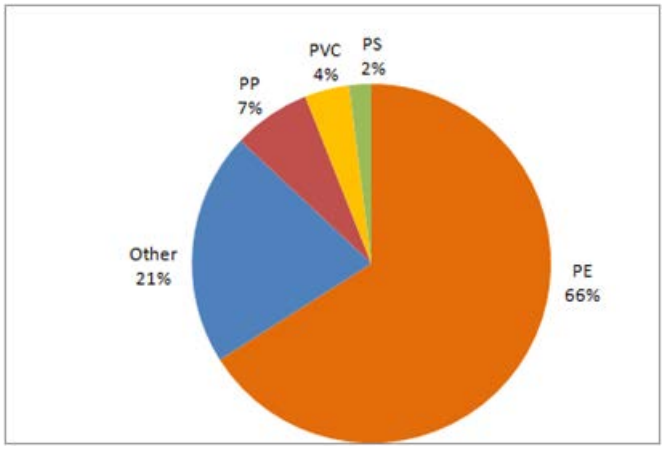
The first table indicates the mass of plastic waste collected for recycling, to which countries it is going and the percentage of this in terms of total plastic exports (top eight countries are listed). Countries of origin were not fully detailed – from what is known, the main countries of origin are Belgium (almost all), followed by The Netherlands, Germany and some from France and other countries in close proximity to Belgium. It can be seen that China is by far the top destination.

Figure 51 details the types of plastic waste exported – the main being waste, parings and scraps, of polymers of ethylene, followed by waste, parings and scraps of plastics other than polymers of ethylene, styrene, vinyl chloride and propylene.

Table 15: Plastic scrap exports from Antwerp Port

Destination country	Net mass of plastic waste (tonnes)	% of total exported
China	200,728,298	59.14%
Hong Kong	61,449,896	18.10%
Vietnam	20,235,168	5.96%
India	14,442,281	4.25%
Malaysia	12,495,079	3.68%
U.S.	5,815,767	1.71%
Pakistan	4,288,066	1.26%
Turkey	3,476,736	1.02%

Figure 55: Percentage of types of plastics exported by Antwerp Port



Fate of plastics recycling in third countries: There is no widespread conclusive evidence on the fate of plastics when they reach their exported destinations, despite EU laws on this matter. Some evidence suggests most final destinations are small manufacturers/reprocessors using low-tech equipment and practices, often family-run, without any environmental protection controls.[61]

3.3 Why the EU exports so much plastic waste

In today's globalised world, waste is largely a freely traded good, with the market deciding the price and thus where waste flocks from and to. As with any globalised market, plastic waste has an inevitably complex market, vulnerable to disruption. The exporting of EU plastic waste for recycling depends on a complex interplay of:

- National and EU waste collection capabilities, reprocessing capabilities and needs, and export/transport laws and controls (and their implementation).
- Market demand and import controls at the major destination countries.
- Global supply chain networks – transport logistics and costs (westbound freight rates, number of empty containers returning to Asia i.e. "reverse haulage", customs).
- Cost of virgin plastics (dependent on oil and natural gas prices) – decreases in their price directly affects the prices and trade volume of secondary plastics.
- Technological innovation – new resins, new sorting technologies and their scale-up e.g. digital watermarks and fluorescent inks are being developed to enable much finer grained sorting of plastics, chemical recycling etc.[62]

Reasons for low rates of domestic recycling and high exports:

- Economic roots:

[61] https://www.iswa.org/fileadmin/galleries/Task_Forces/TFGWM_Report_GRM_Plastic_China_LR.pdf
[62] Adapted from Costas Velis. 2014. *Global recycling markets: plastic waste. A story for one player – China.* International Solid Waste Association.

- Market conditions for plastics recycling in the EU are suboptimal, i.e. there are high fixed costs of recycling and low market prices of virgin material, and externalities are not properly accounted for (emissions from transport, the likely higher environmental and health impacts of recycling in third countries etc.)
- Diverse range of plastics on the market – small quantities of certain types of plastics means there is difficulty in obtaining economies of scale.
- Quality issues, e.g. linked to presence of additives, mixing of different types of polymers and general presence of low quality plastic waste which needs sorting by hand so is often exported.[63]
- Process losses, e.g. only about half of what is collected for recycling is actually recycled.
- Lack of relevant targets and price mechanisms for recycled plastics. Insufficient EU demand for recycled materials.
- High labour cost in the recycling sector e.g. representing up to 30% of the total cost in France, can be a reason for exporting.

- Poor implementation, enforcement and lack of transparency of relevant EU regulations. Ability to still count exports towards recycling targets with ease due to weak enforcement.

Illegal shipments

Despite the Waste Shipments Regulation, illegal shipments of waste are still a significant problem with some estimates suggesting an overall non-compliance rate of around 25% (between all waste streams). A 2014 report from the EU Network for the Implementation and Enforcement of Environmental Law stated that shipments to China and Hong Kong are the most common destinations for illegal trade outside the EU (most common within EU).[64] Of these, the most common were 'plastics', 'paper & cardboard' and 'mixed municipal waste'. The phenomenon of 'port hopping' has been known for some years now where exporters choose to ship their waste via ports with weaker inspection regimes. For Asian destinations, China and Hong Kong accounted for the overwhelming majority of violations, followed by India and Pakistan. As mentioned above, it is up to each Member State to implement the relevant laws and decide on penalties.

The WSR is currently under review and changes have already been made to step up its enforcement. For example, a preliminary correlation table whereby customs officials will be able to identify potential waste streams more easily. The table will thus serve as a tool to assist in curbing illegal exports of waste out of the EU. EU countries will have to prepare inspection plans by 2017.

[63] DIRECTORATE GENERAL FOR INTERNAL POLICIES POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY WORKSHOP Plastic Waste Brussels, 26 September 2013 http://www.europarl.europa.eu/document/activities/cont/201312/20131216ATT76201/20131216ATT76201EN.pdf
[64] https://www.impel.eu/wp-content/uploads/2016/10/IMPEL-Enforcement-Actions-2014-15-FINAL-report.pdf

4. International Recycling standards and agreements

4.1 International recycling standards

The International Organization for Standardization (ISO) has issued a number of standards concerning plastics recycling. As all ISO standards, these are voluntary. Some of the topics they cover are:

- Including environmental aspects in plastic standards (ISO 17422:2002).
- Recovery and recycling of plastics waste. It sets two recycling alternatives: material recovery and energy recovery. Material recovery, in turn, is divided into mechanical recycling, chemical/feedstock recycling or biological recycling (ISO 15270:2008).
- Report on substances and materials that may impede plastic packaging recycling (ISO/TR 17098:2013).
- Recycled plastic packaging use to transport dangerous goods (ISO 16103:2005).
- System and basics for specification, preparation of test specimens and determination of properties of post-consumer PET bottle recyclates (ISO 12418-1:2012 and ISO 12418-2:2012) and of mixtures of PP and PE derived from consumer packaging (ISO 18263-1:2015 and ISO 18263-2:2015).
- Characterization of PE recyclates (EN 15344) and PP recyclates (EN 15345).
- Specifications for compostable plastics (ISO 17088:2012).
- Assessment and minimisation of harmful substances, reuse and treatment options for packaging (ISO 18601 to 18606).

Current ISO standards on recycling are limited; they only set a minimum bar for some processes. They provide guidance on the most recyclable resins only, leaving most resins out. In addition, they are voluntary, so only interested industries tend to use them while major actors fall well below these standards.

The nature of these guidelines is also 'managerial' rather than outcome based. Under the label of being technical guides, they do not address the purpose and need of processes or products, but they only provide guidance on how to implement them better. And yet, they do make stands that are not technical but rather strategic, like considering the use of plastics as fuel as recycling. The reason for this may be industry influence.

Three recycling associations from U.S. and Europe (Association of Plastic Recyclers, Plastics Recyclers Europe and the European PET Bottle Platform) announced the creation of the "Global Plastics Outreach Alliance", an association of industry groups with the aim of harmonising design, global guidelines and testing protocols for plastics. The information released so far suggests that the new alliance will work on PET and polyolefins, which tend to be the most recycled plastics

already. However, this could be the basis for expanding to more types of plastics and creating feedback between recycling and design within industry.[65]

4.2 Intergovernmental agreements on plastics

When it comes to international bodies and meetings addressing plastic pollution, the following are some of the venues where plastic pollution in oceans is discussed:

- The International Marine Debris Conference, organized by the U.S. National Oceanic and Atmospheric Administration (NOAA), UNEP, and other agencies and organizations.

- The Regional Seas Programme, launched in 1974 by UNEP "aims to address the accelerating degradation of the world's oceans and coastal areas through a "shared seas" approach – namely, by engaging neighbouring countries in comprehensive and specific actions to protect their common marine environment." There are 18 Regional Seas programmes. In this framework, a Global Meeting of the Regional Seas Conventions and Action Plans is held.

- The Ocean Conference is a high-level UN Conference to Support the Implementation of Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

- World Ocean Summit, organised by The Economist. World Ocean Summit convenes more than 360 global leaders from government, industry, multilateral organisations, the scientific community and civil society for a constructive and solution-focused dialogue.

- UNEP #CleanTheSeas Campaign: Launched at the Economist World Ocean Summit in Bali in 2017, the #CleanSeas campaign is urging governments to pass plastic reduction policies; targeting industry to minimise plastic packaging and redesign products; and calling on consumers to change their throwaway habits – before irreversible damage is done to our seas.

There is not yet a Convention addressing plastic pollution in all its scope. However, for the past four decades the international legal bodies have been addressing some aspects of plastics pollution, mainly focused on marine pollution.

First international legal frameworks concerning plastic pollution can be found in instruments related to preventing marine contamination. The **Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter**, also known as the London Convention, was signed in 1972 and banned dumping of several types of waste into the oceans, including plastics. It was strengthened by the **London Protocol** in 1996, which banned all waste dumping into the oceans.

[65] *Recycling groups create global coalition to harmonize testing.* Plastic news: October 9, 2017. http://www.plasticsnews.com/article/20171009/NEWS/171009905/recycling-groups-create-global-coalition-to-harmonize-testing#utm_medium=email&utm_source=pn-sustain&utm_campaign=pn-sustain-20171012&email_sustain

Another instrument issued at that time is the **International Convention for the Prevention of Pollution from Ships (MARPOL),** approved in 1973 and amended in 1978, whose goal is the prevention of pollution of the marine environment by ships from operational or accidental causes. Annex V – which entered into force in 2013- bans waste disposal at sea and addresses plastic pollution.

Finally, the **United Nations Convention on the Law of the Sea (UNCLOS)**, in force since 1994, calls on parties to prevent marine ecosystem pollution.

In addition to these conventions, there are a number of voluntary instruments addressing plastic pollution. The **Honolulu Strategy**, adopted in 2011, has three goals pertaining to waste pollution: goal A is to reduce the amount and impact of land-based sources of marine debris introduced into the sea; goal B is to reduce the amount and impact of sea-based sources of marine debris, including solid waste; and goal C is to reduce the amount and impact of accumulated marine debris on shorelines in benthic habitats and pelagic waters.

The **Global Partnership on Marine Litter** was launched at Rio+20 in 2002 by UNEP. It follows the goals of the Honolulu Strategy, creating a multi-sectoral partnership that coordinates actions toward reducing marine pollution. Later in 2016, the **UN Environment Assembly (UNEA)** adopted **resolution 2/11** on marine plastic litter and microplastics during its second session. The resolution places a strong emphasis on prevention and minimization of marine plastic pollution along with environmentally sound waste management systems and clean-up actions.

There is a **Code of Conduct for Responsible Fisheries**, created by the Food and Agriculture Organization (FAO). Efforts include: to ensure proper disposal of fishing gears in order to prevent impacts on marine fauna and flora.

The **Sustainable Development Goals** declared in the framework of the 2030 Agenda for Sustainable Development also address indirectly plastic pollution by talking about waste contamination in goal 6 (Clean Water and Sanitation), goal 12 (Sustainable Production and Consumption) and goal 14 (Clean Oceans).

The **Basel Convention** on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, adopted in 1989 and in force since 1992, regulates the movement of hazardous waste between OECD and non-OECD countries. In addition to the tools provided to prevent illegal movement of these wastes, it also encourages waste reduction and safe waste management. As part of the Convention implementation, several guides have been published, one of which relates to plastic waste management.

In 2015 Germany initiated the **G7 Action Plan to Combat Marine Litter**. The initiative was embraced later by the G20, who adopted it in July 2017. As areas of prior concern and potential policy measures, it identifies to "significantly reduce the use of micro-beads and single-use

plastic bags and where appropriate phase them out" and "significantly reduce the use of micro-beads and single-use plastic bags and where appropriate phase them out".

UN General Assembly has adopted a series of resolutions calling governments to make efforts to reduce marine pollution and take local, regional and international steps to minimize waste discharges to sea both from ships and land.
In July 2018 Sweden led the launch of a high-level alliance to help facilitate a global deal on chemicals and waste within the UN's high-level political forum[66]. The purpose of this alliance is to mobilise engagement for more effective global management of chemicals and waste.

Existing international frameworks haven't proven to be capable of addressing current problem with plastics, for a couple of reasons. First, they are all voluntary or lacking penalties for real enforcement. Second, they only focus on how to reduce marine pollution with an approach to prevent ocean leakage of the plastics. All other problems around plastics, such as the use of non-renewable resources; environmental health impacts related to toxics used production and leaching in use, recycling and disposal; displacement of renewable materials; production and use of unnecessary products and packaging; pronounced increase in waste production, among others, fall out of the radar of these global instruments.

5. Trade flows of plastic scrap

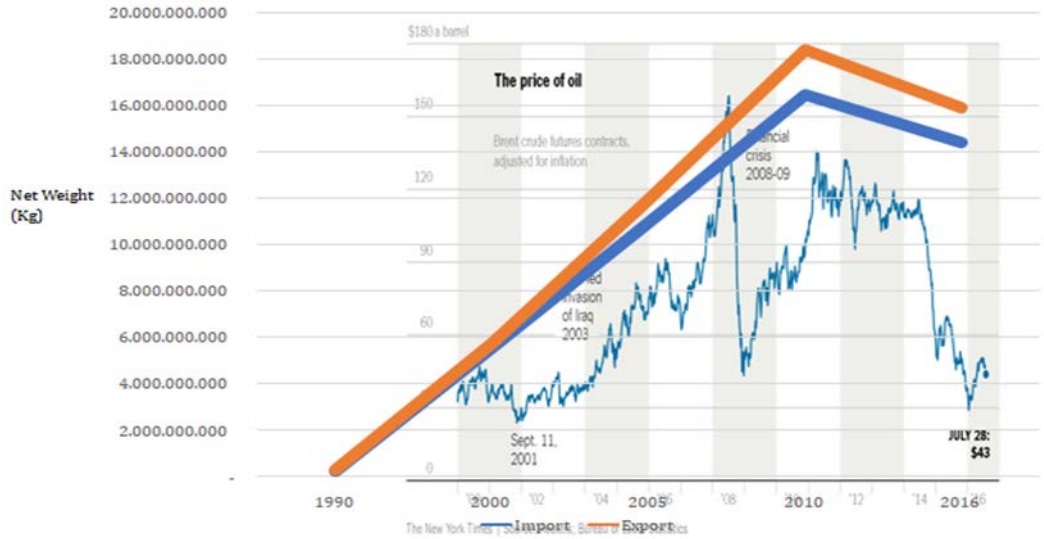
5.1 Major importers and exporters

A big portion of plastics recycling is dependent on global trade. Global trade of plastic scrap accounted for over 15 million tonnes in 2016. China is the top importer and U.S. is the main national exporter. Taken collectively, the EU is the largest exporter.[67]

Global trade of plastic scrap has been in constant rise from 1990 to 2010. After that, it has been descending, following similar trend as oil prices.

[66] https://www.endseurope.com/article/53363/call-to-launch-paris-style-deal-on-waste-and-chemicals?utm_source=18/07/2018&utm_medium=email&utm_campaign=ENDS%20Europe%20editorial%20bulletin?utm_source=18/07/2018&utm_medium=email&utm_campaign=ENDS%20Europe%20editorial%20bulletin
[67] UN Comtrade database.

Figure 8: Global plastic scrap trade 1990-2016



Source: UN Comtrade

Source of oil price trend: The New York Times/Source: Reuters; Bureau of Labor Statistics

Top importers

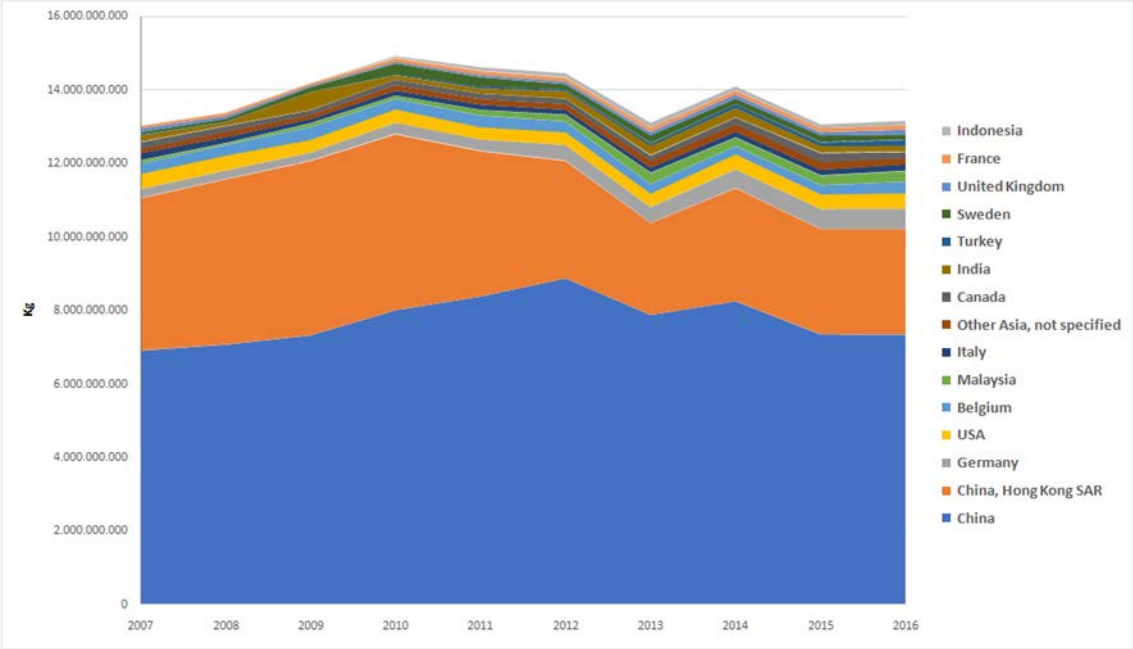
China is the largest plastic producer and consumer, and until now the top importer of plastic scrap globally. China **receives 51% of all plastic scrap exported worldwide**.[68] China produced 77 million tonnes of plastic products in 2016. Plastic demand is only partly covered by used materials. In 2016, 17.85 million tonnes of plastics were collected for recycling in China and 7.3 million tonnes of used plastics were imported, valued at U.S.$ 3.7 billion,[69] but an industry study states that only a small portion of that was actually recycled.[70] The main plastic scrap suppliers to China are U.S. and Japan.

The other top importers of used plastics receive much smaller quantities, namely Germany, U.S., Belgium, and Malaysia.

Hong Kong and most of the countries grouped under the Association of Southeast Asian Nations (ASEAN) are mostly transit countries. For instance, 95% of Hong Kong imported plastic scrap was re-exported to China in 2015 according to UN Comtrade data. Anecdotally it appears that Hong Kong is now increasingly re-exporting more material to other countries besides China, because the government and importing companies are willing to accept more contamination and mixed plastics, thus gaining materials that China now restricts. Re-exporting is sometimes done after preliminary cleaning and sorting. This has also been facilitated by a zero tax agreement between China and ASEAN countries. The case of India is interesting: the country banned certain types of plastic scrap import in 2016, and yet appears among top 15 importers worldwide (see point 4.2 below).

[68] Data for 2016. ISRI: Now What? Preparing for China's Waste Ban.
[69] *China 'Urgently' Bans Foreign Trash Imports.* The Diplomat, 20 July 2017.
[70] Costas Velis. 2014. *Global recycling markets: plastic waste. A story for one player – China.* International Solid Waste Association.

Figure 9: 15 top importers of plastic scrap

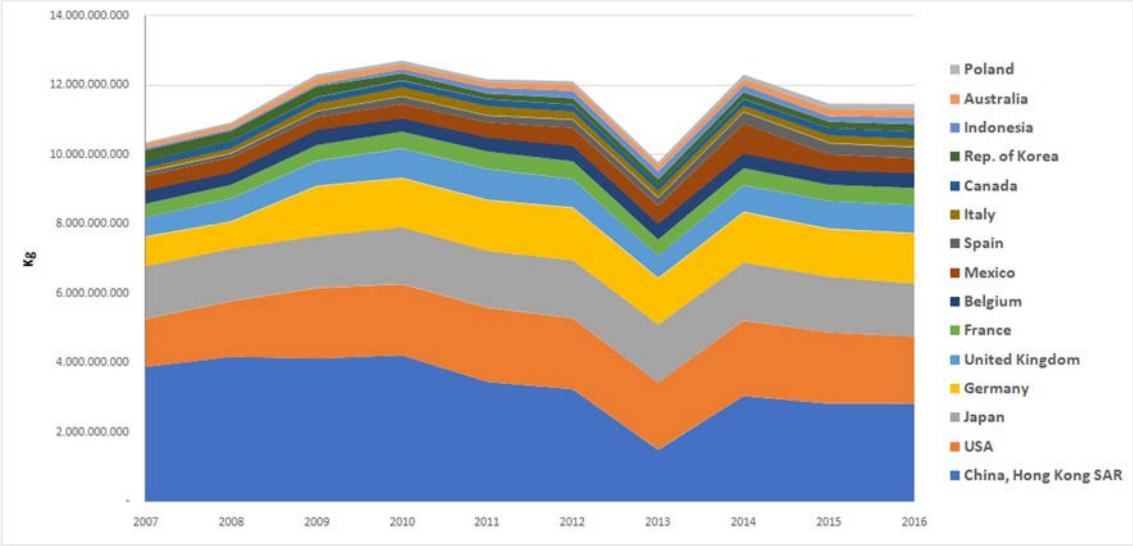


Source: based on information sourced from UN Comtrade database

Top exporters

United States is the largest plastic scrap exporter in the world (not counting Hong Kong, which serves as a transit port on the way to China). The U.S. is also the 2nd largest plastics consumer globally, and the main supplier of plastic scrap to China, although exports to China have been steadily decreasing in recent years. After the U.S., the top exporters of plastic scrap are Japan, Germany, United Kingdom, France, and Belgium. When considered collectively, the European Union overtakes the U.S. as the number one exporter.

Figure 10: 15 top exporters of plastic scrap

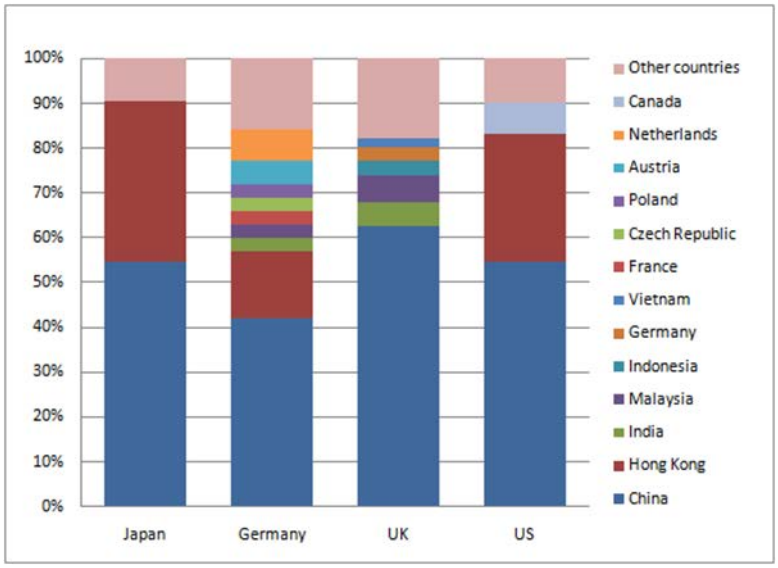


Source: Based on information sourced from UN Comtrade database

The U.S. and Europe are highly dependent on exports to maintain recycling systems. **The EU exports 40% of plastics collected for recycling.**[71] Discrepancies in data on U.S. exports and domestic recycling exposes the lack of transparency and comprehensive data on the issue of plastic waste exports. Using data from the Institute of Scrap Recycling Industries, the **U.S. exported 69% of post-consumer and industrial plastics in 2015.**[72] Another plastic recycling focused research finds a much lower export rate of 28%.[73] And they depend largely on China to absorb their materials, as shown in Figure 11.

[71] Costas Velis. 2014. *Global recycling markets: plastic waste. A story for one player – China.* International Solid Waste Association.
[72] ISRI. 2016. 2015 Annual Report. http://www.scrap2.org/annualreport/files/assets/basic-html/page-I.html (The report states that over 3.5 million tonnes of post-industrial and post-consumer plastic scrap was recycled, and U.S. export of plastic scrap approached 2.2 million metric tonnes, or 2.4 million tonnes)
[73] More Recycling, Plastic Recycling Market Update, webinar for Recycling Partnership, October 2017.

Figure 11: Plastic scrap destination countries for top exporters

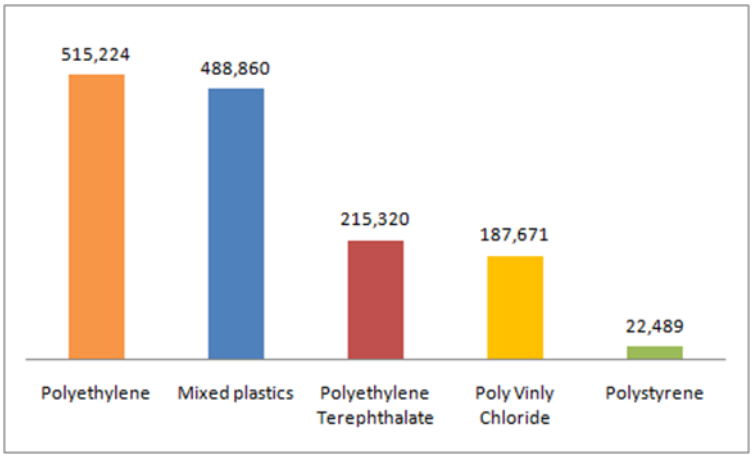


Notes: U.K. data for China includes China and Hong Kong, year 2015. Source: HMRC mentioned in Recovered plastic export destinations. WRAP. Data from U.S. and Japan: 2011. Source: Costas Velis. 2014. Data from Germany: 2015. Source: EUWID, based on Destatis.

5.2 What is being exported and how?

As explained before, the plastics exported tend to be those that are costlier to recycle: post-consumer, mixed ones, and those under codes #3-7.

Figure 12: U.S. plastic scrap exports to China and Hong Kong by type - 2016 (in metric tonnes)



Source: Adapted from Institute of Scrap Recycling Industries, Inc.

In Indonesia, main imports are, by far, of mixed plastics. According to the UN Comtrade database, 69.5% of plastics imported by Indonesia in 2016 were classified under the code 391590, for "other plastics" (including PP, PET, vinyl acetate, epoxide resins, alkyds and polyester, polyamides among others). 30% was PE, and virtually all the rest was PVC.

India, in turn, imports mostly PVC, PET and PE, and has a large industry of PET bottle recycling. According to local recycling firms, between 70 and 80% of local PET recycling industry is based in imports. Most of it is converted into polyester fibre.[74] Saudi Arabia, United Arab Emirates, Spain and U.K. are the top exporters to India.[75]

Plastics scraps are traded as a commodity, and typically considered non-hazardous waste. Plastic scrap trade is regulated by each country, with diverse requirements.

In the European Union, for instance, plastic waste is categorized non-hazardous (green listed waste), thus it can be exported to non-Organization for Economic Co-operation and Development (OECD) countries following the procedure of the EU Waste Shipment Regulation and provided the import is not prohibited by the country of destination. Exports for incineration or landfilling are prohibited to non-OECD countries. Green listed waste for recovery is done without consent of authorities so no notifications to governments are required.

In the U.S., the Environmental Protection Agency does not provide any regulatory framework concerning exporting and reporting of plastic scraps. However, industry-wide guidelines written by the Institute of Scrap Recycling Industries (ISRI) is commonly applied in the market. With ISRI's broad membership covering the U.S. and 35 other countries, the specifications have been more globally adopted by the international industry. According to the specifications, plastic scrap commodities are segregated into 19 categories. Each item is characterized by resin, product type and source. The guideline regulates the level of contamination. For example, the maximum contamination level for 3-7 bottles and all other rigid plastic is 5% with metal, paper/cardboard, liquid or other residues and 0% with any plastic bags, sheets or film, wood, glass, oil, grease, hazardous waste, etc. (in comparison the new requirement by the Chinese government is 0.5% contamination, much stricter than the ISRI standard).

Importing countries control trade through import licenses and quota, inspections on shipments as well as import bans either for certain types of scraps or for countries of origin.

Statistics on global trade can be found in the United Nations International Trade Statistics Database, also called UN Comtrade database. Information published by UN Comtrade is based on annual international trade statistics data provided by countries, detailed by commodities/service categories and partner countries. Plastic waste falls under several categories grouped under the code 3915: Waste parings and scrap.

[74] *Recyclers told to use local waste as government quietly slaps ban on import of electronic, PET scrap.* The Economic Times http://economictimes.indiatimes.com/articleshow/48366863.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst Retrieved on October 2nd, 2017.
[75] Ministry of Commerce, India.

5.3 Problems with the global recycling plastic market

The trade imbalance often makes shipping plastic scrap to global markets cheaper than recycling in the EU or the US. As China is a major goods supplier to the U.S. and Europe, hundreds of container ships arrive in ports all the time. But since U.S. and Europe have a trade deficit with China and the containers have empty space on their way back, Chinese companies offer good deals to take scraps back to South-East Asia. Frequently, this makes shipping scrap to Asia cheaper than recycling it locally. Also, importing Asian countries tend to have lower environmental standards than.

Also, the data on international trade is not consistent and there are serious problems of transparency in shipping plastic scrap. When analysing data declared by the exporting country vs. the importing country in the UN Comtrade, the numbers yield differences. For example, Indonesia reported exporting more than 187 million kg of plastic scrap to China in 2016, while China reported the import from Indonesia at that same year as more than 189 million kg. Many factors contribute to this. In Indonesia for instance, the current system keeps records of imports by country of origin and does not record the application and presence of transit consignment of goods in the third country before it arrives at the final destination. Other contributing factors include different timestamps on transaction reports (departure from origin versus arrived in final export destination), illegal trade, poor documentation and unintentional or intentional mislabelling (e.g. mixed with electronic waste, etc.).

In addition, sometimes the boundary line between export of recyclables and waste trafficking becomes unclear. For example, almost 800 containers of plastic wastes and scrap tyres (some of them contaminated) had been accumulating at Port Klang, Malaysia, after being shipped and abandoned over the years. Storage costs for these containers amount to RM20-25 million (US$5-6 million). It costs Port Klang Authority (PKA) between RM 5,000 and RM 12,000 (US$ 1,200 - 2,800) to dispose each container.

There is great uncertainty of what happens with waste in the importing countries. Exporters do not know the real fate of the materials they ship or have information on the environmental or social performance of reprocessing facilities.

Concerns are that a big portion of the imported plastics end up in dumpsites, landfills or incinerators, or used as fuel in cement kilns and boilers. Shipping waste for disposal is illegal in the European Union.

5.4 Problems with the global recycling plastic market

The Government of China has been taking measures to halt illegal shipments and improve the quality of used plastics and other secondary materials' imports for a long time. In 2004, China introduced import and export license requirements. Given that these were not sufficient to cut illegal trade and perform satisfying controls, later on it introduced stricter measures:

- The Green Fence Policy: From February to November 2013, the National Custom Agency of China implemented this policy to ban the import of unwashed and contaminated

materials. As the number one plastics scrap importer, this policy had a global impact. Consequences were stricter inspections within exporting countries to guarantee better quality of material, rejection of bales that used to be accepted before, stockpiling of waste, among others. Plastic scrap exports from top 15 global exporters fell 20% in 2013, compared to the previous year, and recovered in 2014. China imports, in turn, fell 11% in 2013 according to UN Comtrade data. Some companies shifted exports to ASEAN countries, like Vietnam, Indonesia and Malaysia. However, the Green Fence Policy also meant stricter rules for their exports to China; thus it impacted these countries as well.

- The National Sword: in February 2017, the General Administration of Customs, Ministries of Environmental Protection and of Public Security, and the General Administration of Quality Supervision, Inspection and Quarantine launched a joint action, "National Sword 2017", against smuggling of foreign waste. Under this joint action, the government is to inspect all containers at nine major ports from May until November in order to ensure the proper quality of waste paper and plastics.[76] Policy implementation seems to be effective. Zhanjiang Custom in Guangdong Province, for example, filed 94 illegal cases, and hunted down and seized 889,000 tonnes of smuggled foreign waste in the first half of 2017.

- Announcement of Implementation plan to ban foreign waste and promote reform of solid waste import management system: In July 2017, as part of the National Sword, the General Office of the State Council announced a ban on the import of 24 kinds of solid scrap -grouped under 4 categories- including "personal/household waste plastic", by the end of year. This plan was also announced to the World Trade Organization (WTO). In August, China updated the catalogue of imported solid waste accordingly. In November 2017, the country issued a new notification to the WTO stating the "entry into force" of the ban would be March 1, 2018.[77] In the case of plastics, the policy bans import of post-consumer plastic scrap, and sets stricter standards for the import of pre-consumer plastic scrap.

The original statement details the main objectives of the decision: "For strict management of solid waste importation, completely **prohibit the importation of solid waste with major environmental hazards and intense public reaction by the end of 2017; and by the end of 2019, gradually halt the importation of solid waste that can be replaced with domestic resources**."[78]

[76] Costas Velis. 2014. *Global recycling markets: plastic waste. A story for one player – China.* International Solid Waste Association.
[77] *China proposes new 0.5% contamination standard with March 2018 enforcement.* Waste Dive, Nov. 16, 2017. https://www.wastedive.com/news/china-proposes-new-05-contamination-standard-with-march-2018-enforcement/511122/
[78] China's Announcement of detailed policy on its "Prohibition of Foreign Waste Imports", July 27, 2017. English translation by Institute of Scrap Recycling Industries, Inc. http://www.isri.org/docs/default-source/int%27l-trade/170727chinaannouncement-en.pdf Retrieved on September 30th, 2017.

Among the planned measures to be implemented are:

- Conduct stricter inspections at ports.
- Reduce the number of ports for importing solid waste and the number of import licenses.
- Destroy or order the return of shipments with illegal contents.
- Raising the threshold for pre-consumer plastic import on contamination (proposing a 0.3% "carried waste" first and raising it to 0.5% later.[79] In comparison, current standards range from 5 to over 20%).[80]
- Revise related legislation and regulations.[81]

China's statement provides the following reasons for these steps: "The management system with regard to the importation of solid waste must be improved (...) adjusting the catalogue for managing the importation of solid waste by batches and by categories, and drastically reducing the quantity of imported solid waste by integrated use of legal, economic and administrative means. In the meantime, we must strengthen the management of the recycling and utilization of solid waste in China and develop a recycling economy. It is also exactly for this purpose that we have first banned the importation of 24 categories of solid waste such as waste plastics, unsorted waste paper, waste raw textile materials, and vanadium slag that pose very high risk of environmental pollution and have led to a strong reaction from the general public..."[82]

In this sense, the announcement urges "relevant local People's Governments to carry out clean-up and rectification of recycling activities for electronic waste, scrap tires, waste plastic, etc., with details of improvement to be included among the key contents for the central government's environmental inspection [group]."[83]

Impacts of China's new policy

In 2017, the Chinese government began implementing strict controls over local recycling facilities. 1,074 enterprises out of 1,792 were cited for breaking laws by the Ministry of Environmental Protection (MEP) in July. In August, an even larger scale of joint action by MEP, together with National Development and Reform Commission, Ministries of Industry and Information Technology, of Public Security and of Commerce and State Administration of Industry and Commerce was launched against illegal practices in recycling sector all over the country. Provincial governments were asked to identify, clean up, and rectify the recycling clusters and

[79] Ministry of Environmental Protection and General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China: Environmental Protection Control Standard for Imported Solid Wastes as Raw Materials—Waste and Scrap of Plastics. Available in english at: http://www.isri.org/docs/default-source/int'l-trade/china/16487-12-plastic-(en).pdf?sfvrsn=3

[80] Institute of scrap recycling industry. 2017. *Scrap specifications circular. Guidelines for nonferrous scrap, ferrous scrap, glass cullet, paper stock, plastic scrap, electronics scrap, tire scrap.*

[81] China's Announcement of detailed policy on its "Prohibition of Foreign Waste Imports", July 27, 2017. English translation by Institute of Scrap Recycling Industries, Inc.

[82] China's Announcement to WTO on waste import ban, July 21, 2017. English translation by Institute of Scrap Recycling Industries, Inc. http://www.isri.org/docs/default-source/int%27l-trade/170721chinabanannouncement-en.pdf Retrieved on September 30th, 2017.

[83] China's Announcement of detailed policy on its "Prohibition of Foreign Waste Imports", July 27, 2017. English translation by Institute of Scrap Recycling Industries, Inc.

enterprises by the end of 2017, and MEP and other departments of central government would double check. If any illegal practice is inspected by MEP, the leading official of provincial and local governments is to be punished.

China's Ministry of Environmental Protection has restricted importing licenses plastic scrap since the end of May 2017. In spite of this, the total amount of plastic scrap imported by China in the first semester was not reduced, probably because importers made full use of their approved import quota. Yet, local recyclers are already manifesting lack of access to imported plastic scrap.

The Chinese recycling industry is exploring the option of moving operations to other Asian countries. China Plastic Scrap Association has more than 1,000 members, and half of them are working on foreign trade and influenced severely by the import ban. The Association is organizing visits for the members to countries like Malaysia and Vietnam. They are also trying to categorize clean reprocessed flakes and pellets as raw material instead of "foreign waste" and turning to domestic bulk commodities such as agricultural films, to help its members survive the challenges. Visits to towns that were famous for their recycling centres confirm that many recycling operations have closed in China, and existing facilities lack access to imported plastic scrap and starting to look at domestic waste reclamation.

The government plans to build centralized recycling parks and there are concerns that these will be built in association with private collection companies, with no inclusion of the informal sector. Likewise, incineration is likely to take up some of the plastics that used to be recycled, as it receives subsidies and benefits that escape the recycling sector.[84]

Initially, the global recycling industry poured out its concerns over the Chinese government's announcement, calling the restrictions "devastating" and "catastrophic."[85] The recycling industry has formally requested that the Chinese authorities modify the scope and the time frame of the ban to allow more time to improve the quality of commodities, including a request for a 5 year transition period to the ban. The situation is worse in North America, namely in the U.S., due to strong dependence on exports. Low domestic capacity for 3-7 plastics has put the recyclers in a difficult place with possible loss of tens of thousands of jobs and closure of many recycling businesses throughout the country.

Even though "a tsunami" of waste might not be avoidable in the short term amid high uncertainties and confusion, China's restrictions on waste imports have opened a window of opportunity to strengthen the domestic industry which has been facing shortage in funding for infrastructure. The recyclers are expecting to significantly improve the domestic capacity and the quality of commodities in next 5 years by expanding facilities - accompanied with more staffing and improved sorting at recycling facilities - and dealing with contamination issues as well as developing end markets. At conferences and webinars, stakeholders are discussing strategies

[84] See China case study below for further information.
[85] Plastic News, July 21, 2017.

to address the situation, including state investment, market development, education and outreach to the communities and regulations such as minimum content requirements.

The U.S. witnessed a progress in sorting in late 2017, with requirements on attaching tags and photographs of the bales on the containers. In mid-2017, some MRFs on the west coast of the U.S. admitted they are now required to allow inspectors from the government of China to certify MRF operations in order for that MRF to ship into China. Later in 2018 the evidence shows that waste management companies have opted for discontinuing the collection of less valuable plastics or plastics altogether because of the low value of recyclables which adds up to the low cost of producing virgin plastics[86].

In Europe, the European Commission and many other stakeholders hope that these restrictions will help boost the EU's recycling industry[87]. NGOs believe it is possible the ban could be a driver for rethinking the quantities and the way we produce, consume and deal with plastics in the EU.

For many in the waste management sector, particularly those exporting a significant amount of materials to China, they see this risk as real and concerning. As detailed above, until early 2018 China was the prime destination for plastic exported outside the EU for recycling – now these waste operators have to find a new outlet. Suez, a leader in this field, was recently reported saying that finding new outlets for some specific waste streams like plastic could prove difficult. Whilst plastics like PET are more likely to be taken in by European recycling facilities, other plastics, such as flexible films used in agricultural mulches and largely exported, might end up incinerated or landfilled because of insufficient processing capacity and demand.

There is a high possibility that scrap plastic import into Southeast Asian countries will increase. Industry related sources are confirming this trend, foreseeing that the region of Southeast Asia may become "world leader" in plastic waste imports.[88] Scrap plastic exporters have been diverting attention from China to other markets in Southeast Asia because end-user manufacturers have relocated their production bases to countries such as Vietnam, Malaysia and Indonesia. These countries show a constant increase in plastic waste import since 2013, 2014 and 2015 respectively. Trends in other Asian countries are not so clear yet.

Given the short notice, the already precarious condition at which recycling is done in Southeast Asian countries, and the lack of infrastructure to absorb all that extra plastic waste, concerns are that this shift will have major environmental and health impacts in those countries.

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[86] https://www.sacbee.com/news/local/article214595840.html

[87] *Europe's garbage exporters reel as China slams the lid on trash imports.* Politico Pro, 19, Oct. 2017. http://www.politico.eu/pro/europe-garbage-exporters-reel-as-china-slams-the-lid-on-trash-imports/?utm_source=POLITICO.EU&utm_campaign=daaf56cd62-EMAIL_CAMPAIGN_2017_10_19&utm_medium=email&utm_term=0_10959edeb5-daaf56cd62-189693561&utm_source=POLITICO.EU&utm_campaign=c9f2abc2d2-EMAIL_CAMPAIGN_2017_10_19&utm_medium=email&utm_term=0_10959edeb5-c9f2abc2d2-189017913

[88] *Report: Southeast Asia may become 'world leader' in plastic waste imports*. Plastic news, November 30, 2017. http://www.plasticsnews.com/article/20171130/NEWS/311309999/report-southeast-asia-may-become-world-leader-in-plastic-waste#utm_medium=email&utm_source=pn-sustain&utm_campaign=pn-sustain-20171130&email_sustain

Another scenario is that exporting countries will increase incineration or landfilling of plastics that cannot ship abroad anymore. This would mean taking steps backwards in the waste management hierarchy, and it would pose a great environmental health risk, adding greenhouse gas and other emissions.

Municipal recycling systems will probably be impacted, given the constraint of the recycling market. Possible scenarios are for governments to halt separated collection of plastics that have no local recycling markets. Developing domestic recycling markets would also be a logic scenario. The U.S. has existing capacity to process more recycled plastics, particularly PET, HDPE, and PP. However, the recycling industry in North America states that there is not enough lead time to get permits, construct, or expand recycling facilities in order to expand capacity enough to process all plastics. From an economic perspective, the substantial investments of the petrochemical sector in the production of new plastics derived from cheap hydrocarbons produced from fracked gas is making virgin plastic so cheap that plastic recycling becomes uncompetitive and lacking legislation mandating recycling this is unlikely to happen.

Another potential outcome of this ban would be to strengthen producer responsibility, innovate change and drive redesign to increase recyclability of plastics.

Finally, efforts are being taken to distinguish between what is waste and what is a commodity. Industry is trying to draw a clear line between both, in order to maintain post-consumer plastic export as a commodity, rather than waste.

On another front, commercial data shows that China is already increasing import of virgin plastics. According to a market analysis source, China's import of polyethylene increased 19% in 2017, while polyethylene scrap imports went down by 11%. U.S. plastic industry is rushing to fill China's new demand of primary plastic making use of its advantaged position by having low plastic production costs (thanks to the shale boom), and several planned investments in new plastic plants. At political level, this is regarded as an opportunity to reduce the US's trade deficit with China.

6. Conclusion

Although exports of plastic waste for recycling from Europe are high it remains to be seen if this will be the case in the future, given the rising awareness of the negative impacts of plastic pollution and the rise in EU political action on plastics, as well as ever-changing markets such as the Chinese ban on plastic scrap imports.

If business-as-usual continues, with consumption of plastics high and increasing, paired with increased recycling of plastics (due to EU targets on this) but no increase in recycling infrastructure or comprehensive redesign of plastics, there is a danger of facing an increasing volume of plastics being collected for recycling, including those of low grade, but still a lack of capacity to deal with them domestically.

On the up side, there are several opportunities for positive change:

- Reducing the absolute volume of plastics produced –reducing the amount of plastics put on the market will avoid costs and resources for downstream management, including potential exports.
- Redesigning plastics and plastic-containing products to be more durable, reusable, repairable, easily recyclable based on existing infrastructure and technologies, and eliminating toxic chemicals at source.
- Better management of plastic waste including separate collection and high-quality recycling as close as possible to source.
- Better enforcement of existing regulations and transparency on exports of plastic waste, including stricter enforcement of EU Waste Shipment Regulation, access to reliable and comparable data on waste streams, flows in and out of Europe, volumes and management systems and harmonised criteria on traceability for waste for recycling (inside and outside of the EU).

When it comes to the impact of the Chinese ban, the European Commission and many other stakeholders hope that these restrictions will help boost the EU's recycling industry.[89] This imply investing in better domestic recycling infrastructure, designing out unrecyclable plastics and working upstream to prevent the huge quantities of plastic waste being generated in the first place. However, there is also a real risk that it could drive simply more incineration, energy recovery and chemical recycling within Europe, or simply change exporting destinations to ASEAN countries.

Global political and governance instruments are not addressing the root-causes of plastic pollution, and in consequence they will fall short in prompting real change. However, we are seeing several institutional and governmental international initiatives to address the problem and there is a chance that in the coming years we see quick developments in the regulatory field.

All in all, the situation is rapidly changing and the only thing that can be affirmed is that 2017-2018 have marked a tipping point when it comes to dealing with plastic pollution and, among other things, this is having a significant impact in plastic waste trade. The tendency seems to be to manage plastic waste locally, either through reduction, recycling or disposal in incinerators and landfills but the lack of data and traceability of the flows make it difficult to have a clear picture as to how the market will look like 10 years down the line.

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[89] http://www.politico.eu/pro/europe-garbage-exporters-reel-as-china-slams-the-lid-on-trash-imports/?utm_source=POLITICO.EU&utm_campaign=daaf56cd62-EMAIL_CAMPAIGN_2017_10_19&utm_medium=email&utm_term=0_10959edeb5-daaf56cd62-189693561&utm_source=POLITICO.EU&utm_campaign=c9f2abc2d2-EMAIL_CAMPAIGN_2017_10_19&utm_medium=email&utm_term=0_10959edeb5-c9f2abc2d2-189017913

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Zero Waste Europe was created to empower communities to rethink their relationship with the resources. In a growing number of regions, local groups of individuals, businesses and city officials are taking significant steps towards eliminating waste in our society.

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