PLASTIC ATLAS

Facts and figures about the world of synthetic polymers 2020

MENA Region
First Edition

HEINRICH BÖLL STIFTUNG

#breakfreefromplastic

IMPRINT

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PLASTIC ATLAS

Facts and figures about the world of synthetic polymers

MENA Region First Edition
2020

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INTRODUCTION

At this point in modern life, we touch plastic more than we touch our loved ones. Plastic is everywhere; it is in our air, our water, and in our soils. It is the vehicle for globalization, and the epitome of unregulated late stage capitalism—a system that externalizes costs to people and the environment for the sake of profit. Even for the conscious citizen, plastic is almost unavoidable and successfully living plastic-free requires a certain amount of access and privilege enjoyed by very few in the world.

We are only just beginning to understand the effects of our global reliance on this material. What makes plastic useful is exactly what makes it harmful: it persists. It is designed to fool nature itself, made from molecular chains that are too resilient to biodegrade in a meaningful timeframe. Indeed, plastic degradation has adverse effects on nature itself and mankind. No matter where scientists go looking for plastic, they find it—at the farthest reaches of the earth. It is not just ubiquitous in the environment but also in our own bodies.

We as a species are contaminated with plastic, and not just indirectly by eating fish that have ingested plastic. Plastic pollutes at every stage of its lifecycle from when the oil and gas is extracted to produce it, all the way to the end-of-life where plastic waste is littered, landfilled, downcycled, burned.

Plastic use and production has accelerated at breakneck speed, with more than half of all plastics having been manufactured after 2005.
The market is controlled by a few major multi-national corporations that are collectively investing over 200 billion US dollars in additional capacity to produce even more petrochemicals, the majority of which will become plastic. Capitalizing on shale gas from the United States, their plan is to build out more than 300 new production facilities or expansions, in hopes of adding 40 percent more plastic to commerce by 2025. The supply for plastic far outweighs the demand.

However, plastics and petrochemical companies are increasingly nervous about the growing war on plastics. And although some companies are beginning to at least acknowledge their responsibility for this pollution, they still maintain, aggressively and publicly that the consumer is at fault for plastic pollution.
This is at odds with reality. Fact is, consumer brands are aggressively opening markets in new regions—Asia, Africa, South America fully aware that in most regions the waste infrastructure and recycling systems lag far behind most countries in the global north. Now a movement of 1,500 civil society groups is

working together under the banner of Break Free From Plastic across all geographies to stop plastic pollution for good.

The global English version of the Plastic Atlas was jointly produced by the Heinrich Böll Foundation and Break Free from Plastic. It has the hard facts, data and figures to prove that the story of plastic that industry is telling us is a myth. This edition for the Middle East and North Africa region was produced by the Heinrich Böll Foundation - Palestine and Jordan in cooperation with the hbs-offices in Beirut, Rabat and Tunis. For our readers we have added several articles on the specific situation in our region, which seems to suffocate under plastic and plastic waste. We highlight the local initiatives to ban plastic bags in Morocco and Tunisia, we cast a glance at the situation on the Tunisian islands and on the Moroccan efforts to reduce and recycle plastic waste. In Jordan, we turn our attention to the campaigns of non-governmental actors against the all-pervasive use and disposal of plastic. In Palestine, we explore the difficulties of solid waste management under the constraints of the occupation.

Wherever we look, we come to the same conclusion: we need urgent and drastic reductions in plastic production and consumption and regulation at the local, national and global level that tackle plastic pollution at the source. Solutions to the plastic crisis need to focus on preventing more plastic from entering the market and on implementing and supporting zero waste communities and cities, alternative delivery systems and reusable products. Governments need to hold companies accountable that are currently contributing to and profiting from the plastic crisis. And citizens need to demand real action and solutions from their policy makers to keep our ecosystems and bodies free from plastics and their toxic additives.

Citizens need to demand real action from policy makers to keep our ecosystems and bodies free from plastic.

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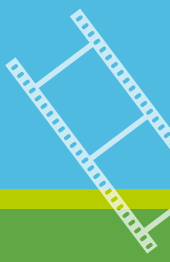
12 BRIEF LESSONS

ON PLASTIC AND THE PLANET



1 The massive expansion of plastic began in the second half of the 20th century, with the discovery that a **WASTE PRODUCT FROM THE PETROCHEMICAL INDUSTRY** could be used to make PVC.

2 Between 1950 and 2017 a total of **9.2 BILLION TONNES OF PLASTIC** were produced. That is more than one tonne for each person now living on Earth. The biggest share consists of single-use products and packaging. Less than ten percent of all plastic ever produced has been recycled.

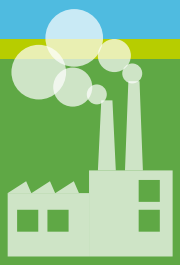
3 In 1978, Coca-Cola first decided to replace its iconic glass bottles with plastic ones. Now, **DISPOSABLE CUPS, PLASTIC PLATES AND OTHER UTENSILS** have become an indispensable part of our fast-paced daily lives.

4 Plastic generates many **HEALTH RISKS**. An array of chemicals is added to the base plastic to give it desirable characteristics. But these chemicals are hazardous to health, and they accumulate in indoor air and house dust.

5 Plastic waste and microplastics floating in the world's oceans are a much-discussed problem. But few realize that **PLASTIC POLLUTION OF THE SOIL** can be between 4 and 23 times higher than in the seas.

6 In 2018, over **1.13 TRILLION ITEMS OF PACKAGING** —most of them plastic—were used for food and drinks in the EU alone. Packaging is not the only problem: agriculture uses around 6.5 million tonnes of plastic worldwide each year.

7 We wear plastic. Polyester and other synthetic fibers are made from petroleum or natural gas. Making a **POLYESTER SHIRT** may emit between **3.8 AND 7.1 KILOGRAMS OF CO2**.



8 Plastic fuels climate change. If current trends continue, plastics will have caused around 56 gigatonnes of CO_2 emissions by 2050. In other words: making plastic could cost **10 TO 13 PERCENT OF THE REMAINING CARBON BUDGET** to keep global warming below 1.5 degrees Celsius.

9 A handful of multinationals control the global market for plastic, which is flooded by **CHEAP FRACKED GAS** from the USA. Ineos, Europe's biggest plastics producer, is investing billions to import feedstock from the USA to make plastics in Europe.

10 For decades, the plastics industry has resisted efforts to limit plastic production and the damage it causes. It invests billions of dollars and pays armies of lobbyists to win subsidies, prevent regulation and **SHIFT THE BLAME** to consumers and poor countries in Asia.

11 In 2018, China banned the import of plastic waste. Other countries also refusing to act as the world's garbage bin and are sending waste back. The four **BIGGEST EXPORTERS** are the USA, Japan, Germany and the UK.

12 The global **BREAK FREE FROM PLASTIC** movement holds consumer-goods companies and plastic producers accountable for the waste they generate and champions zero waste communities and lifestyles. Over 1,500 organizations and thousands of individuals have joined this movement.

BREAKTHROUGH IN THREE LETTERS

The first plastics imitated ivory and silk and attracted just a limited market. Things took off after World War II with the rise of PVC. Cheap plastics soon conquered the world.

Plastics are part of the everyday life of billions of people and are used extensively in industry. Over 400 million tonnes are produced globally every year. But what exactly is plastic? The word refers to a group of synthetic materials made from hydrocarbons. They are formed by polymerization: a series of chemical reactions on organic (carbon-containing) raw materials, mainly natural gas and crude oil. Various types of polymerization make it possible to produce plastics with particular properties: hard or soft, opaque or transparent, flexible or stiff.

The first plastic was presented at the Great London Exposition in 1862. Called "Parkesine" after its inventor, Alexander Parkes, who made it from cellulose, this organic material could be shaped when it was heated and retained its shape on cooling. A few years later, John Wesley Hyatt developed celluloid, transforming nitrocellulose into a deformable plastic by treating it with heat and pressure and adding camphor and alcohol. It replaced ivory and tortoiseshell in billiard balls and combs, and was destined for a bright future in the film industry and photography. In 1884, the chemist Hilaire de Chardonnet patented a synthetic fiber known as "Chardonnet silk." Its successor, rayon or viscose, is a semisynthetic plastic made from chemically treated cellulose—which is cheaper than natural fibers such as silk.

This and other early plastics were made from natural raw materials. It would take another 40 years before a completely synthetic plastic was developed. In 1907, Leo Hendrik Baekeland improved on phenol-formaldehyde reaction techniques and invented Bakelite, the first plastic that contained no naturally occurring molecules. Bakelite was marketed as a good insulator and a durable and heat-resistant material.

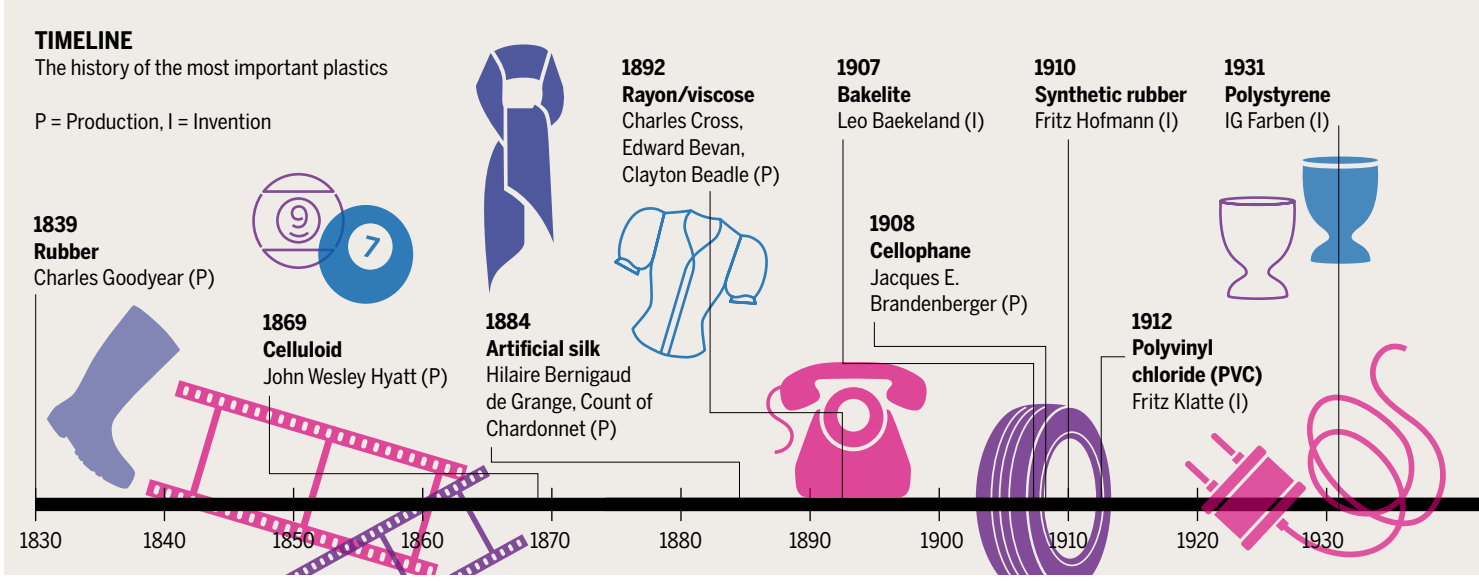
Five years later, Fritz Klatte patented a material known as polyvinyl chloride, better known as PVC, or vinyl. Until the middle of the 20th century, plastics occupied a relatively small market niche. The trigger for the mass spread of PVC was the discovery that it could be made from a waste product of the petrochemicals industry. The chlorine resulting from the production of sodium hydroxide (caustic soda) could be used as a cheap feedstock.

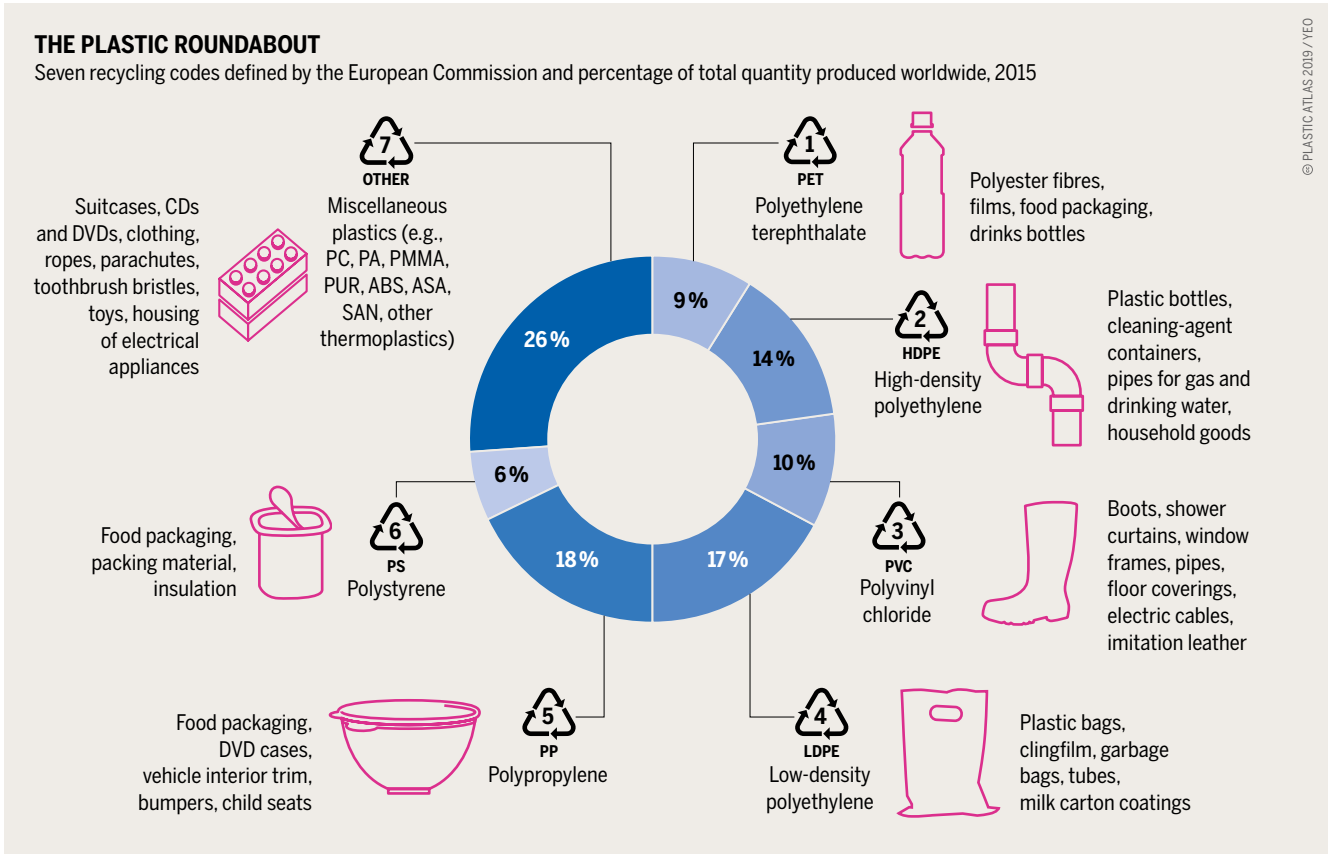
This marked the start of the rapid and uninterrupted rise of PVC. In World War II, demand rose significantly because it was used to insulate cables on navy ships. Although it was increasingly known that PVC production harmed both the environment and human health, the petrochemicals industry took advantage of the new possibilities to turn a waste product into profit. PVC has since become the most important plastic in a wide range of household and industrial products.

Alongside PVC, polyethylene has also gained acceptance. Invented in the 1930s, it is used to make drink bottles, shopping bags and food containers. The chemist Giulio Natta developed polypropylene, a plastic with similar properties to polyethylene. Gaining popularity in the 1950s, it is today used for a range of everyday products such as packaging, child seats and pipes.

At the time, the positive image of plastics contributed to the boom in their use. Plastics were seen as trendy, clean and modern. They squeezed out existing products and muscled their way into almost all areas of life. Today, PVC,

The most important types of plastics were invented between 1850 and 1950. They have been refined, often by mixing them with toxic additives.



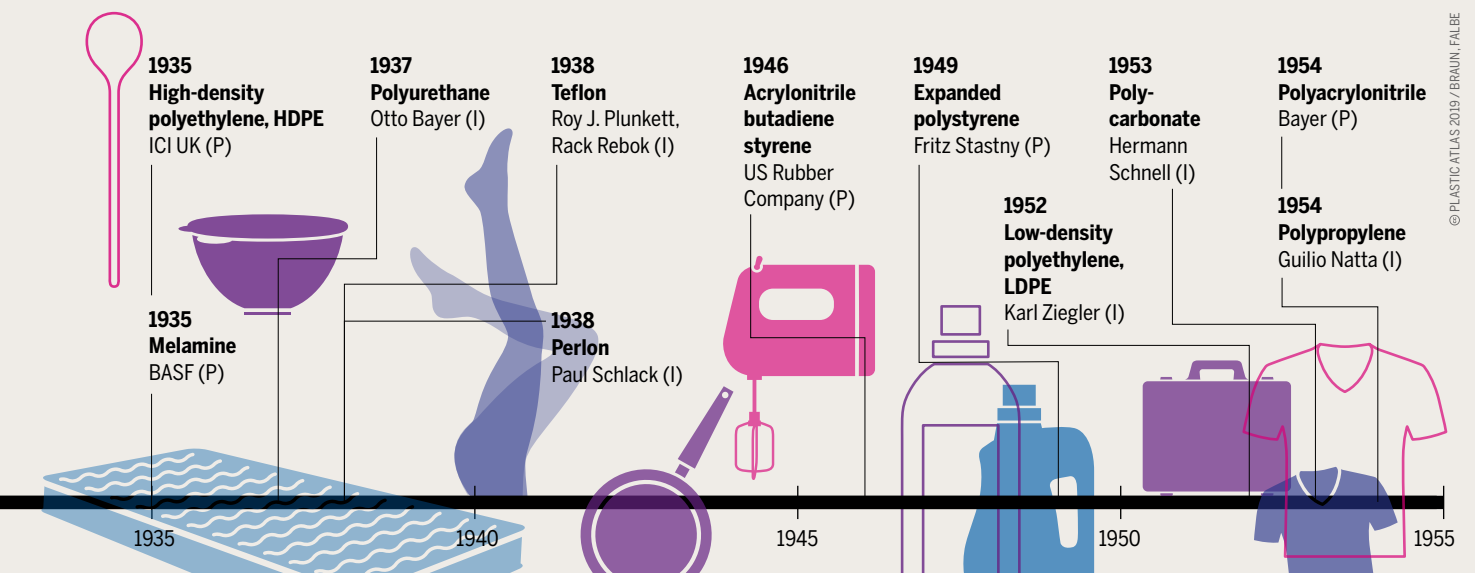


In 2015, 407 million tonnes of plastics were produced worldwide. In theory, all should be recycled. Reality is rather different.

polyethylene and polypropylene are the most widely used plastics in the world.

To improve their properties, plastics are often mixed with chemical additives such as plasticizers, fire-retardants and dyes. Many of these additives make the material more flexible or durable. But they may damage both the environment and health. They can escape from the material and enter the water or air, ending up in our food. They can also be released when plastic is recycled.

A new generation of plastics can be made from biopolymers such as maize starch. For example, a completely new production process has made it possible to make a biodegradable plastic from the shells of shrimp and other crustaceans. This modifies chitin from the shells to make a polymer called chitosan. The developers at McGill University in Canada hope for a bright future based on the 6–8 million tonnes of crustacean waste produced every year. This and other plastics based on natural raw materials are already being used to make drinking straws, disposable plates and cups, plastic bags and food packaging. But it is doubtful whether they can contribute to solving the plastic crisis.



WHY THE WORLD IS WALLOWING IN WASTE

Until the 1950s, people treated plastic with the same respect as they did glass or silk. Then consumer-goods companies discovered the advantages of polymers. A lifestyle emerged that generates increasing amounts of trash.

Once upon a time, things were made to last, and very little was thrown away. Food and drinks came in bulk. Packaging and bottles could be reused or returned. The greengrocer sold loose vegetables, and the butcher wrapped meat in greaseproof paper. Milk came in returnable glass bottles, delivered to the doorstep. Other bottles were washed and reused—or melted down to make new bottles. The pharmacist counted out tablets into a screw-top jar. Now all these items come cocooned in cellophane or encased in PET.

Right after World War II, as plastic was becoming mainstream, people reused it and treated it carefully, as they did with other materials and types of packaging. But in the late 1950s, the economy started to be driven by the need to consume ever-increasing quantities of resources. Manufacturers welcomed the chance to save money and simplify their supply chains, planting the seed of the throwaway culture. By the early 1960s, billions of plastic items were filling dumps, landfills and incinerators in the western world. The shift to throwaway packaging was gradual, until the late 1970s when it took hold globally. In 1978, Coca-Cola introduced a single-use plastic PET bottle to replace its iconic glass one. This shift symbolizes the beginning of a new era for consumer drinks.

By the mid-1980s, the belief that recycling would solve the growing problem of single-use plastics was widespread in the western world, and by the end of the decade, almost all refillable soda and milk bottles had disappeared, replaced by the plastic throwaway. This one-way supply chain approach helped food and beverage producers to consolidate distant new markets, just as developing countries were starting to follow the development model pioneered in the Western world. A throwaway lifestyle was a sign of modernity.

Towards the end of the 20th century, life got even busier. Employment levels rose as more women entered the workforce. Cities grew bigger and the numbers of commuters swelled. Expectations of leisure rose. Families (especially women) had even less time for cooking, gardening or housework. Freezers and microwaves made it possible to replace home-cooked meals prepared from fresh ingredients with precooked "TV dinners" bought from the supermarket.

This "convenience lifestyle" was made possible by single-use plastic. Plastic straws, single-use plastic bags, polystyrene plates and polypropylene utensils for takeaway food form the material basis of daily life. Everything can be acquired quickly, is easy to consume—and what is left can be simply dumped in the bin. Single-use products have become the symbol of the lifestyle in a capitalist economy. Such a lifestyle is both a cause and a consequence of the density and speed of modern life.

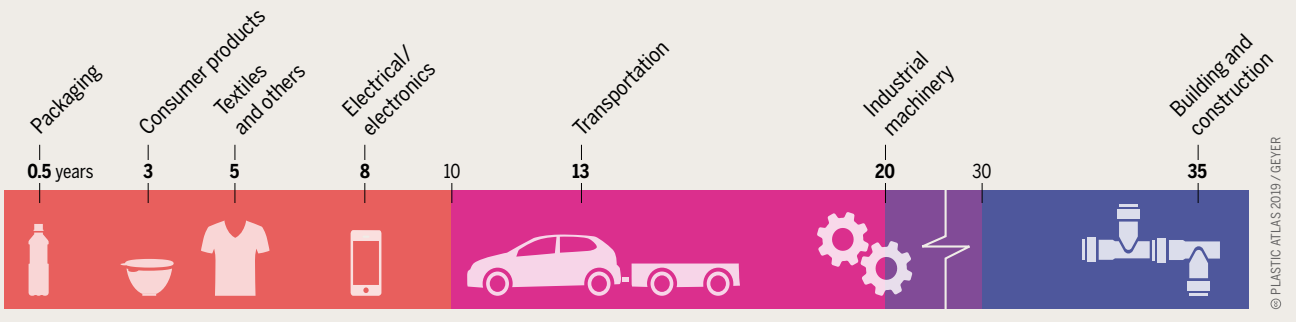
Such attitudes are reflected in the core of popular culture, such as in sport and music events and in Hollywood. Single-use plastics have made their way onto screens of all sizes: college parties heave with plastic cutlery, and television heroes make their way to work grasping a cup of takeaway coffee. Such images spread across the globe. In poorer regions, plastic throwaway items are seen as prestigious and are used en masse. Corporations actively encourage and support such trends.

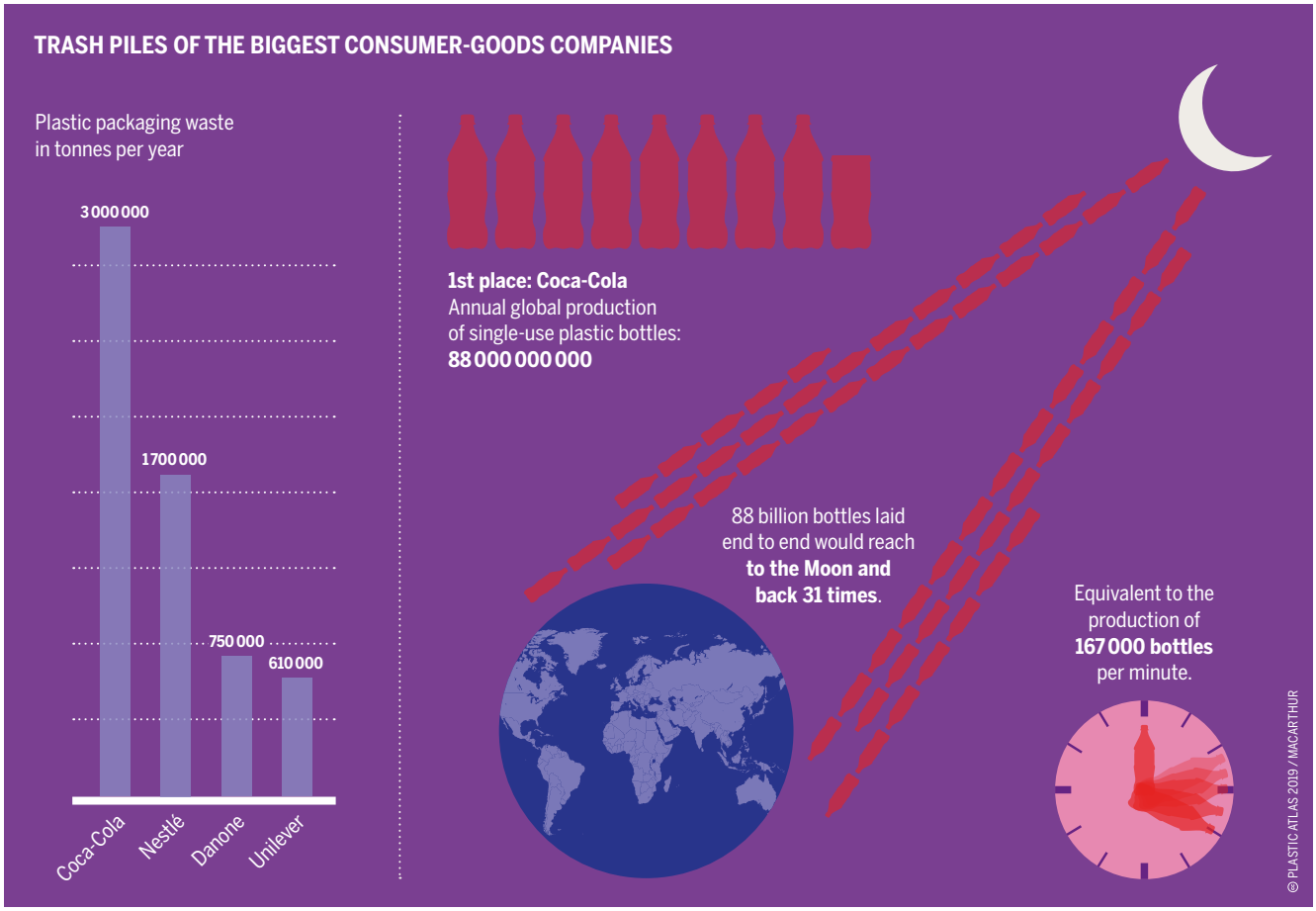
Festivals and other mega-events generate lorryloads of trash that can only be incinerated or landfilled. But this has triggered a rethink among some organizers of such events.

Not all plastic is created equal. Some items have a lifetime measured in decades. But packaging makes up the largest share and typically has a very short useful life.

LIFE IS SHORT

Average useful life of various plastic items, by industrial sector, in years



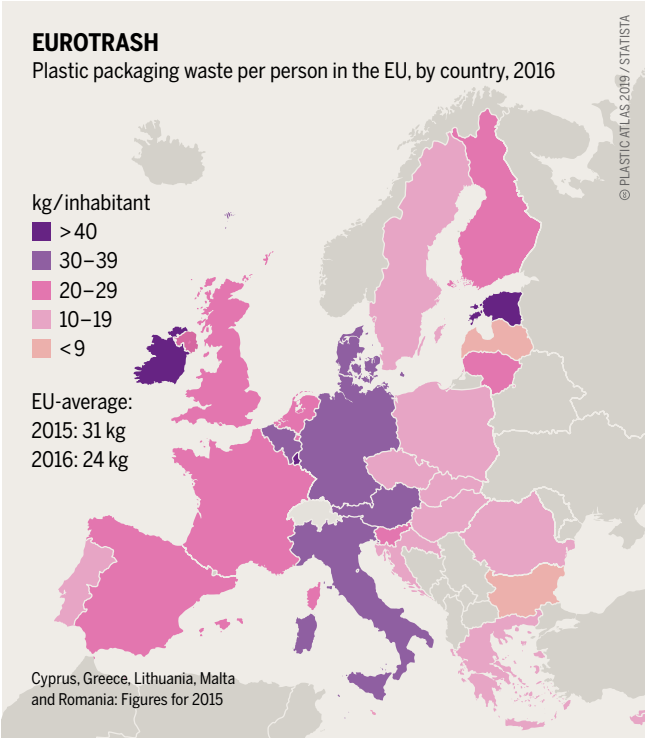


In 2019, along with 31 other companies, Coca-Cola published its plastic figures for the first time. The data show how much waste is generated by relatively few firms.

Some now charge a deposit for cups, which customers must return to get a refund. Food is increasingly served on compostable plates. More and more suppliers of takeaway food and drink are offering their customers a rebate if they bring their own reusable containers. But the throwaway mentality is still dominant, because it makes certain aspects of life that little bit easier. The costs that are incurred by waste are not included in the price of the product.

The specific mechanisms differ from one country to another. In many developing countries, a decisive factor was that consumer-products giants such as Proctor & Gamble supply their products in sachets: to gain market share, shampoo, detergent and ketchup are sold in small, sealed plastic envelopes. The suppliers argue that this makes it possible for low-income consumers to afford such products. But the result is yet more trash.

The disastrous aspect is that such mini-portions embody a drastic mismatch between the amount of packaging needed per unit of product, while at the same time boosting consumption. That is a catastrophe in places where drinking water supplies are inadequate and people resort to buying plastic bottles of water. Without a functioning waste disposal system, they drown in a flood of plastic trash. The producers offer no solutions for disposing of or recycling the packaging. Litter from convenience items has grown to be a massive problem in many cities in the developing world. For there is no incentive to collect them, and no way to dispose of them in an environmentally responsible way.



Luxembourg, Ireland and Estonia are Europe's leaders in chucking out plastic packaging. Good to see: the downward trend from 2015 to 2016.

BLESSING AND CURSE

Plastics have become indispensable. They are found in bags, smartphones and car dashboards. But almost half of all plastic products end up as waste within less than a month. Only a fraction is recycled.

Between 1950 and 2017, some 9.2 billion tonnes of plastic were produced. That is more than a tonne per person alive on Earth today. But the majority of plastic is produced and consumed in four main regions: Northeast Asia, North America, the Middle East and Western Europe.

Plastic is durable, lightweight and easily shaped. These properties make it ideal for many industrial products and everyday items. But contrary to the original idea of positioning plastic as a high-quality material, it is today used mainly for packaging and single-use products. Many items in everyday use are used just once, and usually only for a short time—and then land in the trash. The properties of plastics are both a blessing and a curse: they are very resistant. That is precisely why they degrade extremely slowly.

For various reasons, plastics are especially popular as packaging for food and other products. They retain their characteristics at both high and low temperatures. They may be either flexible or stiff, depending on their composition. Low-density polyethylene (LDPE), for example, is tough, flexible and transparent, and is therefore used to make films.

PET, on the other hand, is impermeable to both gases and liquids, and is the base material for making drink bottles. Polypropylene has a high melting point and is chemically resistant, making it attractive for use with hot liquids. Polystyrene may be stiff, brittle and clear, or made into a foam, making it a versatile material for protective packaging and food containers. And polyvinyl chloride, or PVC, can be used to make rigid or flexible packaging from which neither oxygen nor water can escape.

Plastic is finding an increasing number of uses in the construction sector, for example as floor coverings, doors, windows and pipes. These materials have a long service life, are flexible and resistant against mould and corrosion, and they have a firm consistency. Compared to other materials they are easy to install and maintain. They also protect against cold and heat, and thereby contribute to saving energy.

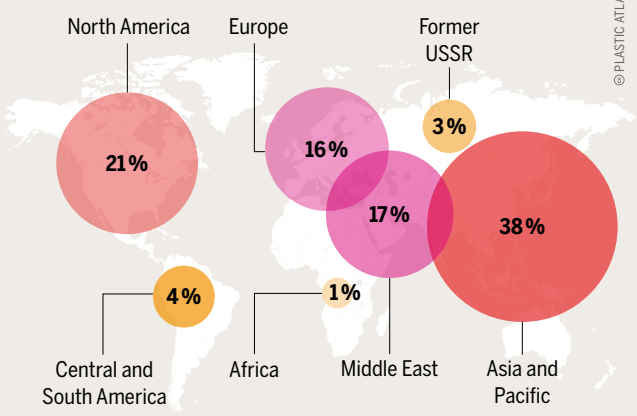
The plastic most commonly used in construction is PVC. Just as in the food sector, plastics enjoy several advantages for building: their durability and mechanical rigidity on one hand, and their light weight on the other. Pipes made from high-density polyethylene (HDPE) are watertight, resistant to environmental influences, and do not rust. They are also flexible, allowing them to be bent and threaded through existing ducts.

Plastic has become indispensable, too, in building vehicles and aircraft, trains and ships. This is because they are durable and lightweight, as well as flexible and recyclable. Plastic parts require little maintenance and are flexible enough to withstand permanent vibration. Without plastics, none of today's cars would be on the road. Most plastics are to be found in the bumpers, interior trim, seats, upholstery, electronics and dashboard. As the demand rises for lighter ships with lower fuel consumption, shipbuilding is using more fiber-reinforced plastics such as glass or carbon fiber. Such materials do not rust, and seawater does not affect them. That extends the maintenance intervals and lowers the vessels' operating costs.

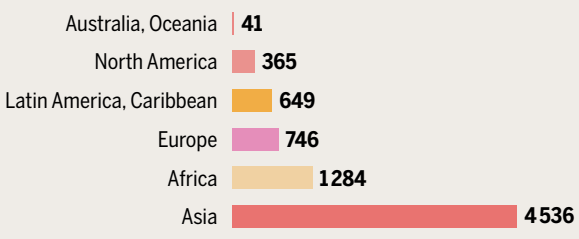
In the aerospace industry, the materials used must tolerate temperature extremes, be immune to corrosion, and withstand jet fuels and chemicals. Plastics such as PVC, acrylic and polyamide have become essential in the construction of aircraft and spacecraft, for example for dashboard surfaces, partition walls, drinks trolleys, toilets, baggage containers and tank caps. Since the 1970s, the use of plastics in aircrafts has risen from four to around 50 percent.

The rising demand for plastics has inevitably led to problems in waste disposal. According to current estimates, some

A WORLD FULL OF PLASTIC
Distribution of the production of single-use plastic articles, by region, 2014



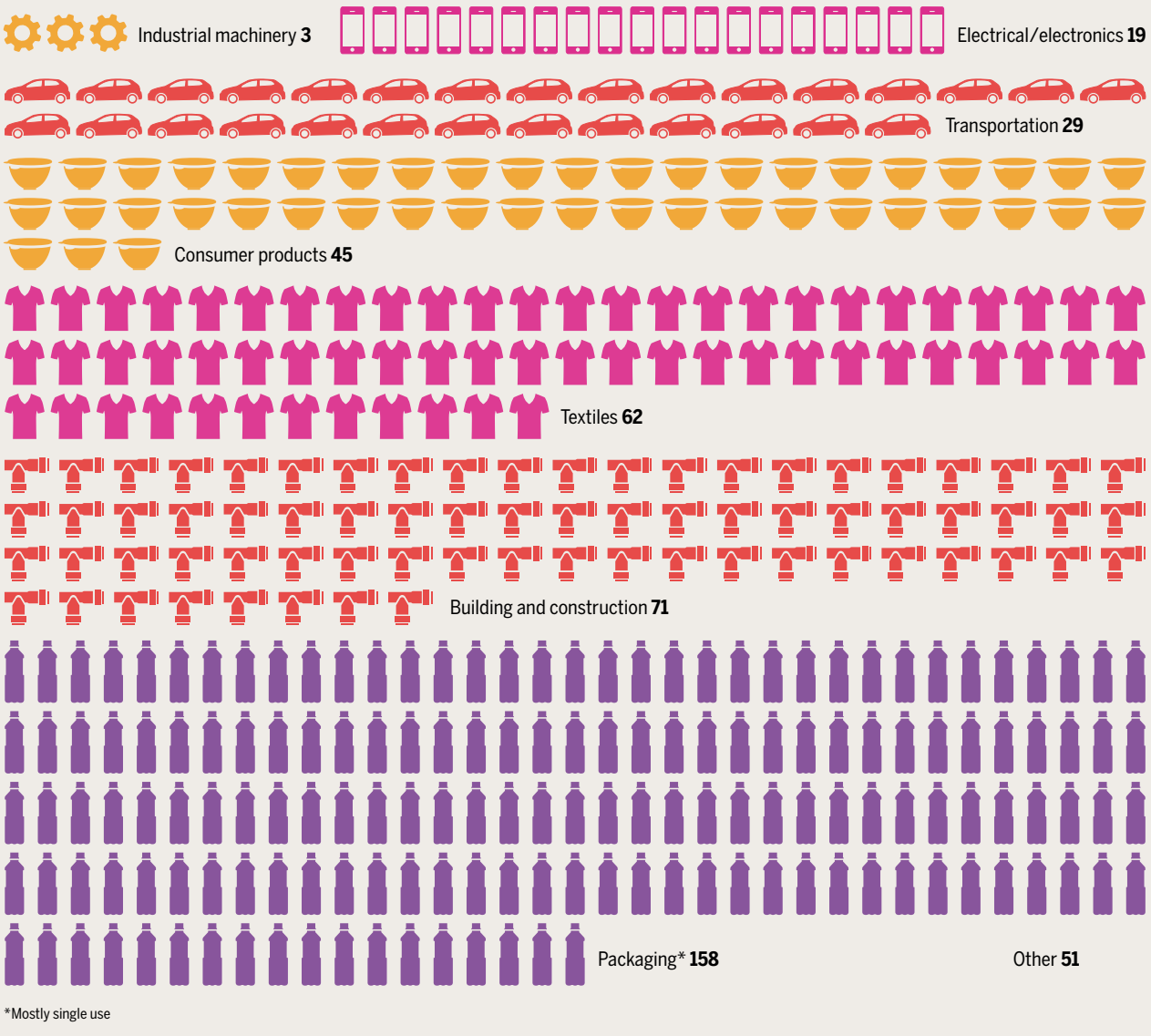
World population by continent, millions, 2018



Single-use plastics have become an icon of the global plastic crisis. Their production is limited to a few regions of the world.

WHAT DO WE USE PLASTIC FOR?

Usage by industrial sector, total volume 438 million tonnes, each symbol represents 1 million tonnes, 2017



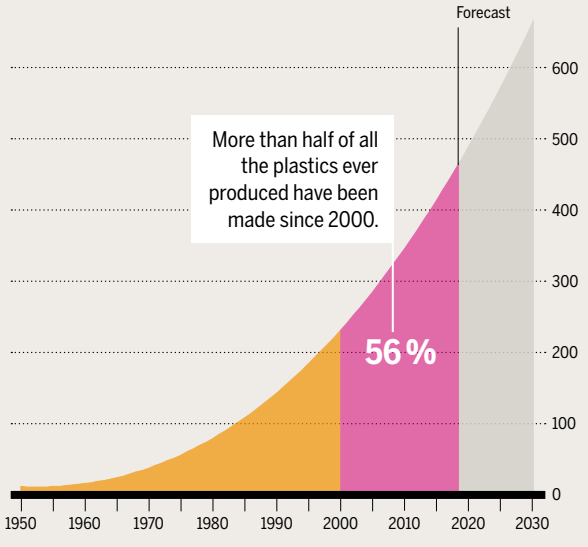
Worldwide, over 400 million tonnes of plastics are produced each year. Packaging accounts for more than a third of all plastics produced.

40 percent of plastic products are garbage after less than a month. This constantly growing mountain of plastic waste causes serious environmental problems. And recycling is only the second-best option to reduce it. In 2025, plastic production is expected to reach over 600 million tonnes per year. Current recycling systems cannot cope with such volumes of waste. A glance into history shows this: only ten percent of the more than nine billion tonnes of plastics that have been produced since the 1950s have been recycled. The best solution is easy to state but is hotly contested: just don't produce so much plastic in the first place.

Since 2000, more plastics have been produced than in the 50 years before. The output of plastics continues to explode.

PLASTIC PLANET

Global plastic production in million tonnes



FOOD CHEMISTRY

The effects of runaway plastic production on the environment can no longer be ignored. Its consequences for human health are less well known—from the extraction of raw materials through to waste disposal.

Most plastic items begin life as petroleum or natural gas. When the oil or gas is being extracted from the ground, especially through the controversial fracking technique, toxic substances are released into the air and water. Over 170 substances used in fracking are known to cause cancer, reproductive and developmental disorders, or damage to the immune system. People living near fracking wells are especially affected by these substances, and by pollution from the large number of diesel trucks used for transport in such areas. Up to 6,000 truckloads of equipment, water and chemicals are needed to develop a fracking field. Research in the United States indicates that expectant mothers who live near fracking sites have an enhanced risk of pregnancy complications and premature births.

Turning oil into plastic means refining it and splitting it into smaller molecules. These are then combined into polymers with longer chains by mixing them with chemicals and applying heat and pressure. Various additives are added to give the material the desired characteristics. Plasticizers turn rigid PVC into the flexible film that forms paddling pools, for example. Fluorinated compounds are used to impregnate weatherproof jackets. Brominated substances serve as flame retardants in electrical appliances and furniture. On average, plastic products contain about seven percent of such additives. For a ball made from PVC, plasticizers may make up to 70 percent of its total weight.

Many of these additives are harmful to health. They gradually escape and accumulate in food, indoor air and household dust. A US study suggests that younger children who always eat school lunches are more exposed to phthalates, a plasticizer used in food containers, than those who never do so. A study of the blood of pregnant Americans detected an average of 56 different industrial chemicals, many originating from plastic products or the processes used to make them. Still other compounds may have been present that were not being looked for. Research in Germany has found that children are especially exposed to plasticizers that may harm their reproductive health. In relation to their body weight, children breathe in more air and have a higher metabolic rate than adults. They are nearer the ground, often play on the floor, and are exposed to more pollutants.

Of particular concern are substances that are endocrine disruptors—a group that includes many plasticizers. These compounds mimic naturally occurring hormones and upset the body's finely balanced endocrine system. A multitude of diseases and disorders are associated with hormonally active substances. These include breast cancer, infertility, premature puberty, obesity, allergies and diabetes.

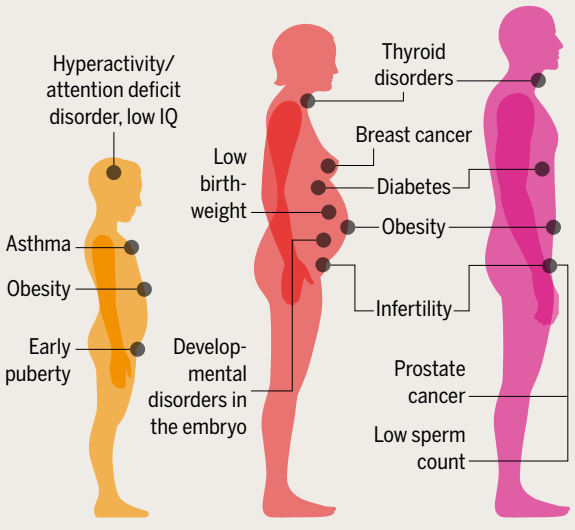
No-one knows the full extent of the chemicals we are exposed to in consumer goods. For consumers it is virtually impossible to identify risky chemicals that products contain. Most retailers have no idea what is in the products they sell: the information simply gets lost on the way through a long and winding supply chain or is often deliberately hidden by manufacturers because it is "confidential business information." There is an urgent need for publicly available information on the use of chemicals in plastics, and on the exact chemical composition of finished plastic products.

The circular economy would benefit from transparency. Industry currently reuses materials that have not been optimized for human and environmental health, turning them into items such as toys and food containers that may be highly contaminated. Research by environmental organizations from 19 European countries found that one in every four products made from recycled plastic contains flame-retardants hazardous to health. The toxins in recycled items come mainly from recycled electrical waste. Recycling is particularly harmful to those who dismantle contaminated materials. The toxic cycle could be broken if producers were made responsible for waste disposal. A general principle is that what goes in at one end comes out at the other. Using toxic materials in plastic should be avoided altogether.

From a global point of view, the recycling of plastics plays only a minor role. There is currently no such thing as plastic recycling, only open-loop recycling or downcycling. Every time a piece of plastic is recycled, it degrades in quality.

INVISIBLE DANGER

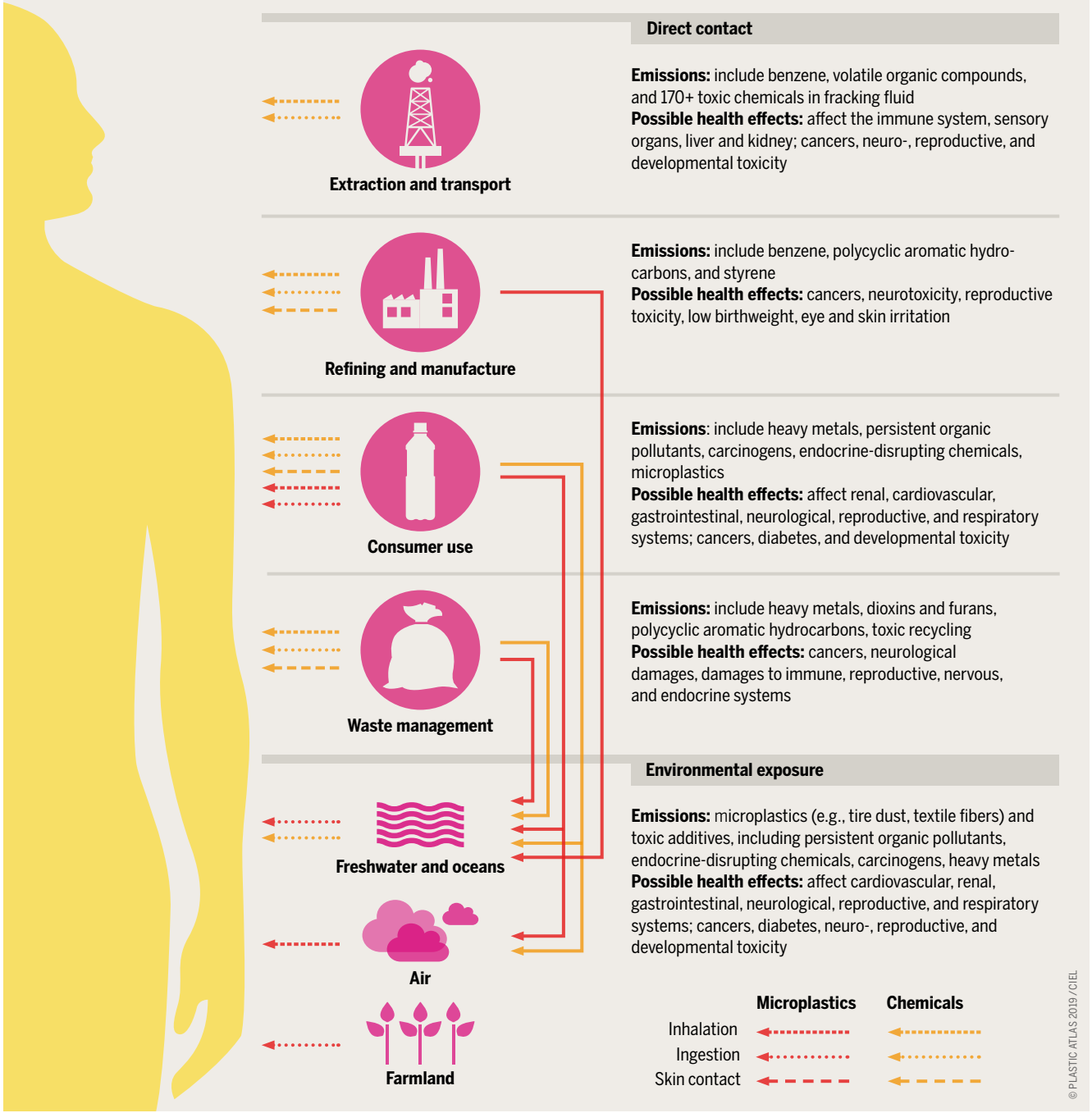
Possible health consequences of day-to-day contact with hormonally active substances in plastics



Many of the chemicals in plastic have an effect on human health. The consequences may be both serious and long-term.

NO WAY TO AVOID IT

We are exposed to toxic chemicals and microplastics at all stages in the plastics life cycle. The pollutants can get into our bodies in many ways.



Even if you try to avoid coming into contact with plastics, you will still be exposed to them. The body has no mechanism to protect itself.

Plastic can be recycled only a certain number of times before it ends up in the landfill or the incinerator. So what we call plastic recycling actually means merely postponing the final disposal.

In the struggle to manage the ever-increasing amount of plastic waste, cities and governments are turning to incineration. But this merely shifts the problem somewhere else. Emissions associated with incineration include dioxins and metals such as mercury, lead and cadmium. Workers and nearby communities are particularly affected, but the toxins can also travel long distances and be deposited on the soil and in water far away. Plus, incinerating plastics produces highly toxic by-products, which end up in ash or sludge and create a new waste disposal problem. This material can end up in landfills, caves, farmland and wetlands, creating a long-term threat to environment and health. Open burning is even more problematic: this is frequently done in developing countries and rural areas that have no access to organized waste management. Addressing the health impacts of plastic production, use and disposal will require actions along the whole supply chain. One thing is clear: transparency will be the key to success.

GENDER

OVEREXPOSED

Women are more affected than men by plastics. Biological reasons are part of the problem: their bodies react in different ways to toxins, and the hygiene products that women use are often contaminated. But alternatives do exist.

The toxins contained in plastics have different effects on men and women, both in the workplace and in everyday life. This is partly due to biology—the differences in body size and the proportion of fatty tissue—but it is also due to the gender roles that women find themselves filling.

Women's bodies contain more fat than men's, and therefore accumulate more oil-soluble chemicals such as phthalate plasticizers. The female body is especially sensitive to toxins during life phases such as puberty, pregnancy, lactation and menopause.

During pregnancy, this can have serious consequences for the unborn child. Chemicals that function in a similar way to hormones—known as endocrine disruptors—are problematic. Because the placenta is not a secure barrier, these compounds may disturb all the developmental phases in the womb that are controlled by hormones. That can lead to malformations in newborns, as well as diseases that appear much later in life.

Endocrine disruptors affect both men and women to the same degree. The World Health Organization suspects that they are responsible for hormone-related forms of cancer such as breast and testicular cancer. It also seems possible that they affect fertility and sperm quality. Endocrine disruptors may also contribute to obesity, diabetes, neurological diseases, premature onset of puberty, and congenital malformations such as cryptorchidism (absence of one or both testes from the scrotum) and hypospadias (malformation of the male urethra). Increasing numbers of children are being born who have been exposed to harmful substances.

Women come into contact with the dangers of plastics in many different places. Some 30 percent of the workers in the plastics industry worldwide are women. So cheap plastic items can be mass-produced for the global market, women in developing countries are commonly employed in industrial production plants at low wages, very often in hazardous conditions and without protective clothing. A Canadian study found that women who handle plastics in the car industry are five times more likely to develop breast cancer.

Feminine hygiene products may also be problematic. Tampons may comprise up to six percent plastic, and sanitary pads consist of up to 90 percent petroleum-based plastic. Both may contain the hormonally active compounds bisphenol A (BPA) and bisphenol S (BPS). Tampon applicators also often contain phthalates. In the USA, a woman may use between 12,000 and 15,000 of these items in her lifetime. Alternatives include washable reusable products and reusable menstrual cups.

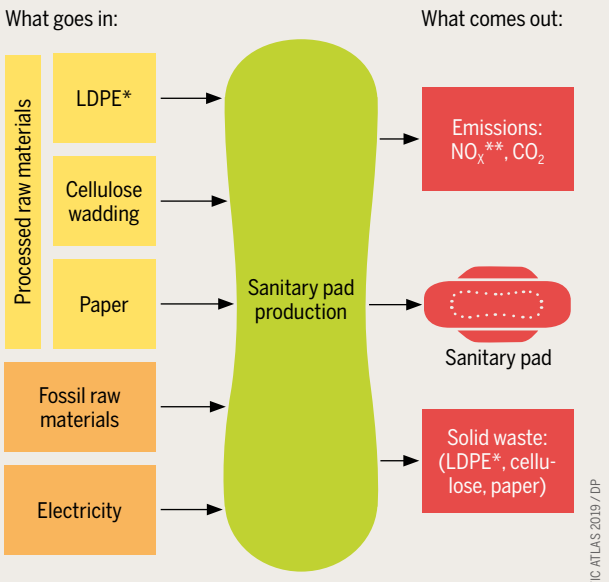
In poorer regions, many women and girls cannot afford to use such hygiene articles, or these products are simply not available locally. That may force a girl to miss school for an average of five days a month during her periods. Cheaper and safer reusable products could close this gap and reduce pollution and waste. Most single-use hygiene articles end up in landfills, in water sources and the sea, and clog sewage systems.

Cosmetics may also be a source of harmful substances. One-quarter of all women in western industrial countries use up to 15 different products every day. These commonly contain up to 100 chemicals, some of which are harmful to health. Many cosmetics contain microplastics, which can pass through the placenta into the foetus.

Last but not least, women are still often responsible for doing the housework, or work as cleaners. Cleaning products also contain microplastics and harmful substances such as surfactants and solvents. Choosing products more carefully, and using environmentally friendly materials or conventional agents such as soft soap and citric acid, could reduce the burden on mankind and the environment. But such consumer choices do not free producers of the responsibility to replace harmful ingredients and raw materials.

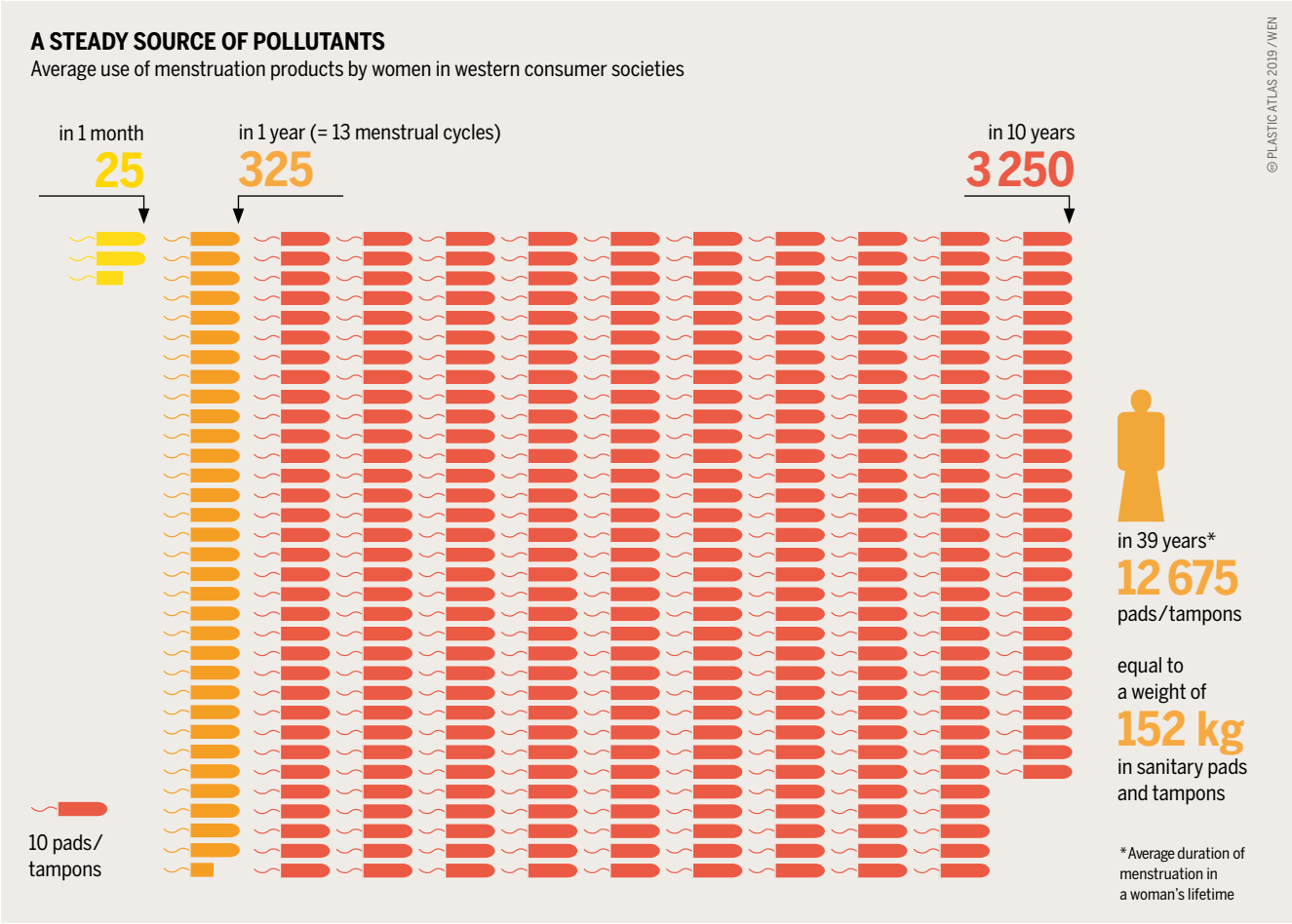
THE SECRET LIFE OF A SANITARY PAD

Life-cycle assessment of the energy and materials used in production



* Low-density polyethylene ** Nitrogen oxides

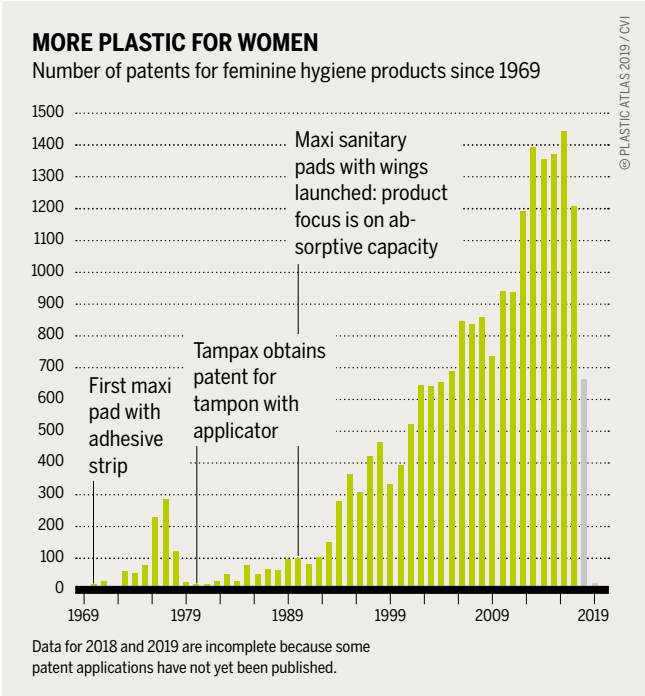
The production of a modern sanitary pad is not possible without using fossil raw materials and plastics.



A woman who uses disposable menstruation products comes into contact with hazardous plastics for nearly four decades.

When waste is exported to developing countries, landfills become important sources of income for the poor. Millions of waste-pickers around the world, often women and children from the poorest sections of society, pick over such sites for recyclable plastics and electrical waste. Often the only source of family income comes from these highly toxic locations. To get to valuable copper, PVC-coated cables are burned. The smoke contains highly toxic dioxins that are harmful to reproduction, damage the foetus, and can cause cancer. It is mostly women who burn household rubbish in backyards or who sort through toxic trash.

Knowledge about the dangers posed by plastics is unevenly spread throughout the world. Women are an important target group in efforts to trigger a fundamental switch in attitudes and everyday practices, as well as in demanding political action. Women are often more sensitive to various dangers than are men, and they are less prepared to put people and the planet at risk. That is true in their roles both as entrepreneurs and as consumers and managers of their families. There is considerable evidence that they act in a more environmentally responsible way than men. Initiatives that aim to reduce the consumption of plastic and protect people and the environment from pollutants are often started by women. They deserve an equal place in politics, businesses, families and communities so they can make an even greater contribution to bringing about a plastic and toxin-free society and environment.



Patents for feminine hygiene products have jumped sharply since the end of the 1990s. One reason is the mass availability of cheap plastics.

TASTY MORSELS

The food industry is a big user of plastic. Films and foams are meant to shield food from damage, keep it fresh, and make it look attractive. But beauty has a price: the plastic lands on fields and gets into our food system.

Cucumbers cocooned in polythene, pre-cut salad ready to eat in disposable bowls, ready-made meals in individual portions: supermarket shelves are laden with plastic-wrapped food. Plastic takes on a central role when food marketing moves out of local market stalls and into supermarkets with their rich assortments of processed food sourced from across the globe.

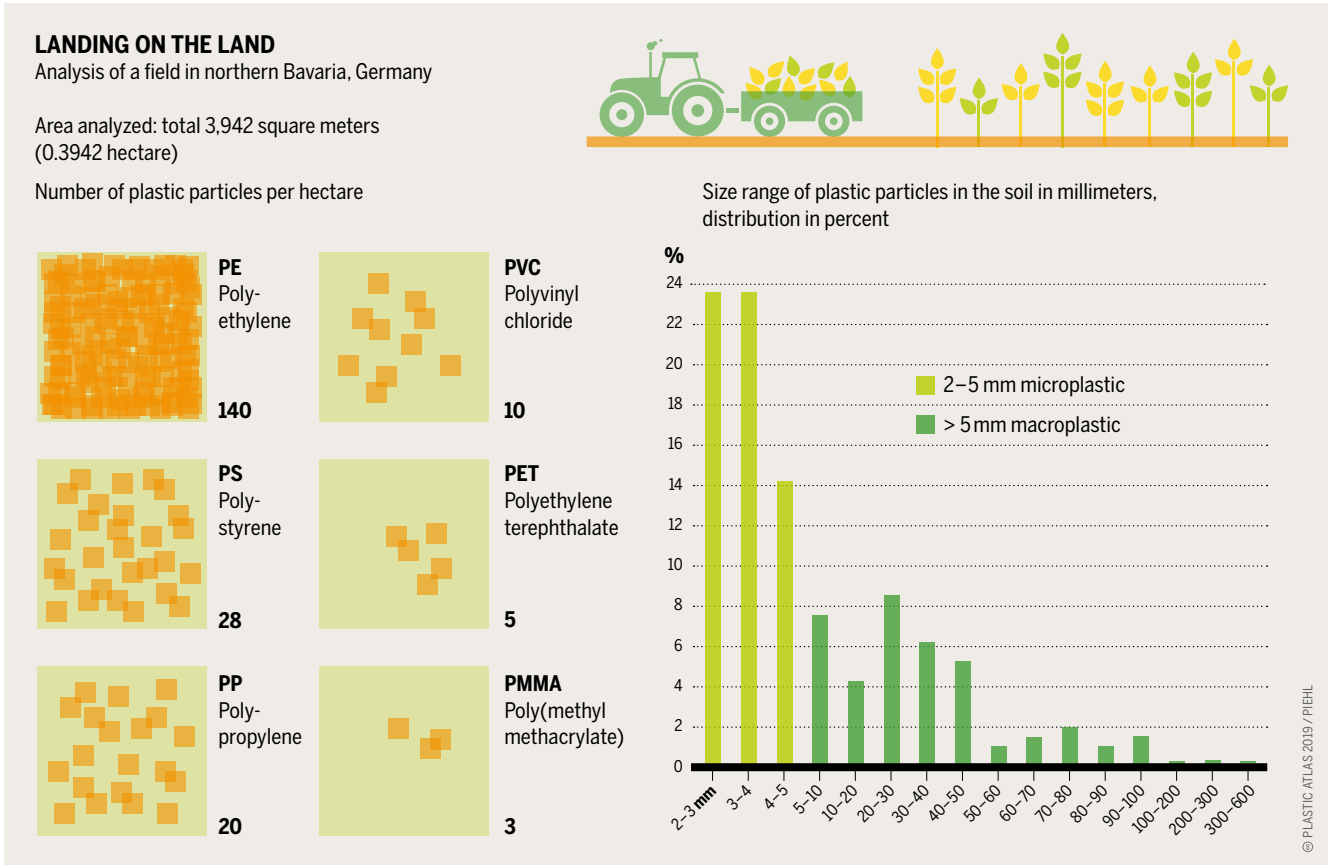
Supermarkets like to offer the same groceries year-round, regardless of the region. Packaging guarantees that items stay fresh and can be transported from afar. Plus, many consumers in the developed world want to be able to prepare food quickly: convenience is the order of the day. Research in Germany in 2019 found that 48 percent of people thought it important to be able to prepare their meals quickly and easily. The food industry responds to such demands by offering pre-cut and pre-cooked items, all wrapped in plastic.

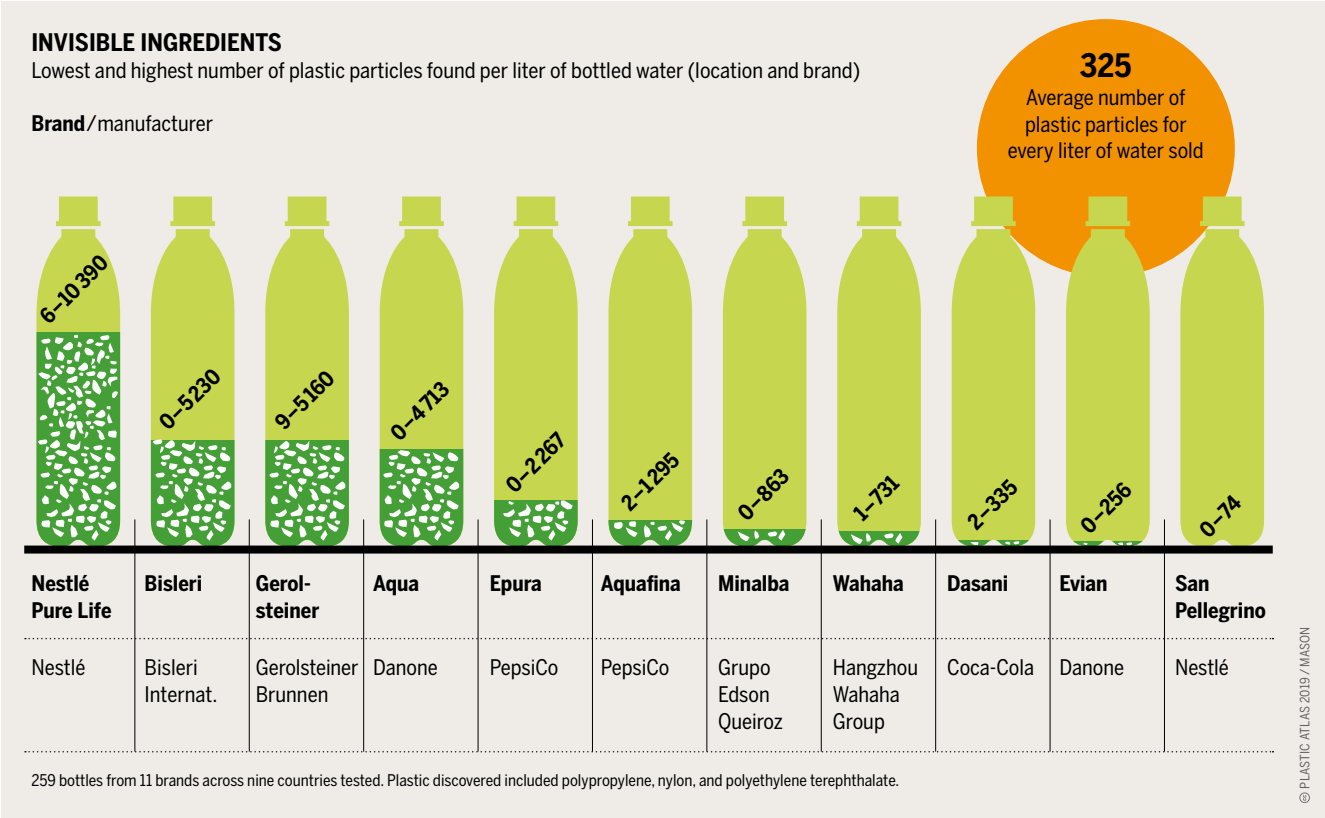
More and more people around the world now live in cities and alone. And middle-class eating habits are changing. These trends boost the market share of supermarkets as well as that of the packaging industry. The amount of packaging used in the food industry has been rising for years. Grand View Research, a US organization, estimated the market value of the food-packaging industry at $277.9 billion in 2017—with a forecast growth of over 5 percent for 2018. Trends in Europe are very similar: in 2018, the industry used over 1.13 trillion items of packaging. The most common type of packaging was, of course, plastic. An analysis by the Institute for European Environmental Policy supports these findings: most plastic trash in the oceans is discarded food packaging.

But packaging is not the only culprit. Agriculture is the sixth-largest user of plastics in Europe: worldwide it uses some 6.5 million tonnes of the material each year. Fruit and vegetable production seems unimaginable without plastic: irrigation systems, greenhouses and polytunnels are all made of it. Plastic nets keep birds out of fruit trees and bushes. Entire fields are covered with sheeting to warm up the soil and extend the growing season—for example by allowing asparagus to be harvested earlier.

The debate is only just beginning over microplastics in the soil, in livestock and in our food. Relatively little research has been done on the damage caused to the soil by plastics and microplastics. Scientists at the Free University of Berlin

How much plastic ends up in the soil is little researched. But soil contamination is thought to be between four and 23 times higher than in the sea.





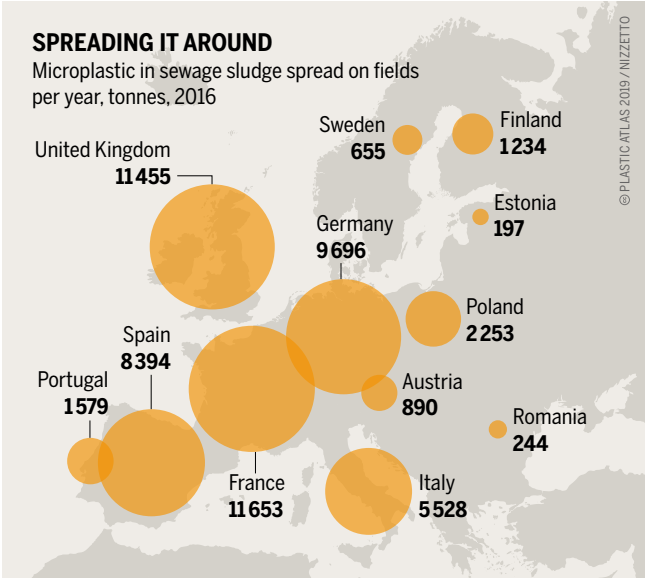
Bottled water is marketed as a healthy alternative to tapwater. Bottlers have to list the mineral contents in detail. Microplastic does not appear as an ingredient.

and the Leibniz Institute for Freshwater Ecology and Inland Fisheries, both in Germany, think that research on microplastics in the oceans is about a decade ahead of similar research on the soil. According to estimates, of the 400 million tonnes of plastic produced each year, about one-third ends up in one form or another in the soil or inland waters. Depending on the situation, that would make the contamination of the soil between four and 23 times higher than that in the sea. Microplastics change the structure of the soil as well as the habitat of living organisms that are important for maintaining soil fertility—from microorganisms to earthworms. In addition, microplastics act as a magnet that attracts certain types of toxic substances.

Worldwide, several hundred thousand tonnes of microplastics are spread on the soil through the application of sewage sludge as fertilizer. The sludge comes from treating wastewater from industry and urban areas. In Germany, treatment plants filter out nine-tenths of the plastic particles from the wastewater, leaving them in the sludge. One-third of the municipal sludge is used as fertilizer on fields: up to five tonnes per hectare over a period of three years. The wind may pick up these plastic particles and carry them far and wide. They have been detected in remote parts of the Alps: probably carried there by the wind.

The possible effects of microplastics on the human body are still largely unresearched. But it is known that plastics can get into the body when we eat and drink. A study by the University of Newcastle in Australia in 2019 estimates that people may ingest up to 5 grams of plastic every week—about the weight of a credit card. Another study, from Canada, found that people who drink water from plastic bottles wash something like 130,000 microplastic particles down their throats every year. With water from the tap it is just 4,000 particles. Those are worrying numbers. But they say nothing about what the health consequences might be. It is not known if ingested plastics can get into the bloodstream and thus into the internal organs. It is quite possible that they leave the body again through the digestive tract.

Microplastic particles that sewage-treatment plants cannot separate out are sprayed onto fields with the residual sludge commonly used as a fertilizer.



WEARING THIN

At first sight, fabrics made from synthetic fibers have many advantages. They are cheap, dry quickly, and shape themselves to the body. But they have become disposable articles and contribute significantly to climate change. They may also be harmful to human health.

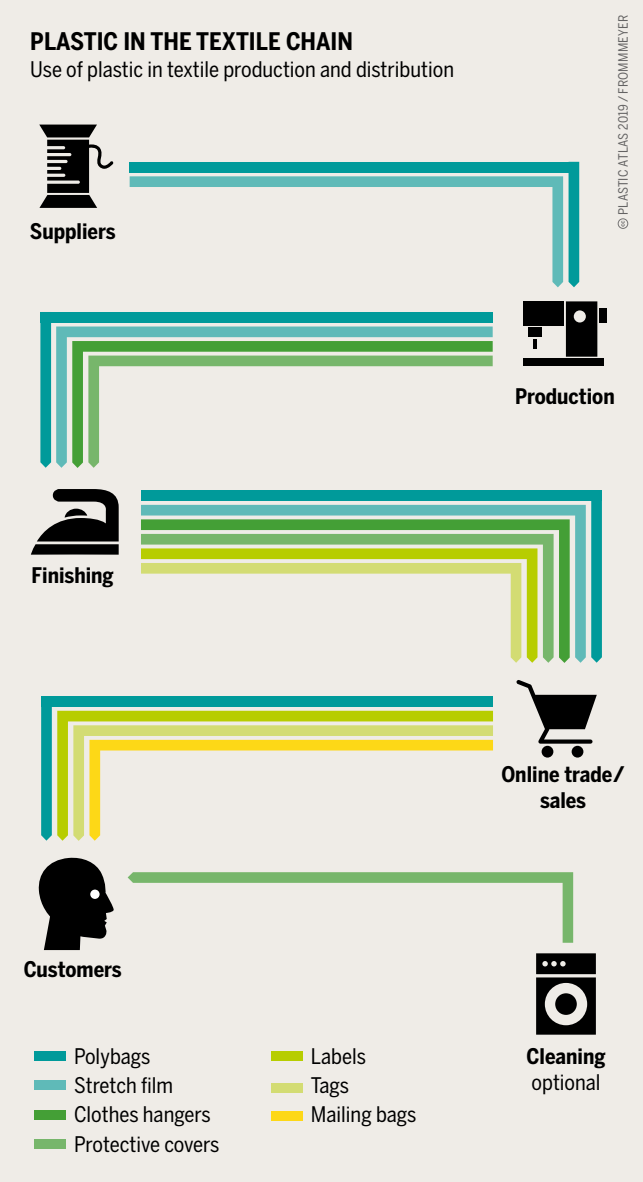
Many of the garments we wear every day are made in part or entirely out of polymers. Consumers often do not know that terms like polyamide, polyester, acrylic and nylon actually refer to synthetic fibers—in other words, plastics. Such materials are popular among producers and consumers alike. They are elastic and dry quickly. They feel soft to the touch and weigh less than comparable clothes made from natural fibers such as cotton.

The polymers that are used to make chemical fibers fall into two categories. Those based on cellulose, such as rayon, are usually made from wood. Synthetic polymers, such as polyester, undergo several production steps, but ultimately they are made from crude oil or natural gas. In 2017, around 70 percent of all fibers produced globally were synthesized chemically. At 80 percent, polyester accounts for by far the biggest proportion of synthetic fibers, and production is rising steadily. In 2017, some 53.7 million tonnes were sold. About 94 percent of the material is produced and processed in Asia, mainly in China. About half of the polyester fibers produced go into clothing. Textiles—including industrial textiles, make up 15 percent of the world's annual output of plastics.

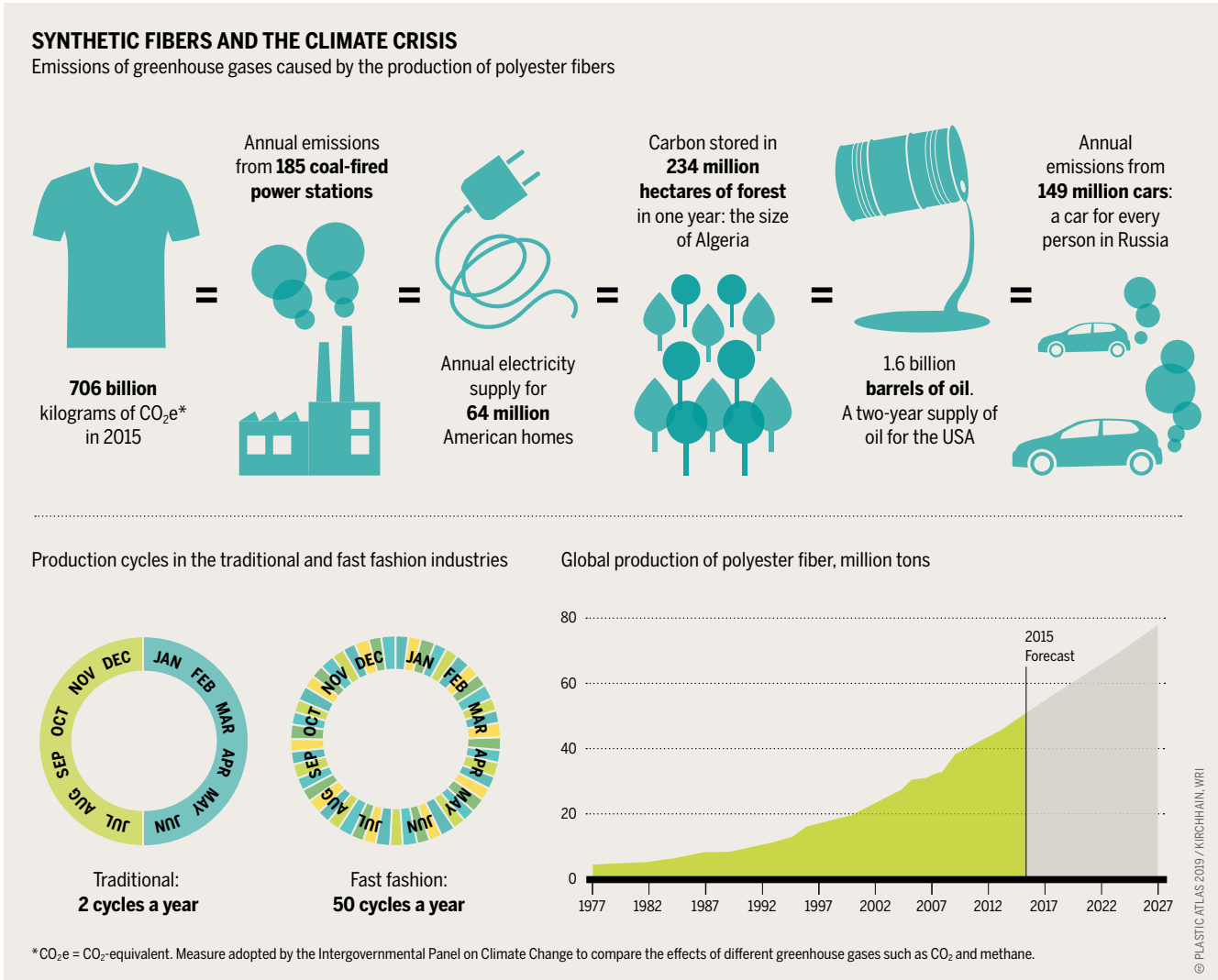
The textile industry is a major polluter of groundwater, rivers and the sea. Between 20,000 and 40,000 different chemicals are used to process and dye clothing. Many of them are carcinogenic, alter the genetic code, and impair reproductive ability. They may also cause allergies and influence the hormone system. Known harmful additives include formaldehyde, the so-called perfluorinated chemicals, fire-retardants, and dyes and other additives. Workers are exposed to such contaminants at numerous points along the value chain. These substances also harm the people who live near production plants and wastewater streams.

The consequences are far-reaching. Many workers in the textile industry—some 70 percent of them worldwide are women—suffer from work-related illnesses. A link between formaldehyde and deaths due to leukaemia has been proven. Women who work with synthetic fibers in textile factories have a high risk of contracting breast cancer. And textile workers in China who come into contact with these fibers have been found to have an increased risk of miscarriage.

Clothing made from synthetics continues to cause problems after the last button has been sewn on. When they are washed, microplastic particles enter the environment. Researchers have found that washing five kilograms of clothing can release six million microfibers into the wastewater; washing a single synthetic fleece jacket can set free 250,000 such particles. Little is known about the effects of these microplastics on human health. But it is particularly worrying that microplastics attract other contaminants like a magnet. These contaminants includes persistent organic compounds and other long-lived toxins that are especially harmful to health. These compounds attach themselves to the microplastics and enter the food chain. They have already been detected in salt, fish, mussels and even in human faeces. Sewage treatment plants and washing machines are not yet able to filter out the offending microfibers.



Plastics are used in the textile industry not just in the production process, but also to protect items during distribution and marketing.



The textile sector has less obvious effects on the climate than the car industry. But producing polyester generates a broad plume of greenhouse gases.

Consumers must bear part of the responsibility. Even though the clothing could still be worn, 64 percent lands in the garbage. In the European Union, 80 percent ends up either in a waste incinerator or in a landfill. Of the remaining garments, just 10 to 12 percent are resold locally. The remainder is exported to developing countries, where it undercuts local clothing producers and destroys their markets. Textiles that end up in the sea float at a greater depth than other plastic products and can interfere with marine life there.

One cause of these problems is the "fast fashion" industry. Companies flood the market with huge amounts of cheaply produced clothing. In the USA in the last 20 years, the volume of clothing that is thrown away each year has doubled from 7 to 14 million tonnes. That means the fast fashion industry contributes in a big way both to environmental pollution and to health risks. Outdoor culture, which demands clothing that is as functional as possible, also fuels the production of synthetic fibers.

The recycling of clothing is gathering pace, but it makes little difference to the underlying problem. The global consumption of recycled polyester rose by 58 percent between 2015 and 2016. But to make large-scale recycling feasible, different types of fibers should not be mixed. Separating blended fibers during recycling is very costly. Along with the need to produce fabrics that are suitable for recycling, a comprehensive system to return used clothing is needed—one that does not yet exist in many countries. But this still remains a superficial, temporary solution. Recycling makes it possible to use synthetic fibers for a longer time, but their quality deteriorates with each cycle, and in the end they still land in the trash.

A more sustainable mode of consumption is unavoidable if we really want to reduce the environmental and health risks. Buying clothing in second-hand shops and swapping garments with other people are good ways to slow down the production of new clothes. Producers cannot currently meet the demand for clothing using fibers from sustainable sources, such as organically grown cotton. Organically based textiles exist, and new approaches are being developed to transform natural materials, such as crustacean shells, trees, hemp, nettles and flax—ideally from local sources—into fibers suitable for making textiles. But these processes too must be checked for their effects on the environment, health and society. Potential pitfalls that must be avoided include monocultures, the use of chemicals that are harmful to the health or the environment, and unsustainable forestry practices.

TURNING THE TIDE ON THE TIDE OF TRASH?

Sun-kissed beaches, swaying palm trees… and a knee-deep carpet of garbage at the water's edge. Tourists come to see pristine beauty, but help destroy it through their carelessness, and because waste systems cannot cope.

Pictures of plastic floating in the sea and washed up on beaches have become common in the media over recent years. Millions of tonnes of plastic items enter the ocean every year: carried there by rivers, discharged by drains, dumped or lost from ships, or carried away from the shore by the waves. The high-tide lines of beaches around the world are now marked by a tangled mess of plastics, putting off tourists and damaging the brand images of iconic locations such as the Caribbean islands and Bali.

The tourism industry is having to take note—and in a few places it is beginning to live up to its responsibilities. Eighty percent of all tourism takes place in coastal areas, putting a special burden on seaside locations that cannot cope with the sheer numbers of visitors they welcome each year. Tourist sites are faced with substantial costs of the clean-up necessary to maintain the attractiveness of their shorelines.

The damage caused by plastic pollution of the oceans is huge: one estimate from the United Nations Environment Programme puts it at $13 billion a year. Some of these costs are borne by certain industries and coastal communities directly, in the form of clean-up costs and litter removal. Other costs come in the form of lost revenues from fishing and tourism. The costs are hard to quantify because of a lack of research and data. Plus, it is inherently difficult to put a monetary value on things like the impact of invasive species that live on plastic debris that drifts along with the ocean currents.

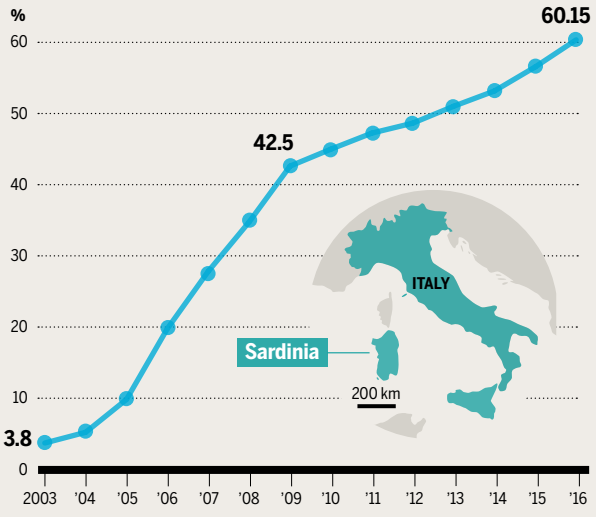
Tourism is not just an innocent victim of plastic pollution. It is also a major cause of it. Tourism expands the environmental footprint of travellers. The journey to an exotic destination—most often by car or plane—generates carbon emissions. And tourists are much more likely to consume single-use plastics and packaging than they normally do. Catering services in airports, on board planes and trains, and at gasoline stations, solve their supply-chain constraints by distributing food and drinks in single-use packaging or plastic bottles.

When they arrive at their destination, tourists are faced with unfamiliar products and situations. They are more likely to buy packaged food, and they may not know how to use the local recycling service (if indeed such a thing exists). Many tourist destinations lack the facilities required to collect and handle the growing mounds of waste generated by the large numbers of visitors they receive. Too many tourists carelessly toss away litter in a way they would not do at home. The amount of plastic litter going into the Mediterranean rises by 40 percent during the summer months, demonstrating a direct link between the tourist industry and plastic pollution.

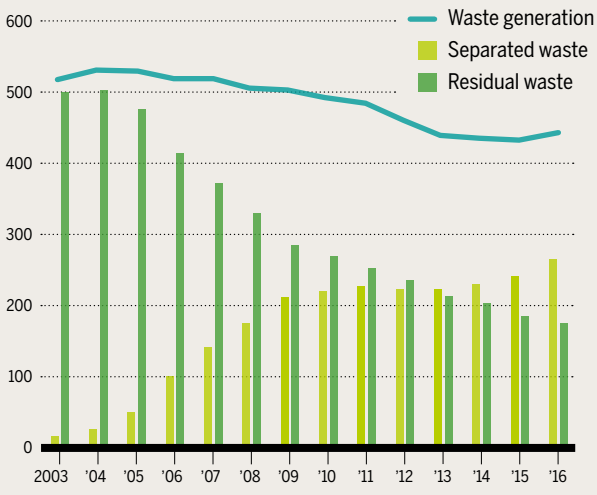
In the early 2000s, Sardinians separated little of their waste. Public awareness and waste-collection practices have since changed radically.

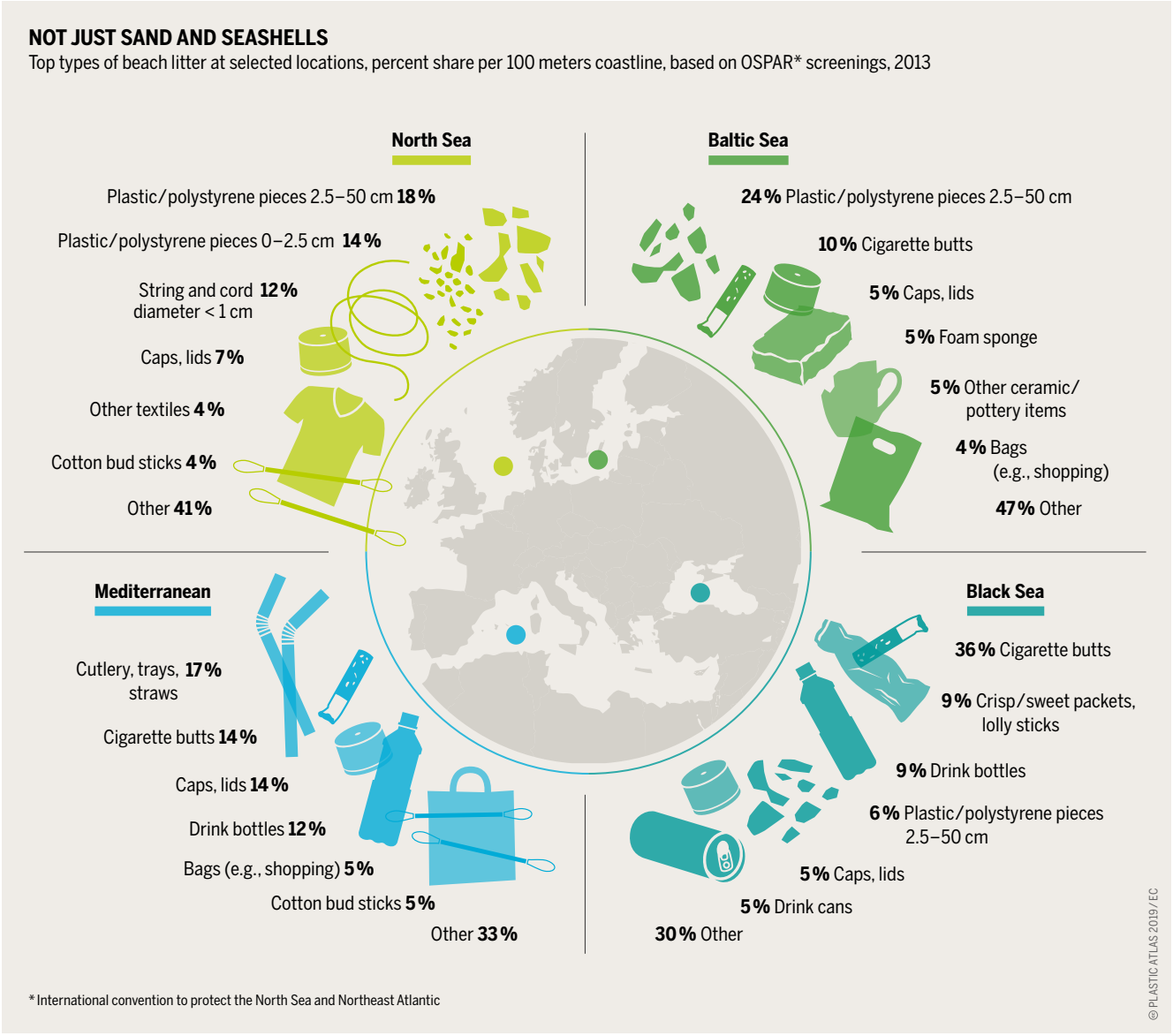
LESS TRASH IN THE TYRRHENIAN SEA

Separate waste collection in Sardinia, in percent



Changes in waste generation and disposal, in kilograms/inhabitant/year





Plastic bottles, straws and bags are easy to spot. But the trash on beaches also includes less-visible garbage such as cigarette butts or cotton bud sticks.

The average airline passenger generates 1.4 kilograms of waste per flight, according to the International Air Transport Association. In 2017, that resulted in 5.7 million tonnes of passenger waste. The waste bags that are collected by flight attendants and cleaning crews contain a mix of garbage that the planes offload at their destinations. Waste-management systems differ at each location, so little of this airborne trash is ever recycled.

Over the years, as planes have turned into highly optimized environments, plastic has become the material of choice: hygiene regulations require serviceware and food to be packaged, further stimulating the use of cheap plastic items. Reducing weight is important for airlines because it cuts fuel consumption, costs and carbon emissions, so lightweight plastic usually wins out against more environmentally friendly but heavier alternatives.

A few airlines are formulating an alternative vision and are taking the first steps towards plastic-free flights. They are switching to compostable or reusable trays, tableware, cutlery and packaging made of paper, bamboo or wood.

Elsewhere in the travel industry, TUI Group the largest leisure, travel and tourism company in the world, promised in 2018 to remove 250 million pieces of single-use plastic by 2020 from their hotels, cruise ships, airlines, destinations and offices.

Seasonality is a major challenge for tourist cities, resorts and organizations. Waves and tides wash in plastic waste from the ocean all year long, but garbage-management measures and infrastructure have to cope, especially in the high season, when tourist numbers and waste generation are highest.

The Italian island of Sardinia has shown how to turn the tide on waste production and disposal locally. In 2003, only 3.8 percent of the waste was segregated by type. This is now over 60 percent, and on track to reach the target of 80 percent by 2022. This has been possible because waste is collected separately, door-to-door, rather than from central collection points, as is common elsewhere in Italy. The tax on disposal has been increased, and municipalities have been given economic incentives to reach staged targets, with rewards and penalties for cities and towns according to their waste-management achievements.

NOT GREEN, BUT GREENHOUSE

Plastics are sometimes seen as environmentally friendlier than other materials—not least because of their light weight. But the plastics boom is pumping huge amounts of greenhouse gases into the atmosphere.

Making, using and disposing of plastic have serious effects on marine ecosystems, coastal environments and human health. While their impact on the climate is less well-known, it is just as significant.

In the 2015 Paris Climate Agreement, nations committed to limit global warming to well below 2 degrees Celsius—and to pursue efforts to keep the temperature rise below 1.5 degrees. In 2018, the Intergovernmental Panel on Climate Change concluded that to keep warming below the 1.5 degree limit, we must cut global greenhouse gas emissions by 45 percent by 2030, and we must reach zero net emissions no later than 2050.

In climate policy, attention is largely focused on the transition to renewable energy and cleaner transport. But industry is also important: it accounted for 30 percent of global greenhouse-gas emissions in 2010. The production of plastics is one of the largest and fastest-growing contributors to these emissions. Plastics, along with many fertilizers, pesticides and synthetic fibers, are petrochemicals, derived from mineral oil and natural gas. More than 99 percent of plastics come from such fossil-fuel feedstocks. Petrochemicals are the fastest-growing form of oil consumption globally; the International Energy Agency forecasts that they will account for half of the extra demand for oil by 2050. In the United States and elsewhere, plastics and other petrochemicals form a large and rapidly growing destination for fracked gas.

As plastic production grows, it will lock in new fossil-fuel infrastructure and increase emissions that arise from the exploration, extraction, transport and refining of oil, gas, and coal. Global production of plastics has increased from 2 million tonnes in 1950 to 400 million tonnes in 2015. The production and use of plastics have nearly doubled in the last 20 years; they are expected to double again over the next 20, and quadruple by the early 2050s.

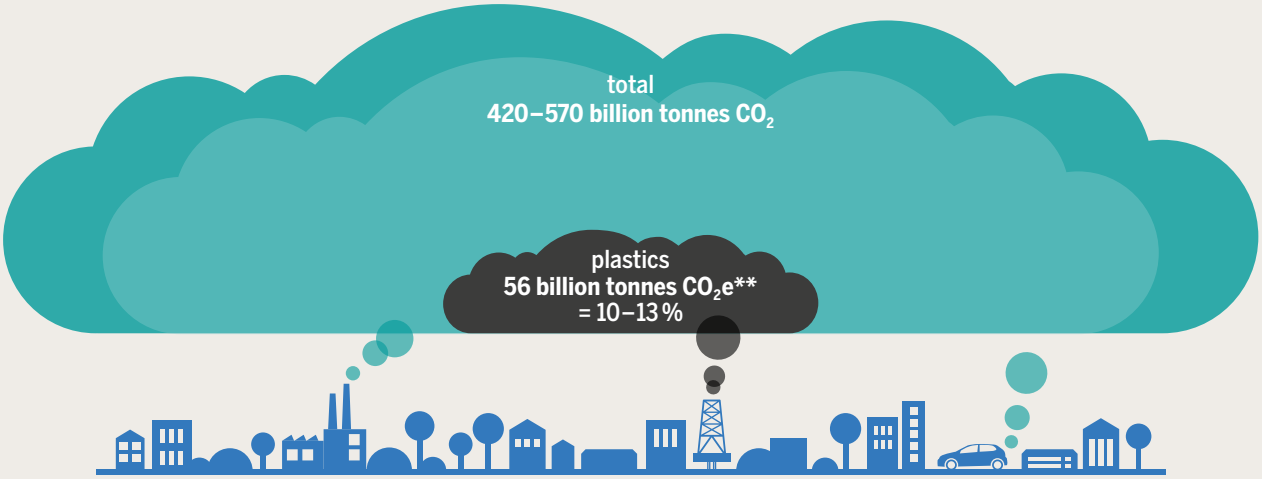
Carbon dioxide, methane and an array of other greenhouse gases are released at each stage of the plastics life cycle—from the extraction and refining of fossil fuels, to the energy-intensive processes that produce plastic resins, to the disposal, incineration, and potential environmental release of waste plastics. This has big implications for efforts to meet global climate goals. To avoid overshooting the 1.5 degree target, total emissions must stay below the remaining (and quickly declining) budget of 420–570 billion tonnes of carbon dioxide.

The non-profit Center for International Environmental Law estimates that at current and projected rates of growth, the production of plastics alone could generate 53.5 billion tonnes of carbon dioxide emissions by 2050. Adding the incineration of waste plastics pushes this total up to nearly 56 billion tonnes. In other words, plastics alone could consume between 10 and 13 percent of the earth's remaining carbon budget for staying below 1.5 degrees. Even assuming plastic production grows much more slowly after 2050, and

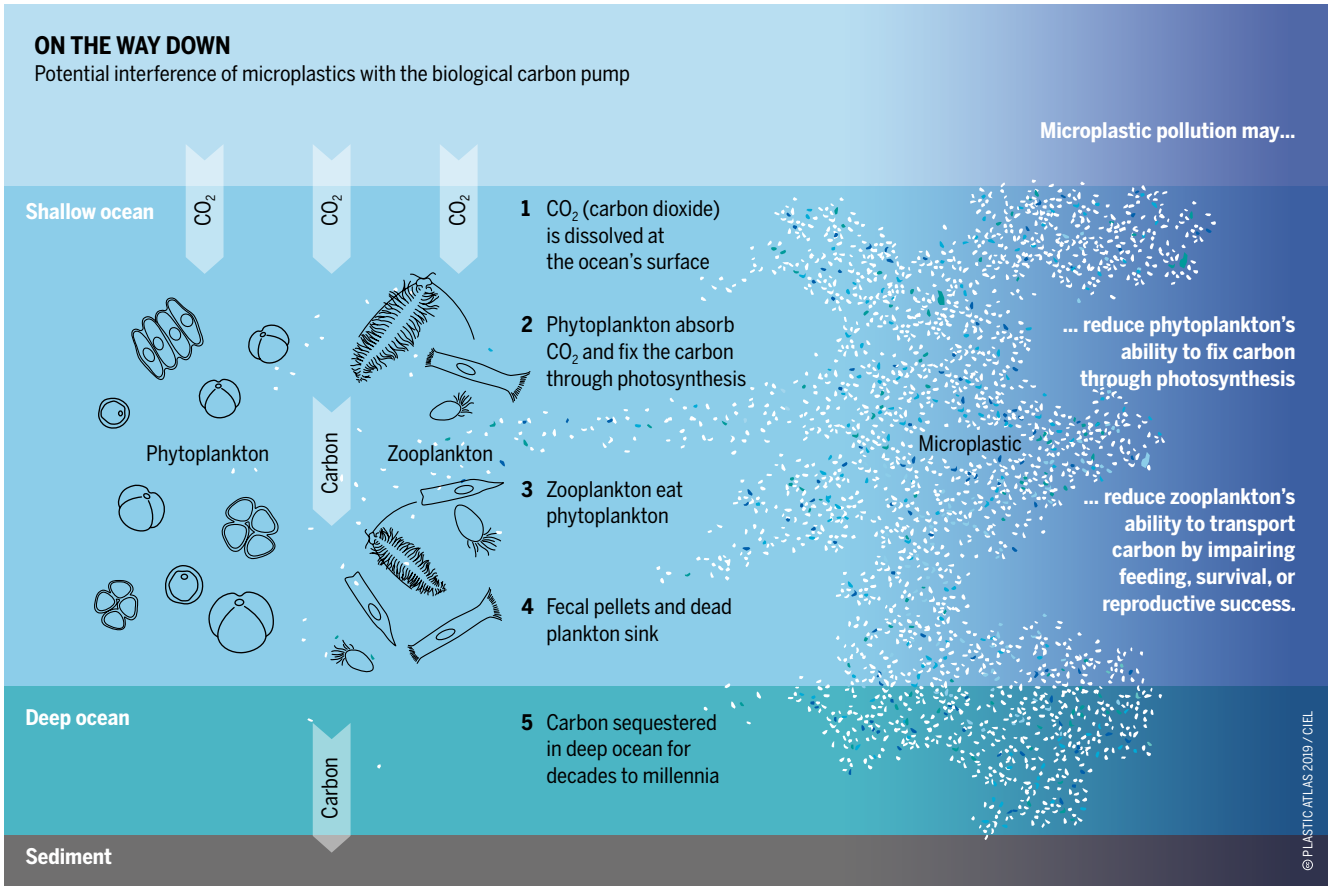
Transport, energy and farming are the three sectors most often blamed for climate change. The emissions caused by plastics production are often forgotten.

THE THREAT TO THE WORLD'S CLIMATE POSED BY PLASTIC

Projected share of CO_2 emissions from global plastic production, maximum budget to meet **1.5 degree warming target*** by 2050



* In 2015, the international community agreed to limit global warming to well below 2 degrees Celsius and to pursue 1.5 degrees Celsius compared with the pre-industrial times.
** CO_2 equivalents: unit of measurement for standardizing the climate impact of different greenhouse gases.



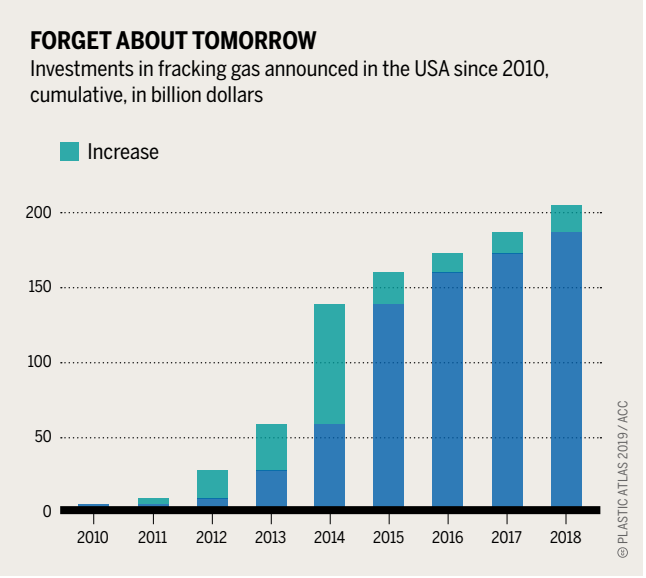
The oceans absorb a quarter of anthropogenic greenhouse emissions. Pollution by microplastics may put the biological carbon pump at risk. More research is needed.

incineration does not grow at all, emissions from plastic production and incineration could total nearly 260 billion tonnes of CO_2 equivalent by the end of the century, potentially consuming over half the available carbon budget.

But these figures may still underestimate the total climate impact of plastics. We know little about some aspects of the extraction, transport, and refining of fossil feedstocks for plastics. In North America, for example, official estimates of emissions from natural gas production routinely exclude the effects of forest clearance and other land disturbance needed for new drillpads and pipelines. Gas pipelines and facilities can leak substantial quantities of methane, a potent greenhouse gas—but government and industry estimates of the number of these facilities differ by orders of magnitude.

Emissions from plastics do not end when they are thrown away. Waste-to-energy projects that incinerate plastics are increasingly being proposed as a solution to plastic pollution. Because incineration emits a lot of greenhouse gases, the widespread deployment of waste-to-energy could lead to a big rise in emissions. The research group Material Economics projects that in Europe, incineration for waste-to-energy could make plastics a major source of emissions. And waste plastic continues to release greenhouse gases as it degrades in the environment. The true scale of these emissions is unknown.

The effect on emissions may also be indirect. Growing levels of microplastic debris in the oceans may interfere with the biological processes through which plankton capture carbon dioxide at the sea surface and sequester carbon in the deep oceans. The biological carbon pump is part of the oceanic carbon sink, contributing to the earth's climate balance. The mechanisms and extent to which microplastics may be interfering with that balance are of great importance, but remain poorly understood. More research on these mechanisms and interactions is required.



Cheap fracked gas from the United States is flooding the market and fueling the plastic crisis around the world.

ALL AT SEA?

Marine pollution is fed mainly by trash floating down rivers, like smog is fed by fires and smokestacks. But plastic does not stay long in the open ocean. It moves into shallower waters, sinks to the sea floor, or is washed ashore.

Every year, some 10 million tonnes of plastic waste enter the oceans from land: equivalent to a truckload every minute. Plastics that end up in the sea tend to concentrate in five enormous gyres: in the north and south Pacific, the north and south Atlantic, and the Indian Ocean. The gyre in the North Pacific, popularly known as the "Great Pacific Garbage Patch", is the most famous.

But contrary to common perceptions, these are not areas of consolidated plastic waste: rather they are merely where the concentration of waste is highest. In reality, microplastics are widely distributed in all aquatic environments worldwide: they form a plastic smog, like air pollution over large cities. We can think of rivers as horizontal smokestacks that release plastics into the global ocean. Even in the most remote areas, in the deep ocean or in the Arctic, plastic now drifts along or litters the shoreline. The levels of pollution are growing rapidly: within a decade, the amount of litter in the deep sea of the Arctic Ocean has risen twenty-fold. On the sea surface, between 15 and 52 trillion plastic particles weighing 93,000 to 236,000 tonnes are floating.

The Mediterranean has similar levels of plastics to the five great oceanic gyres. With less than one percent of the world's sea surface, the Mediterranean is home to around seven percent of its microplastics. Surrounded by land, it exchanges only a limited amount of water—and plastic—with the world ocean, allowing trash levels to build up. In other seas too, high concentrations of plastic are to be found. On every square kilometer of the seabed of the North Sea 11 kilograms of marine litter can be found.

Marine trash comes from various sources. In the Mediterranean, most comes from poor waste management and single-use plastics used in coastal settlements. In the North Sea, much waste comes from fishing, the marine industry and shipping. The Baltic suffers mainly from tourist waste. The composition of the waste depends on how the particular sea is used and the types of settlements along its coast.

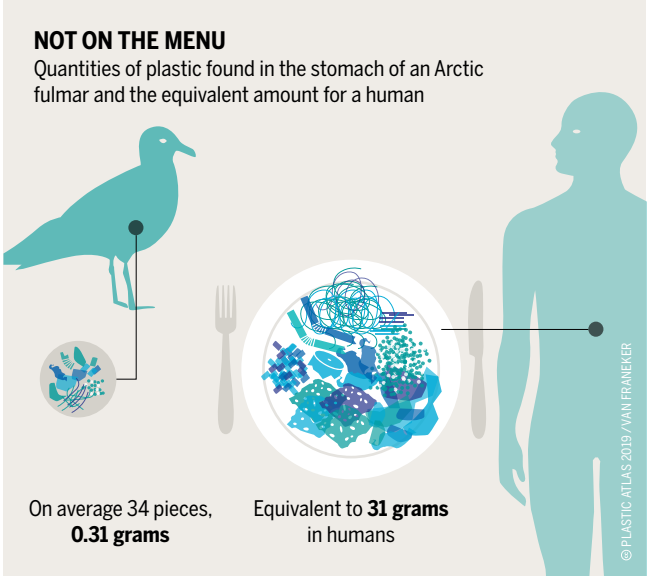
Maritime activities such as aquaculture, fishing and shipping are the source of some floating plastic. Some comes from the land: trash from beaches, microplastics carried by the wind. But the most is carried down to the sea by rivers. Estimating how much is difficult because of a lack of data. Estimates vary widely: from a low of 0.41 million to as many as 12.7 million tonnes a year. Ten major rivers, eight of them in Asia, are thought to be the source of the vast majority of this waste—part of which is trash exported by the US and Europe. But rivers elsewhere also carry significant quantities: the Rhine, for example, has an average microplastic load of 893,000 particles per square kilometer.

Evidence suggests that plastic does not stay afloat for long. Currents, biological interactions and degradation mean that it gradually moves elsewhere: into shallower water, down to the sea floor, and onto the shore. Of all the plastic entering the ocean since the 1950s, 98.8 percent is no longer on the surface: most has fragmented and sunk.

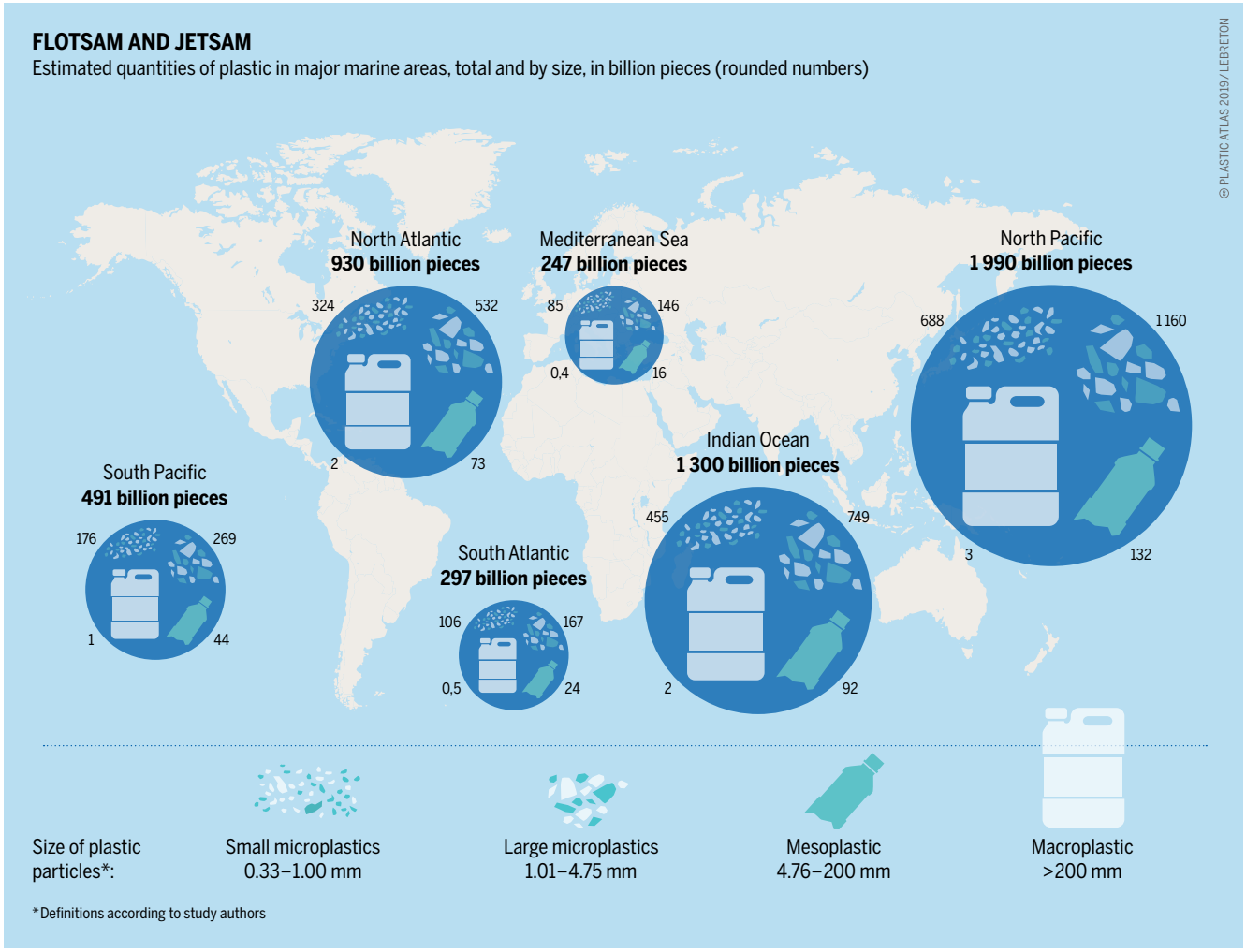
Chemical processes, mechanical abrasion and photodegradation through sunlight and ultraviolet light gradually degrade plastic floating at or near the surface, breaking it up into smaller and smaller pieces. But there is much less small microplastic (i.e. particles up to 1 mm in diameter; in general microplastics are defined as particles smaller than 5mm) than expected: it appears that such particles do not stay in the surface layer but are transported elsewhere. Some are washed ashore. Most sink: they lose buoyancy as they degrade, colonization by marine organisms makes them heavier, or they are eaten by marine life and then excreted in feces. Fishes that live between 200 and 1000 meter deep in the North Pacific eat an estimated 12,000–24,000 tonnes per year. Seabirds consume perhaps 100 tonnes a year.

While the plastic pieces become smaller and smaller, they are unlikely to disappear completely. A recent study on marine microbial assemblages on microplastics found that bacteria cannot decompose plastic, and that they are unlikely to acquire this ability through evolution.

Like the ocean surface, rivers are not the final resting place of plastics. A study of riverbed sediments in northwest England found up to 517,000 microplastics particles per square meter. But after seasonal rains, around 70 percent



As they hunt, many birds cannot distinguish between a fish and a glistening piece of plastic floating in the water.



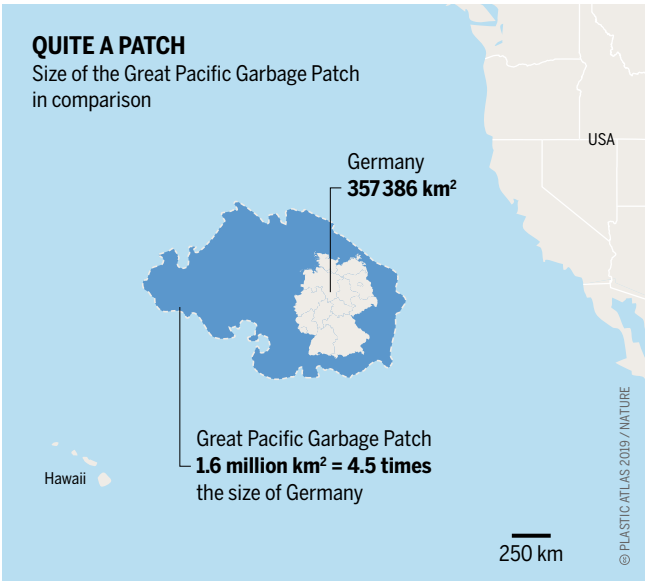
Only a small share of plastic trash stays on the sea surface. The vast majority is either washed ashore or sinks: out of sight, out of mind.

had been removed: flooding had flushed them downstream. Another study found that microplastics in rivers harbor a distinct set of bacteria, helping transport them downstream—and out to sea.

Fish and birds are directly exposed to the dangers of floating plastic: they get entangled in it or mistake it for food. Packaging, especially rings and strings, are particularly hazardous. Worldwide, at least 2,249 different marine organisms interact with plastic trash in some way. Many are harmed and have become endangered. Of the 120 species of marine mammals on IUCN's Red List of Endangered Species, 54 are known to eat plastic garbage or get caught up in it.

On Heligoland, an island in the North Sea, 97 percent of nests in the Northern gannet colony contained plastics, and one in every three injured or dead gannets found there is tangled in plastic. Another example: Arctic fulmars are a good indicator of plastic pollution in the ocean because outside the breeding season they live solely at sea, where they feed at and close to the sea surface. They mistake plastics for food. 95 percent of fulmars found dead on North Sea beaches have plastic in their stomachs. The birds starve to death on a full stomach: their gastrointestinal tracts blocked, injured or inflamed.

Toxic substances such as PCB and DDT accumulate on the floating plastic. Animals ingest not only the harmful substances in the plastic itself, but also high concentrations of these other toxic compounds.



The Great Pacific Garbage Patch floats off the coast of California. Here, currents bring together different types of plastic trash from across the world.

BLAMING THE CONSUMER

Masters in lobbying, petrochemicals firms and plastic producers focus attention on waste management and recycling so they can evade their responsibility for the true problem: the growth in the volume of plastics being made.

Plastics are the downstream end of the vast petrochemicals industry, which is dominated by a handful of giant corporations. More than half of all plastics go into consumer products, mainly in the form of single-use packaging. While analyses of plastic waste in the ocean or elsewhere tend to focus on countries as the source, only a few dozen food and consumer-goods corporations are the sources of almost all the "litter". Even fewer multinationals dominate the production of plastic resins, making the polymers that go into plastics.

As early as the 1950s, chemicals corporations like Dow, and petroleum producers like Esso (now ExxonMobil) held discussions, internally and publicly, sometimes with government representatives present, about the growing plastic pollution crisis. Yet those same corporations strongly resist efforts to limit plastic output and the damage it causes. They often push a dual strategy of lobbying and high-profile advertising of "litter" being a problem of consumer behavior that can be solved by recycling alone, as with the popular "Keep America Beautiful" campaign.

Under-funded NGO advocates are dramatically outspent by industry interests. Corporations use their vast resources to ensure preferential regulations to maintain their profits and minimize any liabilities. The top plastics producers, based in just a few countries (USA, UK, Saudi Arabia, Switzerland, Germany, Italy, South Korea) with a production footprint in almost every country of the world, hire teams of lobbyists to influence policymakers. The industry also jointly funds hundreds of global, regional and national trade associations. The American Chemistry Council alone, which represents over 150 chemicals and plastics producers, has spent nearly $100 million on lobbying since 2009.

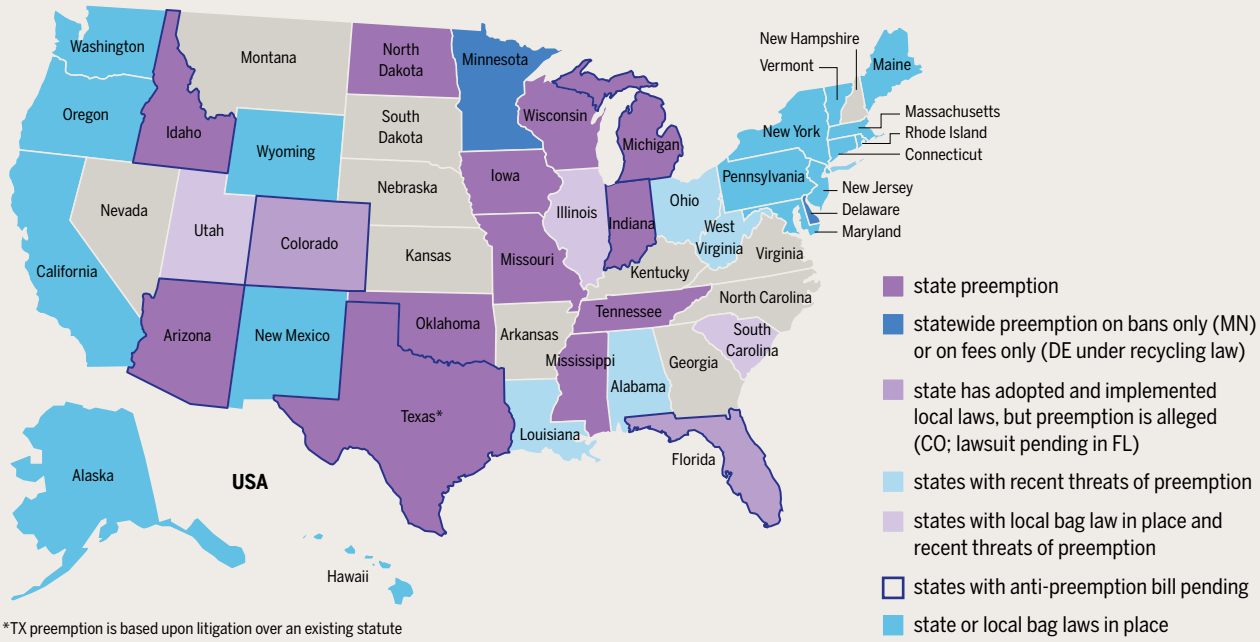
Fracking is a key driver of plastic production. In 2005, a US commission made up of regulators and oil industry lobbyists (with little public input) wrote legislation to exempt fracking from the Safe Drinking Water Act. In Louisiana, Texas and other states, fracking plants are exempt from billions of dollars in taxes. In 2017, the British petrochemicals firm Ineos, and its allies got the UK government to exempt it from fees intended to fund the shift away from fossil fuels. Rather than investing in clean energy, Ineos and its partners avoid more than £100 million in taxes. Lobbyist-authored rules and exemptions drive the production of plastics by enabling profit where it would not otherwise exist.

In the USA, an industry-funded playbook propagated by the conservative American Legislative Exchange Council, is eliminating the power of local authorities to restrict plastics,

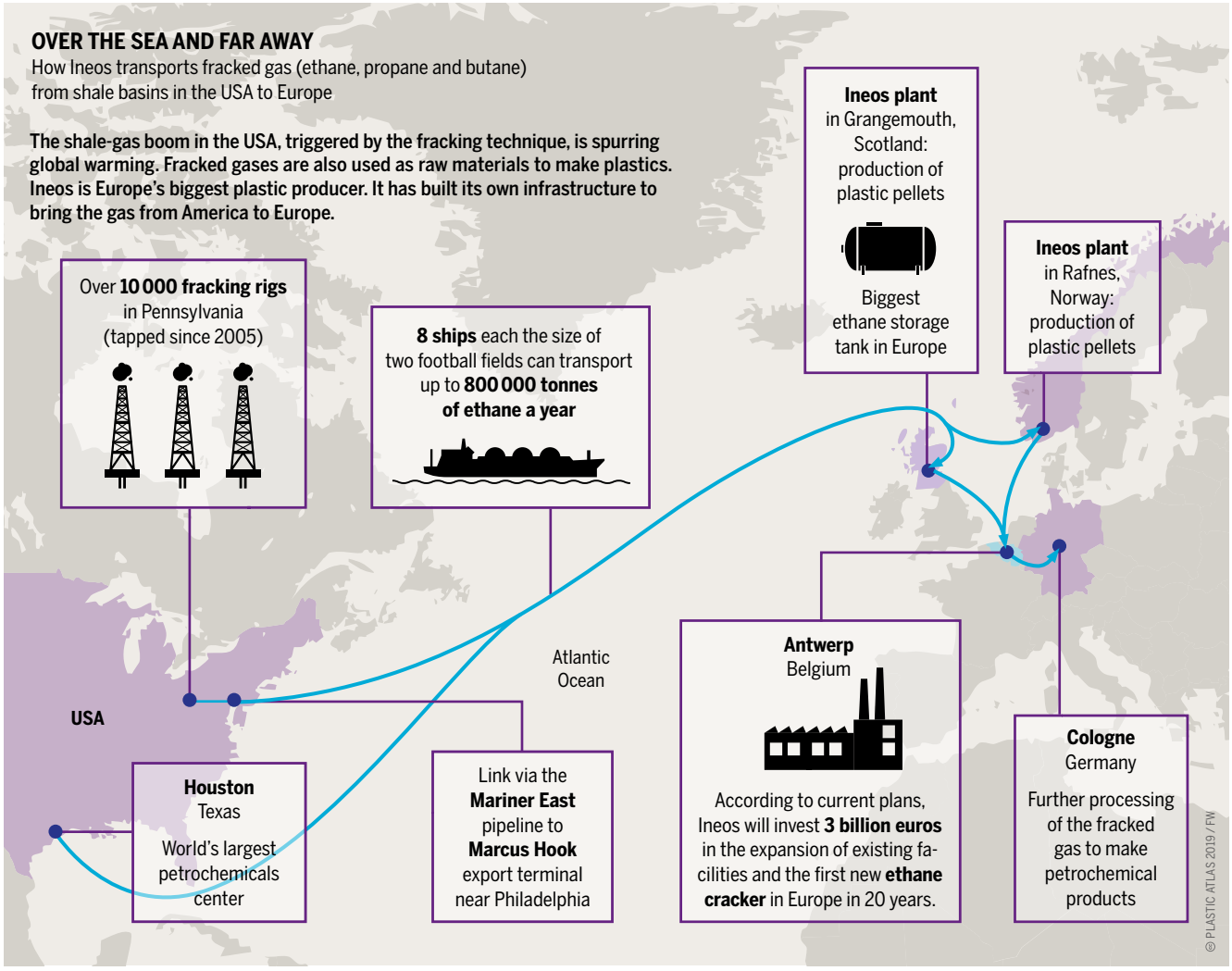
In the USA, progressive states and cities aim to restrict the use of plastic bags. Industry lobbyists are working with conservative states to prevent such initiatives.

THE BAG STOPS HERE

State-level preemption of local authority efforts to limit or ban the use of plastic bags



*TX preemption is based upon litigation over an existing statute



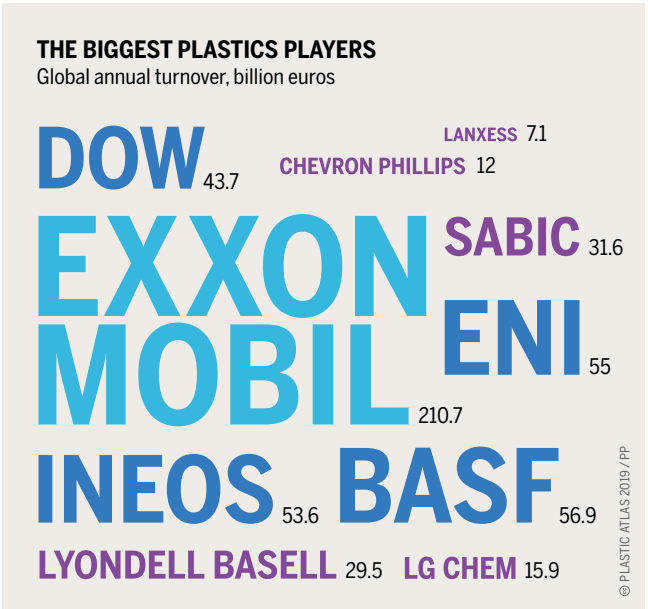
Ineos was founded in 1998 by the chemical engineer, Jim Ratcliffe, one of the richest men in Britain. He plans to expand plastics production in Europe.

for instance, by preventing them from banning plastic bags. Such moves undermine waste prevention and perpetuate the myth of better waste management as the solution.

Corporate lobbyists rotate between government and industry jobs, facilitating privileged communications between the two. In the process to publish the European Commission's Plastic Strategy in 2017, corporate representatives (including from PlasticsEurope, an industry association) had nearly three times as much access to members of the Commission as did NGOs.

Even the lines between NGOs and industry representatives are blurred. A two-pronged strategy has emerged: corporations make big donations to existing mission-driven NGOs, while simultaneously creating and funding organizations that are organized as NGOs but which exist primarily to drive industry interests. Leading up to the 2018 European Union plastics strategy, industry-funded NGOs served as a front to ensure industry interests were served.

This power imbalance results in regulations that favor the petrochemicals and plastics industries, and that devalue the rights of people and the environment. Industry lobbying leads to policies focused on recycling and consumer behavior (i.e., "avoiding litter"), and that ignore the need to reduce the production of plastics.



Just a few major corporations produce most of the world's plastics. Some are household names; others are far less well-known.

THE CHILD OF GLOBAL TRADE

Global economic growth since World War II would not have been possible without plastic. Plastics are both the result of globalization and a fuel that powers it. Online shopping is piling mounds of rubbish higher still.

After World War II, the Western world enjoyed unusually rapid growth by historical standards. The economy entered a golden age: productivity rose steadily, driven by increasing automation and the use of energy derived from fossil fuels. Large sections of the population were able to achieve a hitherto-unknown degree of prosperity. The average middle-class household soon had its own car, washing machine and television. Industry churned out consumer products in ever-increasing volumes at ever-lower prices.

Plastic played a key role in this. Technological advances in the petrochemicals industry made the production of plastics so cheap and flexible that they could be used for single-use items and as packaging, thereby making it possible to sell yet more items. For shoppers that meant consumption any time, anywhere, and simply disposing of the packaging. At the same time, supply chains became ever longer. Transporting goods over huge distances made new types of packaging necessary. Plastics were ready to smooth the way to this wonderful new world.

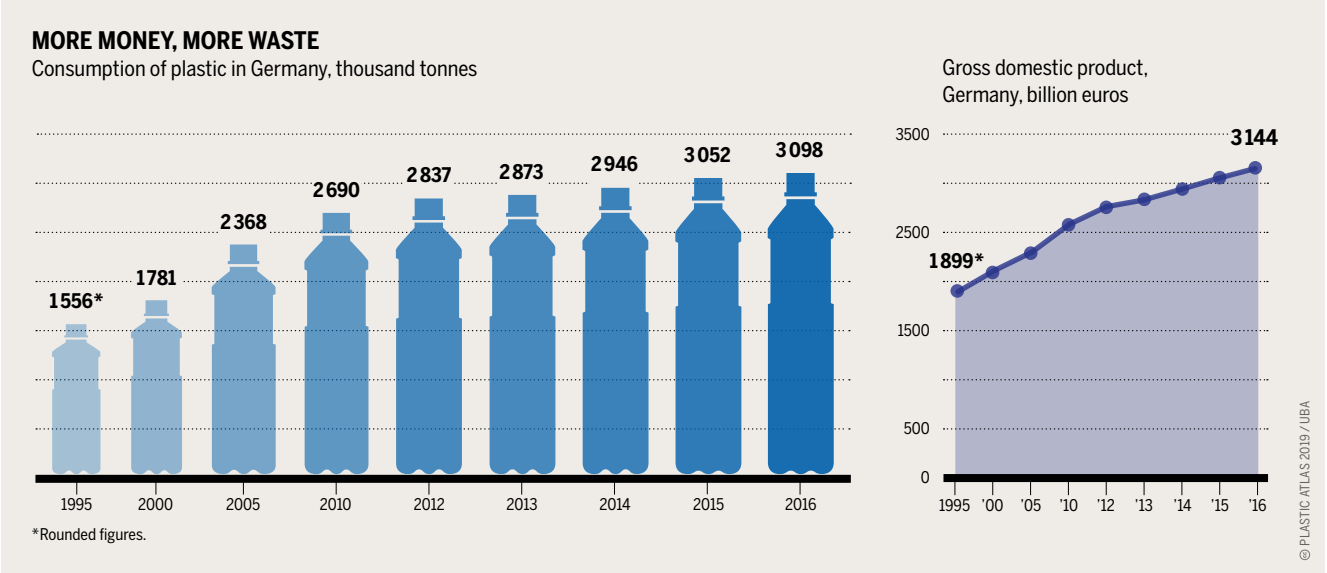
From the invention of Bakelite—the first modern plastic—in 1907, to today's multitude of synthetic compounds, plastics have become nearly indispensable. Companies like Dow Chemical and Mobil Corporation (now ExxonMobil) developed new products, thereby creating new markets for their oil and gas. Chemical giants turn the primary constituents of hydrocarbons into intermediate chemicals, and then into numerous polymers that they mold into a huge variety of end products.

Some materials and products are designed for a specific use; for others, new market applications must be created. This is how the oil and gas industry, threatened by the transition to green energy, is trying to diversify and strengthen its markets. That in turn creates a pressure to develop new materials: to transport food ever further, to offer more attractive packaging properties, or to maximize durability for a given weight. In this way the plastic industry has sunk strong roots into the product design and packaging sectors. Packaging is forecast to remain the most prominent use for plastics until at least 2025.

The massive expansion of single-use packaging is both a result of globalization and a driver of international trade. When a supply chain crosses the globe and the consumer is far away from where the product is made, returning reusable packaging to the production facility is costly and complicated. That is why in the 1960s companies such as Coca-Cola and PepsiCo lobbied against deposit laws that would have required them to take back their glass bottles. Things got worse with an oversupply of plastic feedstock. It was much more convenient and cost-effective to package products in single-use containers. That allowed brands to shed the cost and burden of reverse logistics and ignore any responsibility for what happened to the containers after their contents had been consumed.

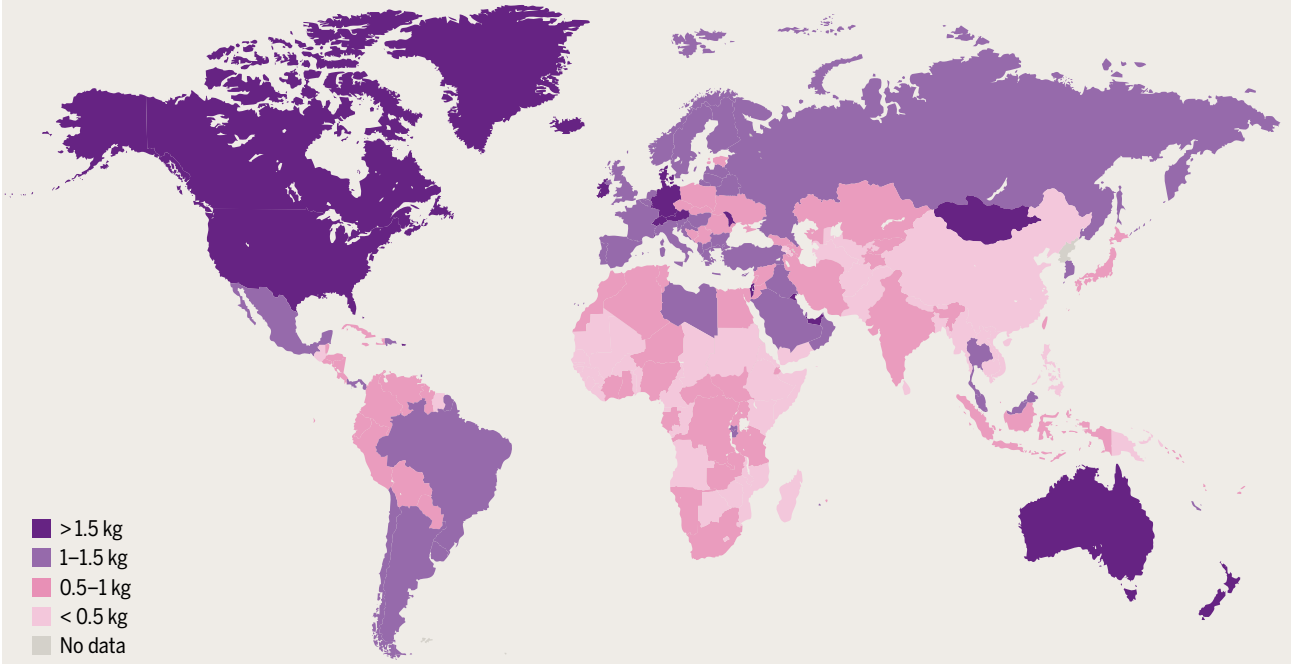
In the digital age, consumers have succumbed to this type of thinking. To save time and effort, more and more people are shopping online. Led by mega-players such as Amazon and Alibaba—today the most valuable companies in the USA and China—online retail has grabbed a significant share of consumer purchases, generating sales of hundreds

The tide of plastic is tied to the economy. Economic growth leads to greater consumption, which means more packaging that must be thrown away.



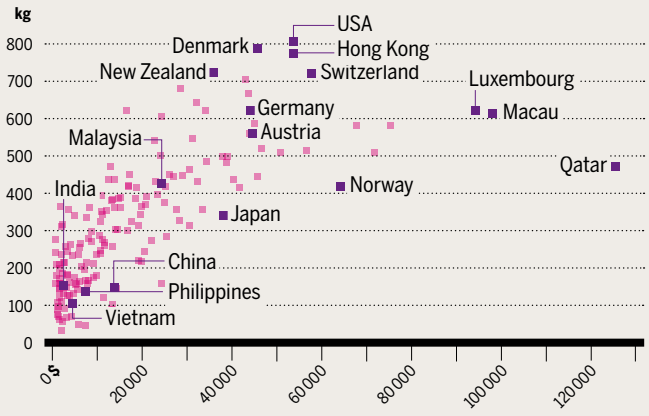
AFFLUENCE AND EFFLUENCE

Waste generation per person per day, 2016



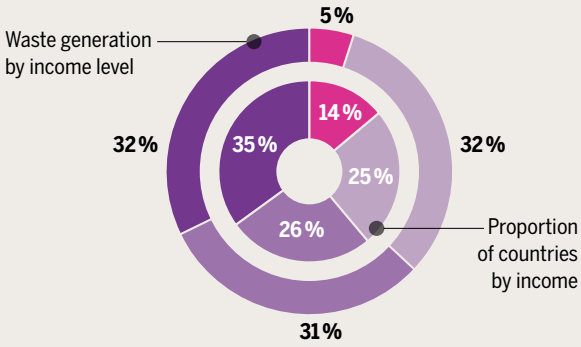
Waste generation and gross domestic product

Kilograms per person/year, GDP per person in US dollars, 2016



Relationship between waste generation and income level

All countries, 2016



Average income in US dollars per person/year by country

- 12 476 or more
- 4 036–12 475
- 1 026–4 035
- 1 025 or less

On average, each person on Earth generates 0.74 kilograms of waste each day. The amount increases with rising incomes.

of billions of dollars a year. With huge numbers of packages shipped, the environmental impact of producing and disposing of plastic and cardboard has become a major issue. Industry leaders are coming under increasing pressure to use reusable, recyclable or compostable materials. In 2017 in India, the plastic crisis led to a ban on certain single-use plastic articles.

Simply eliminating single-use plastic and packaging cannot be done without drastically changing how global markets operate. It has become clear that plastic recycling has no chance of coping with the scale of the environmental challenge. Single-use plastics continue to dominate, and plastic-free alternatives are restricted to a few niche markets. The stimulus is lacking for a true paradigm shift. Plastics are still both eminently practical and super-cheap.

Nonetheless, consumer habits have to change. The first signs of this are evident: sustainable packaging is playing an important role in local food and other items—a market that is growing slowly but steadily. A few years ago the first grocery stores opened that dispense with packaging completely: they sell items loose, and customers bring their own containers. Increasing numbers of takeaways are offering discounts for customers who bring their own cups. And bans targeted by the European Union on certain single-use plastic items are at least sending out a signal at an international level that things must change.

REPLACING OIL WITH MAIZE IS NO SOLUTION

Plastics made from renewable raw materials are supposed to be environmentally friendly. They degrade more quickly—at least, according to their corporate backers. A close look shows that they create a new set of problems.

Its biggest advantage is also its biggest drawback: plastic that is made to be very robust does indeed last almost forever. Depending on the type of material, it can take several hundred years for a plastic to break down naturally. Renewable raw materials are already being used as alternatives to petroleum as a plastic feedstock. The so-called “bioplastics” come with an implicit assurance: unlike conventional plastics, they biodegrade more quickly. But they fail to live up to this promise. Just because their name says “bio” does not mean that they are any more environmentally friendly.

“Bioplastics” come in two main types: bio-based and biodegradable. Bio-based plastics are nowadays commonly used instead of PET and PE in packaging. They are based on raw materials such as sugarcane, mainly cultivated in Brazil. This crop is grown as a monoculture with the considerable use of pesticides, which has massive consequences for nature and mankind. Some of the chemicals applied are banned in the European Union to protect the health of people and animals—and especially bees—from their toxic effects. Global price pressure and the dominance of a few firms in Brazil have led to low wages and poverty in the growing regions. The cultivation of genetically modified sugarcane has been permitted in Brazil since 2018.

Other agricultural commodities used as raw materials for “bioplastics,” such as maize and potatoes, are also products of highly industrialized farming. Large-scale industrial plants convert these agricultural commodities into the chemical building-blocks that are fed into a production process similar to conventional plastic production. Depending on the item, the renewables may account for between 20 and 100 percent of the end product. The rest consists of fossil raw materials, or increasingly of recycled ingredients.

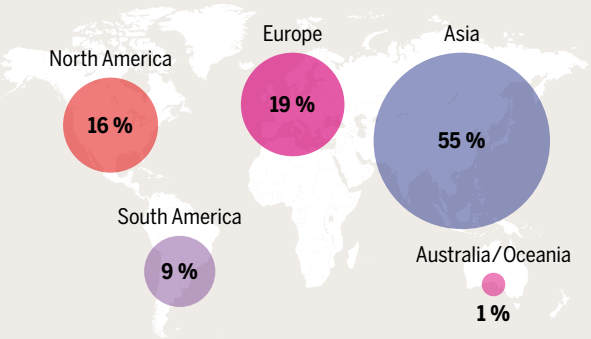
In 2017, the production capacity of bio-based plastic was about one percent of total plastics output. Currently, only 0.02 percent of the global agricultural area is used to grow the plants that go into them. At first sight, replacing fossil raw materials with agricultural commodities may therefore seem unproblematic. But this proportion is expected to grow rapidly in the coming years. If one considers the forecast growth in plastics production against the use of arable land, and one thing becomes clear: the pressure on the current cultivated area is going to rise even more. In some parts of the world this is already leading to water shortages, species extinction, desertification and the loss of natural habitat. Expanding the cultivation of agricultural raw materials is not an option for producing environmentally friendly plastic.

The second category—biodegradable plastics—are designed to be degraded by microorganisms under specific conditions. These plastics may also be bio-based, but they do not have to be. Biodegradable plastics are used for everything

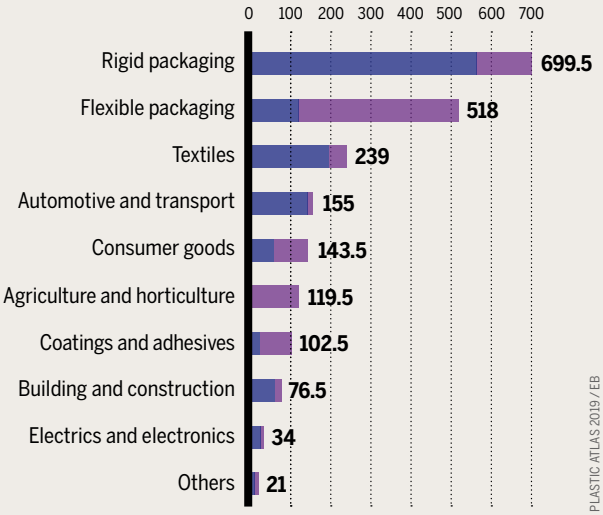
The volume of “bioplastics” produced worldwide is still small. But it is becoming more popular as an alternative to fossil raw materials.

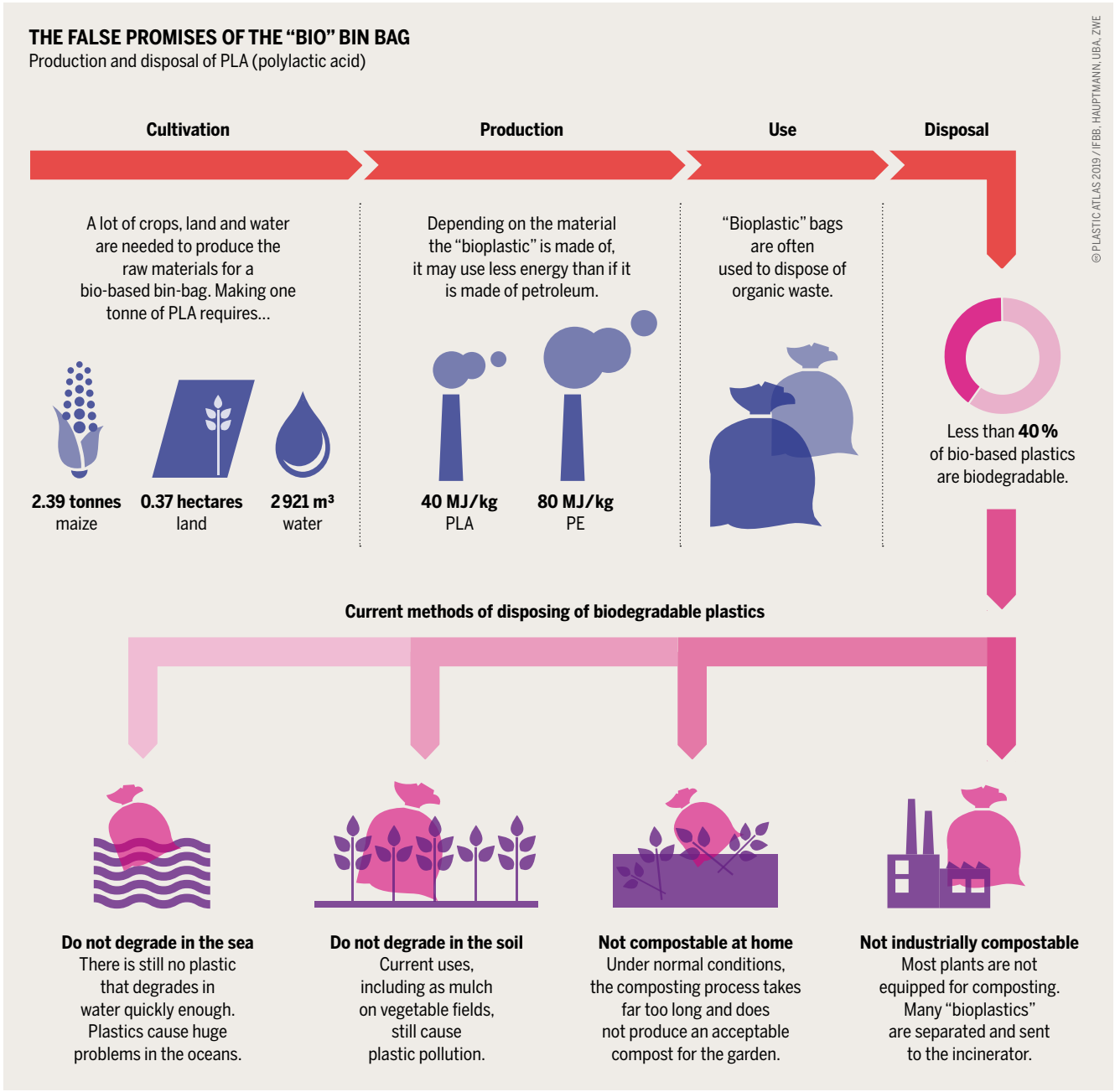
PRODUCTION AND USE OF “BIOPLASTICS”

Production capacity of bio-based plastic in percent, 2018
(total: 2.11 million tonnes)



Bio-based plastic by industry sector, thousand tonnes, 2018





A bin bag that is made out of renewable raw materials implies a sustainable cycle, but it creates significant environmental problems.

from compostable bin liners, to food packaging such as yoghurt containers, to takeaway coffee cups and fast-food trays. A specially designed international label is supposed to certify that the item can be composted. But reality is rather different.

According to the test criteria for the label, the plastic has to be 90 percent degraded after 12 weeks at 60 degrees Celsius. But most composting plants allow waste to rot for just four weeks. Extending this period does not make economic sense. At the end of the process, only water, carbon dioxide and mineral additives remain, but no materials that can form humus. Plus, heat is released that cannot be used in the further recycling process. To make the next bin liner or yoghurt pot, more energy must be generated. Strictly speaking, this process is not really composting, but simply waste disposal. Regardless, the majority of Europe's biodegradable plastics currently ends up in incinerators.

One argument often used to justify bio-based and biodegradable plastics is that taking their whole life cycle into account, they have less of an impact on the climate than comparable, conventionally produced plastics. But even that claim is undermined by the overwhelming acidification and overfertilization of soils and water caused by the conventional cultivation of the crops used to make bio-based plastics. And even such life-cycle assessments fail to take into account the direct and indirect changes in land use or the effects of using genetically modified crops. The consequences for biodiversity in the areas that produce crops for "bioplastics" have not yet been adequately studied.

The attempt to simulate biological cycles will not be enough to stem the flow of plastic waste. "Bioplastics" only shift the problem and distract attention from the real solutions.

WE CANNOT RECYCLE OUR WAY OUT OF THE PLASTIC CRISIS

It is a widespread misconception: as long as we separate our waste into different types, we do not have to change our consumption patterns. But the reality is different: a large proportion of plastic waste is not recycled, much of it is incinerated or ends up in the environment.

Since the start of large-scale production of synthetic materials in the 1950s, 9.2 billion tonnes of plastic have been made. Only 24 percent remains in use, resulting in 6.3 billion tonnes of waste. No way has yet been found to deal with this waste without causing yet more problems.

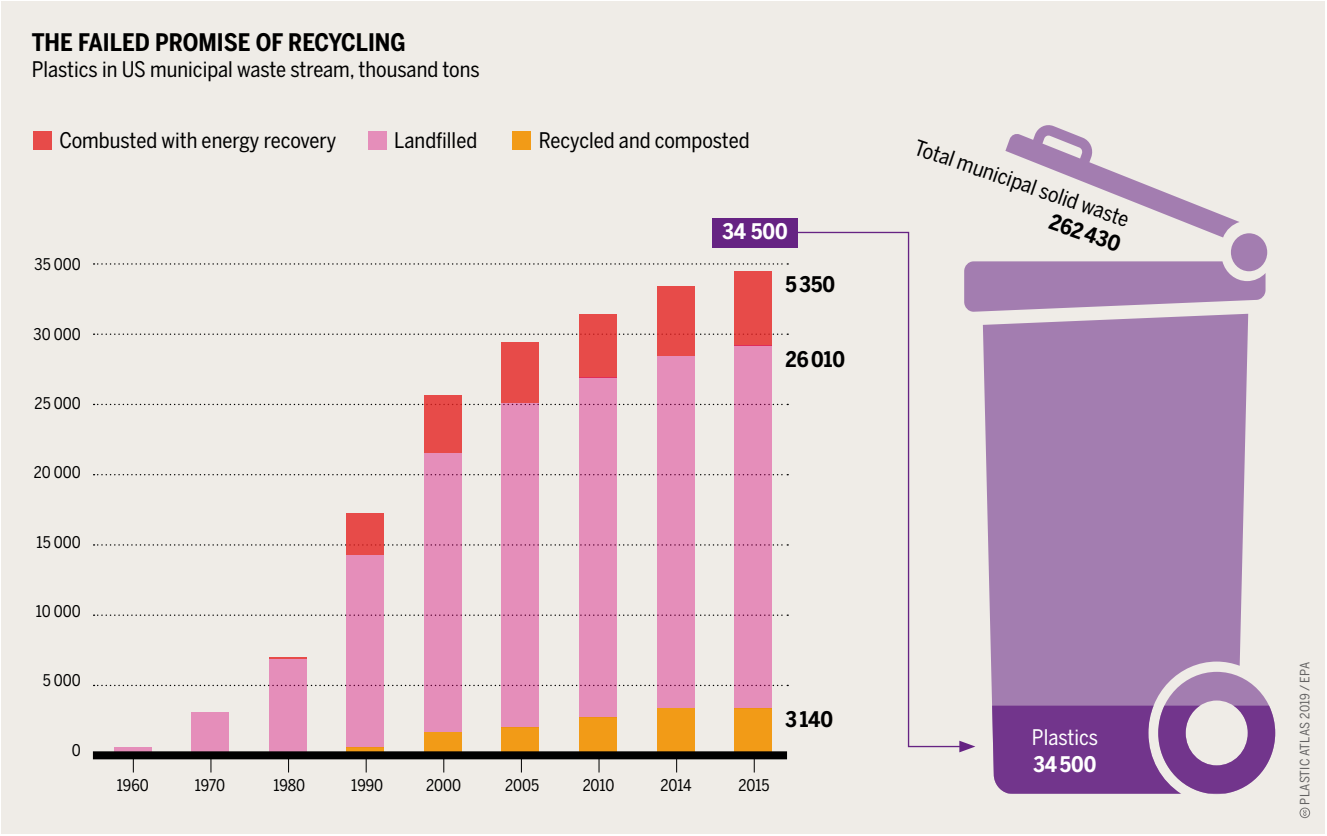
Packaging, which makes up 40 percent of all plastic waste, poses a particular set of difficulties. Most is designed to be thrown away after a single use, but it is extremely difficult to recycle as it is commonly made from multi-layered materials. On a global scale, 14 percent of plastic packaging is currently recycled—though this usually means "downcycling" to make an inferior-quality product. Another 40 percent is disposed of in landfills and 14 percent is burned in incinerators. The remaining 32 percent finds its way into the environment, including dump sites, rivers and the sea, or into the air we breathe.

Allowing plastic waste to enter the environment presents a myriad of environmental and health hazards—beyond the well-known visual blight of plastic bottles on our shores and bags and wrappers blowing along our streets. Originally derived from fossil mineral oil and gas, and mixed with hazardous additives, plastic has the potential to remain on the land or in the ocean for hundreds of thousands of years. In the sea, plastic litter threatens marine organisms, especially fish, seabirds, and marine mammals. On land, the health effects and other impacts of plastic gradually breaking down and seeping into the soil or entering food streams are still being researched.

Open burning is one way to get rid of plastic, but this simply releases carbon dioxide and many toxic chemicals that plastics contain into the atmosphere. In addition to dirtying the air we breathe, it is no secret that burning hydrocarbons is a leading contributor to climate change.

Incineration takes the practice of open burning and does it at an industrial scale. Incineration facilities come in many forms, including "waste-to-energy" plants, co-incineration

Despite the hype, very little plastic is recycled in the USA. The US recycles less than one-tenth of the plastic waste it generates. Most goes into landfills.



in industrial boilers and cement kilns, and "plastic-to-fuel" technologies such as gasification and pyrolysis. As with open burning, these solutions convert plastic waste into air pollution in the form of respiratory irritants, cancer-causing dioxins and furans, heavy metals including mercury, cadmium and lead, and major greenhouse gases. Even sophisticated pollution control equipment cannot prevent all pollutants from being released into the air. The captured pollutants are concentrated in the ash, which is sent to landfills or mixed in cement and other building materials. From there the pollutants can leach into the soil and groundwater.

Incineration is also cost-prohibitive, both because of the massive investment and maintenance requirements, and due to the low efficiency of waste as a fuel and a constant demand for feedstock to keep the system operational. Solid-waste combustion is the most environmentally damaging industry in the US relative to the benefit it provides. Meanwhile it undermines recycling by consuming recoverable materials as feedstock and taking investments away from true renewable energy and zero-waste solutions.

While recycling is preferable to incineration, it too presents considerable economic and technical challenges. This is why only ten percent of all discarded plastic has been recycled. Different types of plastic require separate processing, and even the most advanced technology can recover only small amounts of material that is as good as new. Recycling usually produces low-quality mixed plastics that can be used only for low-value items such as the bases of traffic signs. The market for such products is restricted.

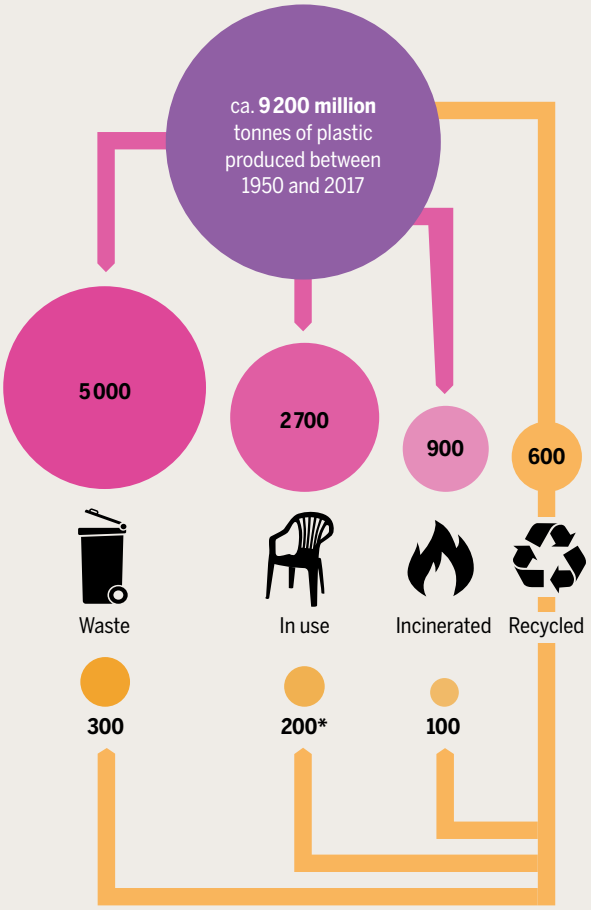
Manufacturers tend to prefer using virgin plastic rather low-quality recycled material. The rock-bottom price for new plastic, and the costly sorting and processing needed for plastic scrap, has led to much plastic waste from developed countries being shipped overseas. In January 2018, China, the main importer of such scrap, ended this practice, forcing the market to find other destinations for the waste. In the United States, Philadelphia is now sending its recyclables to be burned in the nearby city of Chester.

So-called "chemical recycling" is no better. This type of processing turns plastics into fuels and gases. But attempts to break scrap down into basic constituents that can be turned into new plastic have so far proved to be impractical at a large scale. Problems include the emissions, toxic by-products, and high energy consumption. Attempts have been dogged by high-profile failures, fires, explosions and financial losses. The US Environmental Protection Agency thinks that such processing poses similar health risks to conventional waste incineration.

All the current processes to use waste plastic in other ways lag far behind the huge volumes of new materials being generated. As consumption continues to grow, even high-quality recycling cannot diminish the amount of oil and gas being pumped to make new plastic. The most effective way to reduce the damage caused by plastic after its useful life is over would be to reduce the flow at source. The first step must be to eliminate single-use plastic items.

THE CAUSES OF THE CRISIS

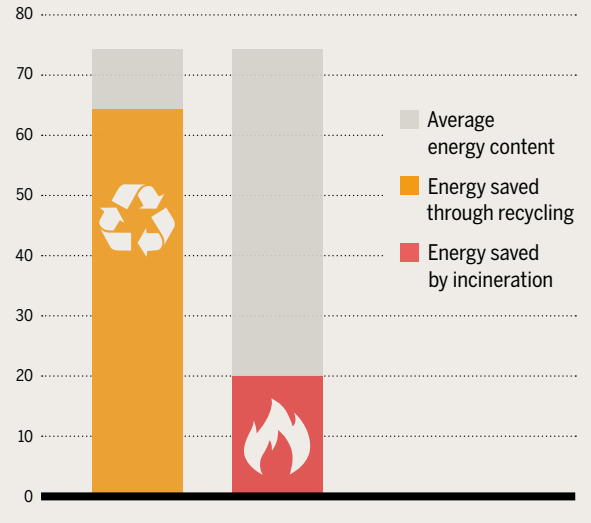
Global production, use and disposal of plastics, 1950 to 2017, in million tonnes



A glance at the flows of plastics made since the 1950s shows that recycling is part of the problem, not part of the solution.

WASTED ENERGY

Energy balance of incinerating waste, energy in megajoules/kg



Recycling saves a large majority of the energy contained in plastic waste. That is not the case with incineration, where most of the energy is lost.

THE RUBBISH DUMP IS CLOSED

What to do with your unwanted plastic bottles and bags? Simple: send them somewhere else. Until recently, much of the developed world's hard-to-recycle waste was shipped off to China. That is no longer an option.

Until January 2018, China was the main destination where exporting countries (predominantly G7 nations) sent their plastic waste to be recycled. Since 1988, around half the planet's plastic waste has been sent to this country to be melted down and turned into pellets. That changed dramatically when China announced it would only accept bales of plastic waste with less than 0.5 percent contamination by non-recyclable materials—a much higher bar than the previous level of 1.5 percent. The new standard is almost impossible to meet, given that plastic material entering recycling facilities in the United States may contain 15–25 percent contamination. The new rule effectively banned the vast majority of plastic scrap imports and created a moment of reckoning for international recycling markets.

China had many reasons for shutting its doors to foreign waste. "Materials recovery facilities" in the developed world would sift through plastic waste, sort out the valuable stuff (like PET and HDPE) for recycling locally, and ship the remaining low-quality items off to China. Such waste contains a variety of materials, chemical additives and dyes that make it next to impossible to recycle. Workers who process these shipments are often exposed to hazardous chemicals. The plastic that cannot be recycled is disposed of in incinerators, landfills or dumpsites, polluting the air, land and sea. These environmental and social ills led China to close its borders, drastically shifting worldwide flows of plastic waste.

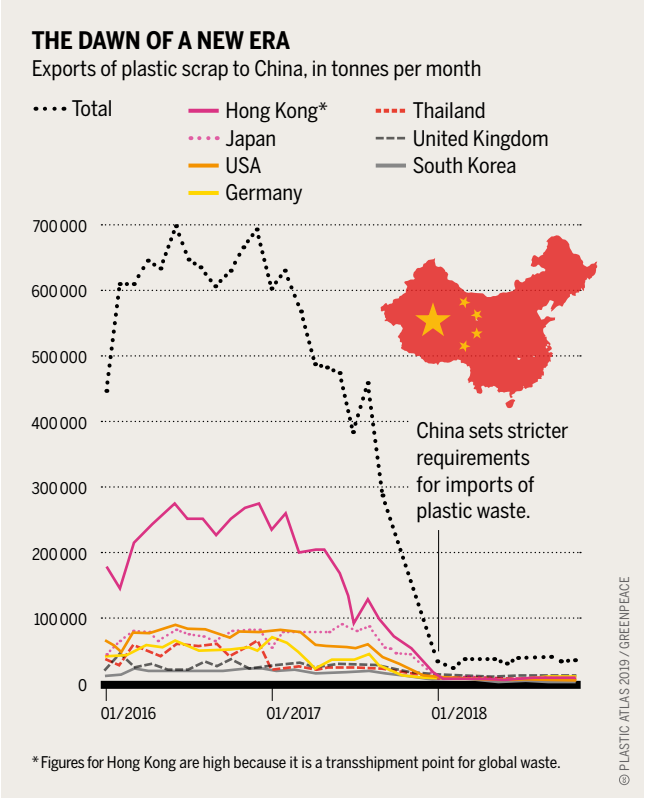
With the primary importer of plastic waste out of the market, exporting countries began sending increasing volumes of scrap to Southeast Asia. In Thailand, imports of plastic scrap rose nearly seventy-fold in the first four months of 2018 compared to the same period in 2017, and in Malaysia they rose over six-fold. In the same time period, imports in China fell by 90 percent. The sheer quantity of imported scrap overwhelmed ports and caused a sharp uptick in illegal recycling operations and waste shipments. In May 2018, a big Vietnamese shipping terminal temporarily stopped accepting scrap materials after it had amassed more than 8,000 containers full of plastic and paper. In Malaysia, almost 40 illegal recycling factories were set up, dumping toxic wastewater into waterways and polluting the air with fumes from burning plastic. In just a single raid, inspectors in Thailand found 58 tonnes of illegally imported plastic.

The environmental and human health impacts have led many importing countries to restrict or ban imports of plastic scrap. In 2018, both Thailand and Malaysia announced bans on imports of plastic scrap by 2021; in 2019 India and Vietnam followed suit with their own plastic import bans. Indonesia has restricted imports of non-recyclable waste.

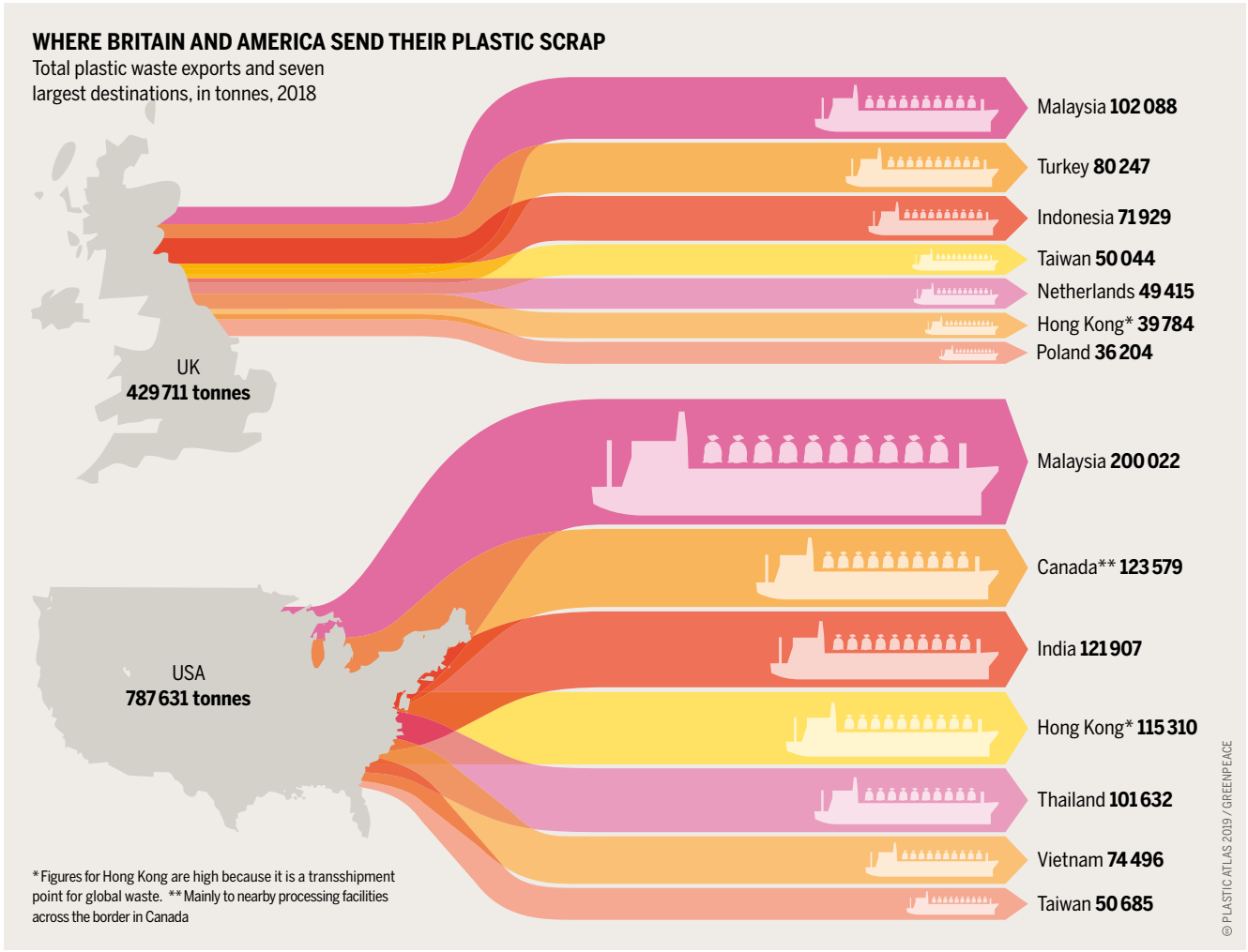
These countries are also cracking down on contaminated foreign waste imports—by sending them back where they came from. In May 2019, the Philippines succeeded in getting Canada to take back the waste that had been mislabeled and dumped there six years previously. That same month, the Malaysian Minister of the Environment, Yeo Bee Yin, said her country would by the end of the year ship back a total of 3,000 tonnes of waste, or around 50 containersful, to countries like the UK and USA.

In July 2019, Indonesia announced it would return 49 containers at Batam port to Australia, France, Germany, Hong Kong and the USA because their contents violated laws on the import of hazardous and toxic waste. That same month, Cambodia declared it was "not a dustbin" for foreign waste, and would be sending back 1,600 tonnes of garbage.

Facing mounting piles of post-consumer plastic and a collapsing global recycling market, exporting countries have resorted to landfilling or burning recyclables. In the UK, thousands of tonnes of mixed plastics collected for recycling are being sent to incinerators. In the USA, cities in Florida, Pennsylvania and Connecticut incinerate their recyclables; other municipalities across the USA landfill materials they cannot stockpile. Australia has announced that exports of recyclable



In 2016, monthly exports of plastic trash to China exceeded 600 000 tonnes a month. By 2018, they had shriveled to less than 30 000 tonnes.



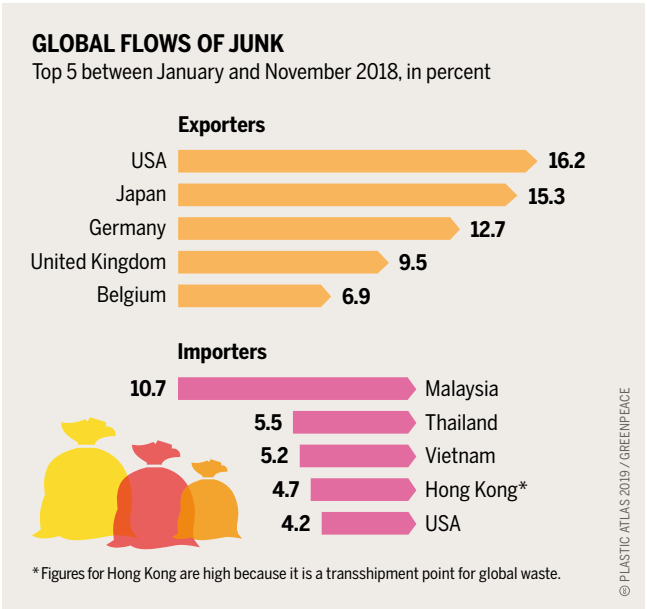
Britain and the USA are among the world's top exporters of plastic waste. Most of what arrives in Asia is almost impossible to recycle.

waste would be banned to prevent ocean pollution, and is considering incinerating its plastic waste.

But incineration emits carbon monoxide, nitrous oxide, particulate matter, dioxins, furans, and other pollutants linked to cancer, respiratory illness, nervous disorders and birth defects. Such emissions threaten nearby communities. The residual ash may end up contaminating land and water.

Asia's bans and restrictions and the mounting urgency of the plastic waste problem have led to suggestions for reforms to the global waste trade system. In May 2019, 187 countries agreed to amend the Basel Convention (which governs trade in hazardous wastes) to subject shipments of scrap plastic to tighter controls and greater transparency. Set to come into effect in 2021, this amendment will create more accountability around the plastic scrap trade, preventing its worst effects and paving the way for more substantial reforms.

While the world struggles to handle the flood of waste, industry plans to increase plastic production by 40 percent in the next decade. The rising costs of plastic waste are forcing governments to take action. Cities and countries are imposing bans, fees and other restrictions on single-use packaging in an effort to force producers to change their business practices. The world is starting to understand that we cannot recycle our way out of plastic pollution: we simply need to make less of it.



The industrial world is the source of most plastic waste exports. The biggest importers are in Asia. Most waste consists of containers, films and sheets.

SCRAPS FROM THE TABLE

In many poor countries, waste pickers take over the tasks of the municipal garbage truck and waste processing plants. They divert a significant amount of waste back into productive uses.

Waste pickers survive by sifting through waste and selling items that are of value: glass, paper, cardboard, metal—as well as plastic packaging, bottles and bags. They are a common sight in the cities of Africa, Latin America and Asia, but they are also found on the streets of North America and Europe. It is not known how many there are, but local organizations in Latin America estimate that about 4 million, including large numbers of women and girls, work in that sector. In a survey of 763 waste pickers in Africa, Asia and Latin America, 65 percent of the respondents said they earned the majority of their income by collecting and selling waste.

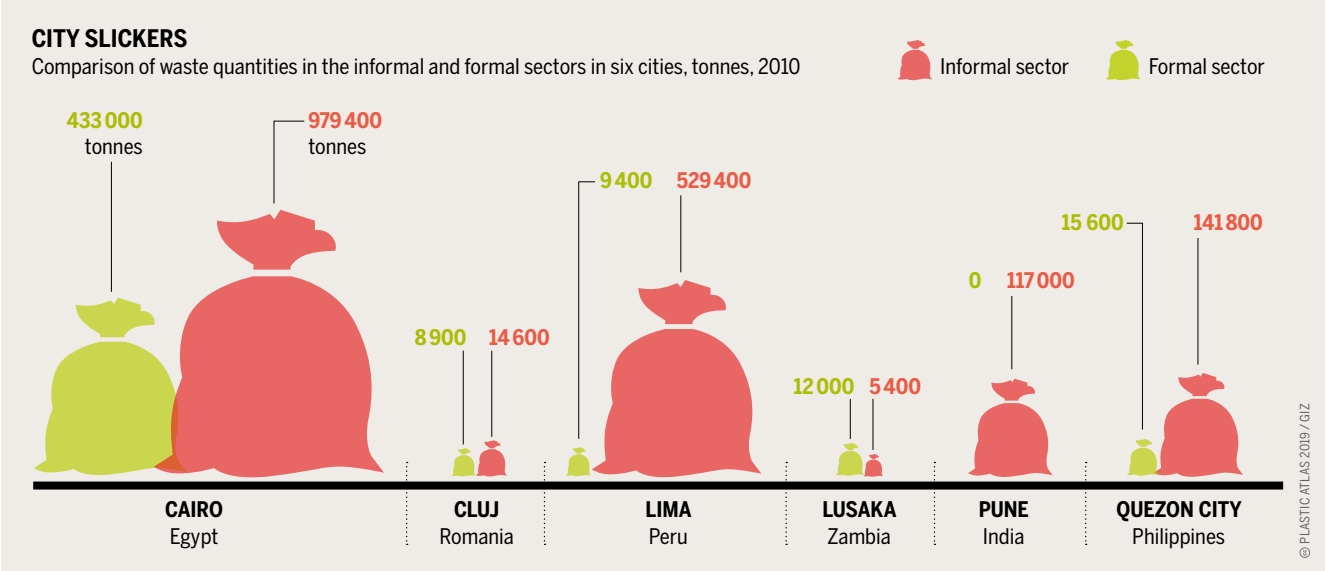
Waste picking is intrinsically related to widening social and economic inequality. People without access to education, housing, health services and even food have no choice but to scrape a living by processing other people's garbage. Many waste picker families—some of which span three generations—live on dumps and next to open pits. Fallen into a cycle of poverty, they face numerous health problems from handling contaminated materials, eating spoiled foods and contracting diseases from flies, rats and cockroaches. Dumps are physically dangerous: it is not uncommon for people to die trying to get at the best materials that garbage trucks bring in. Some waste pickers are homeless or live far from the wealthier residential or commercial areas that generate trash. They pull handcarts to such areas to collect rubbish from bins and roadsides, then haul them home to sort and sell the recyclable portion.

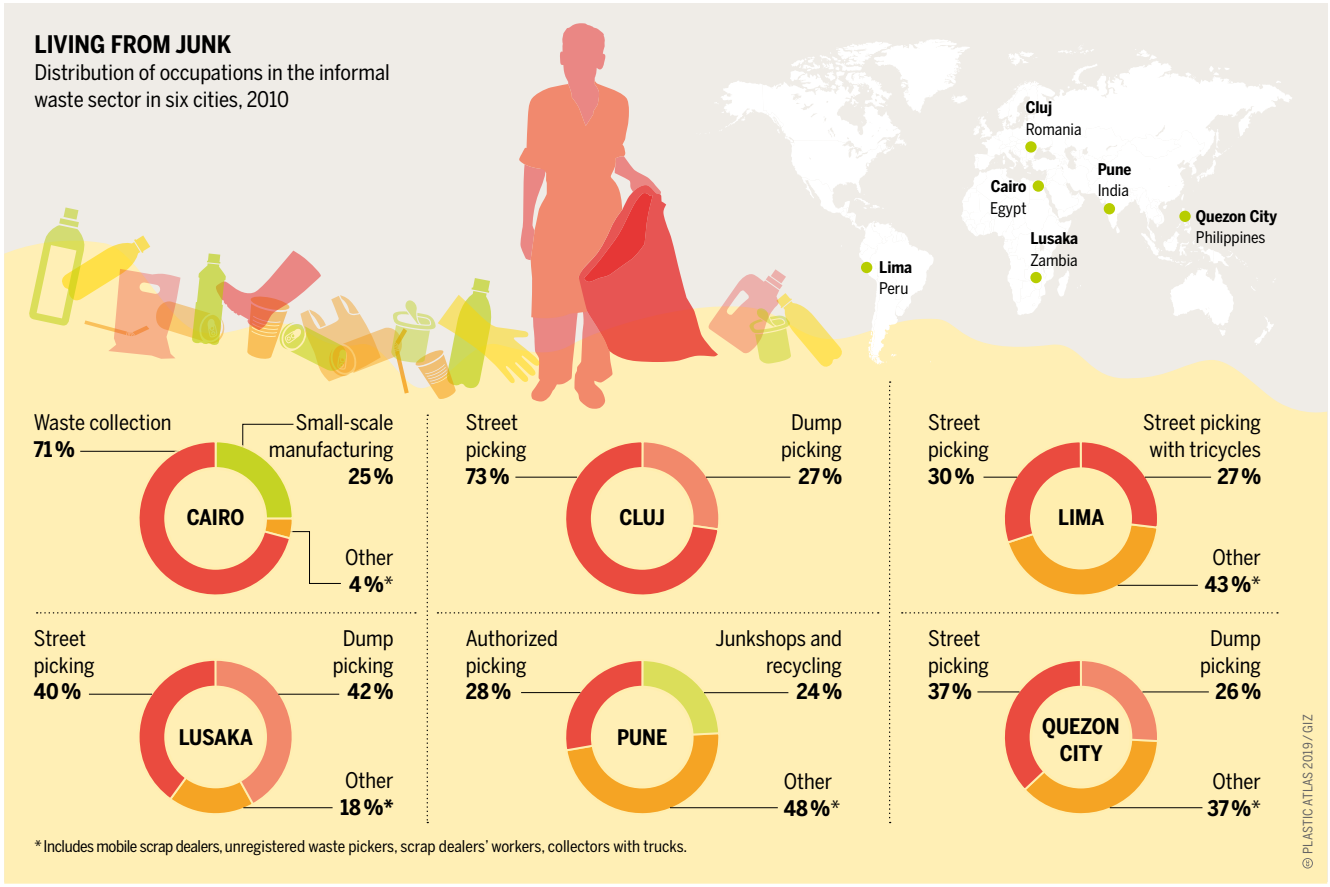
Many waste pickers have organized into associations, cooperatives or community groups. These can gain access for their members to waste materials with greater market value, and fight for less contamination and safer working conditions. By pooling larger quantities of materials, they can leverage their bargaining power and secure better prices from buyers. They can also advocate for national and local policies that guarantee rights to better working conditions, safer equipment, personal protection equipment, and higher remuneration. For example, in many countries, waste pickers collect and separate materials in categories required by the recycling industry, and they carry out environmental education activities with residents to separate recyclables properly so they can be sold.

These workers spend more time than anyone else with the detritus of the global consumer economy, so they know more than most about the composition and nature of post-consumer plastic products and packaging. Because they make a living by reselling discarded material to secondary markets, they have an acute sense of which items are valuable and which are not. Plastic products are typically the most problematic to collect and resell, due both to their design and to market conditions. In some places, the vast majority of plastic has no aftermarket value; in others, recyclable products are limited to a few items. In Latin America, waste pickers find it worthwhile to process only three of the seven major types of plastic: PET, HDPE and LDPE.

A survey of waste pickers in Africa, Asia, and Latin America found that 65 percent earned a major part of their household income from collecting and selling recyclable products. They are often the only people to divert reusable materials

The informal sector plays a huge role in keeping mounds of rubbish under control, especially in cities with little recycling or waste disposal infrastructure.





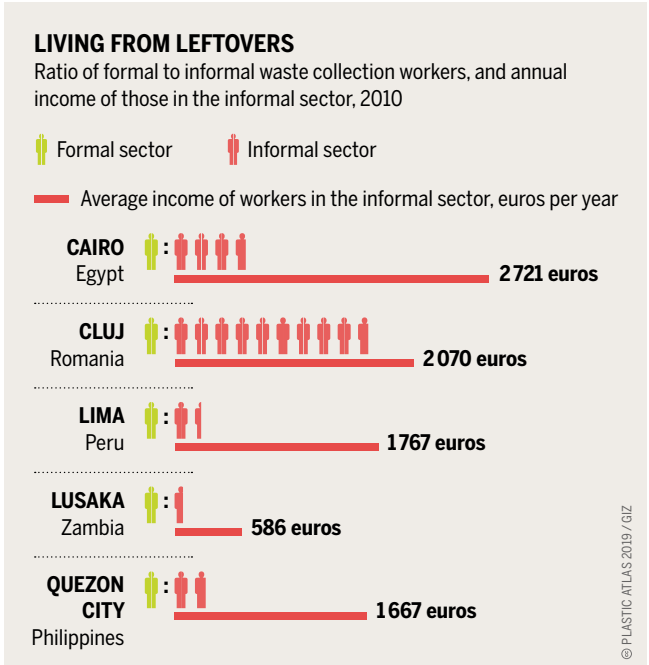
A broad spectrum of informal waste picking businesses exists. All rely on the processing and sale of waste as their basic source of income.

from landfills and dumps into the secondary market, so closing the loop and creating a circular economy. In Latin America, recycling companies rely on waste pickers to provide some 25–50 percent of all recyclable material. Their efforts help reduce the need to extract and process raw materials, reduce greenhouse gas emissions, and provide environmental-health benefits to the community.

Waste pickers have been at the forefront of identifying plastic as problematic. By aggregating and sorting different types of rubbish, their coops can assess waste streams more comprehensively than individuals can. The prices paid for plastics are very low compared to paper, cardboard and metals. Any demand for plastic is typically seasonal, making it difficult to earn a reliable income from it. Sorting plastic takes a lot of time, for example to separate non-recyclable plastics from those that have some value. Often, a significant portion of the plastic collected and sorted cannot be resold.

Waste pickers around the world are often marginalized and their efforts go unrecognized. Laws are needed to recognize and strengthen them as professionals performing a vital service. Funding for space, facilities, equipment, trucks and other types of support can mean the difference between a waste picker co-op struggling to survive and flourishing. Initiatives can support waste pickers and their families by improving their working conditions, and by providing housing and health services. One scholarship programme in the Philippines offers stipends so children can stay in school instead of having to help support their family by picking waste themselves. Producers can help build circular economies by making products reusable or recyclable and by implementing "extended producer responsibility" schemes that properly compensate waste pickers.

For many of the poorest families in the developing world, their sole source of income comes from sorting waste and selling it to recycling firms.



SOLUTIONS AT THE WRONG END

There is no lack of agreements and initiatives to manage the plastic crisis. But almost all address waste disposal only; they are not coordinated with each other, and they absolve manufacturers of their responsibilities.

Approaches exist at various levels to regulate plastic production and the handling of the resulting waste at the end of the product's useful life. But all these approaches have something in common: they are of limited effectiveness. That is partly because the large number of binding international agreements and voluntary initiatives have been developed independently and have not been coordinated with each other. It is also because most current agreements reduce the plastics problem to one of waste. That prevents them from dealing with the full implications of using plastics.

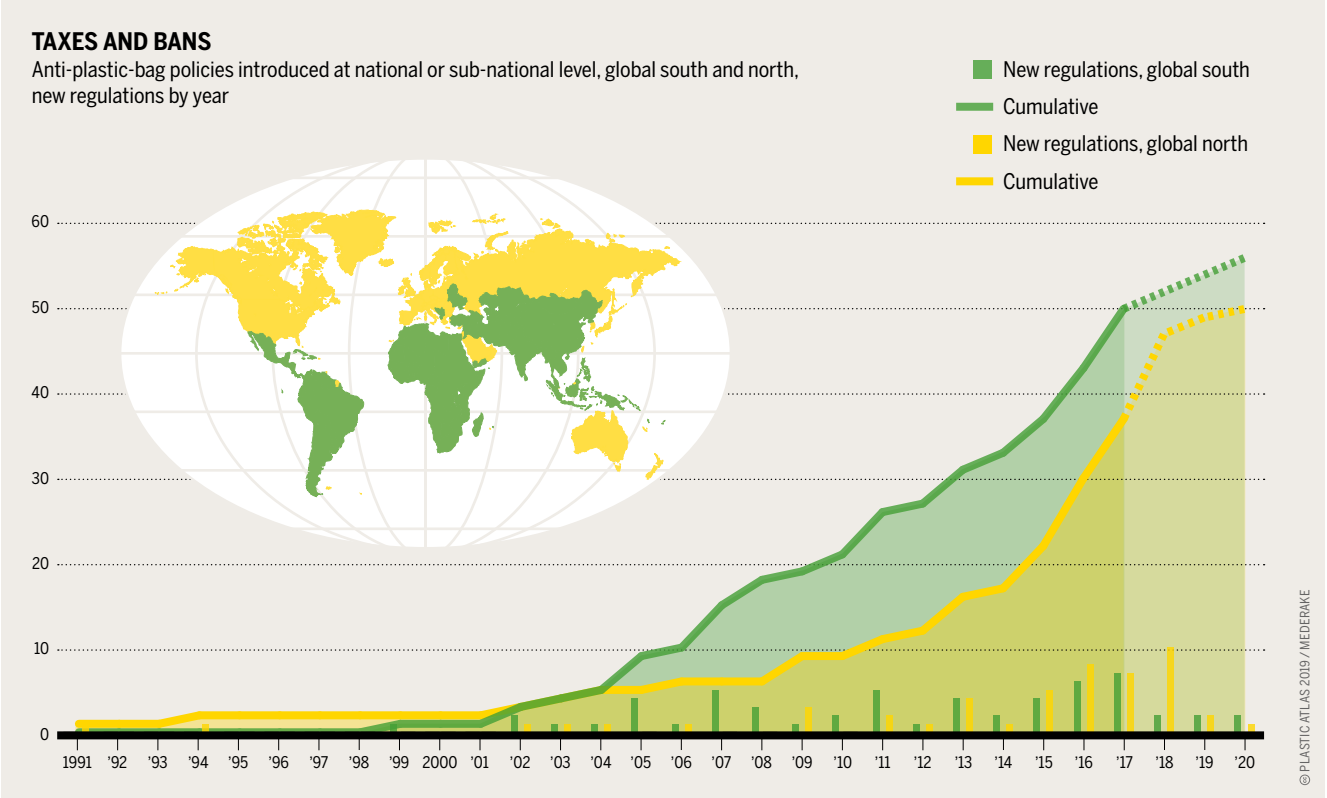
Examples abound. The International Convention for the Prevention of Pollution from Ships (MARPOL) was signed in the 1970s to prevent the littering of the oceans. The 1982 United Nations Convention on the Law of the Sea (UNCLOS) also regulates the dumping of waste at sea. Then there are currently 18 different conventions covering 12 regional seas: some of these refer to marine sources of plastic waste, some focus on land-based sources, and some are concerned with both. Another treaty, the Stockholm Convention on Persistent Organic Pollutants, prohibits the use of certain harmful chemicals in plastics, such as plasticizers. Some international conventions are ambitious, but all are so narrowly drawn that they fail to be fully effective.

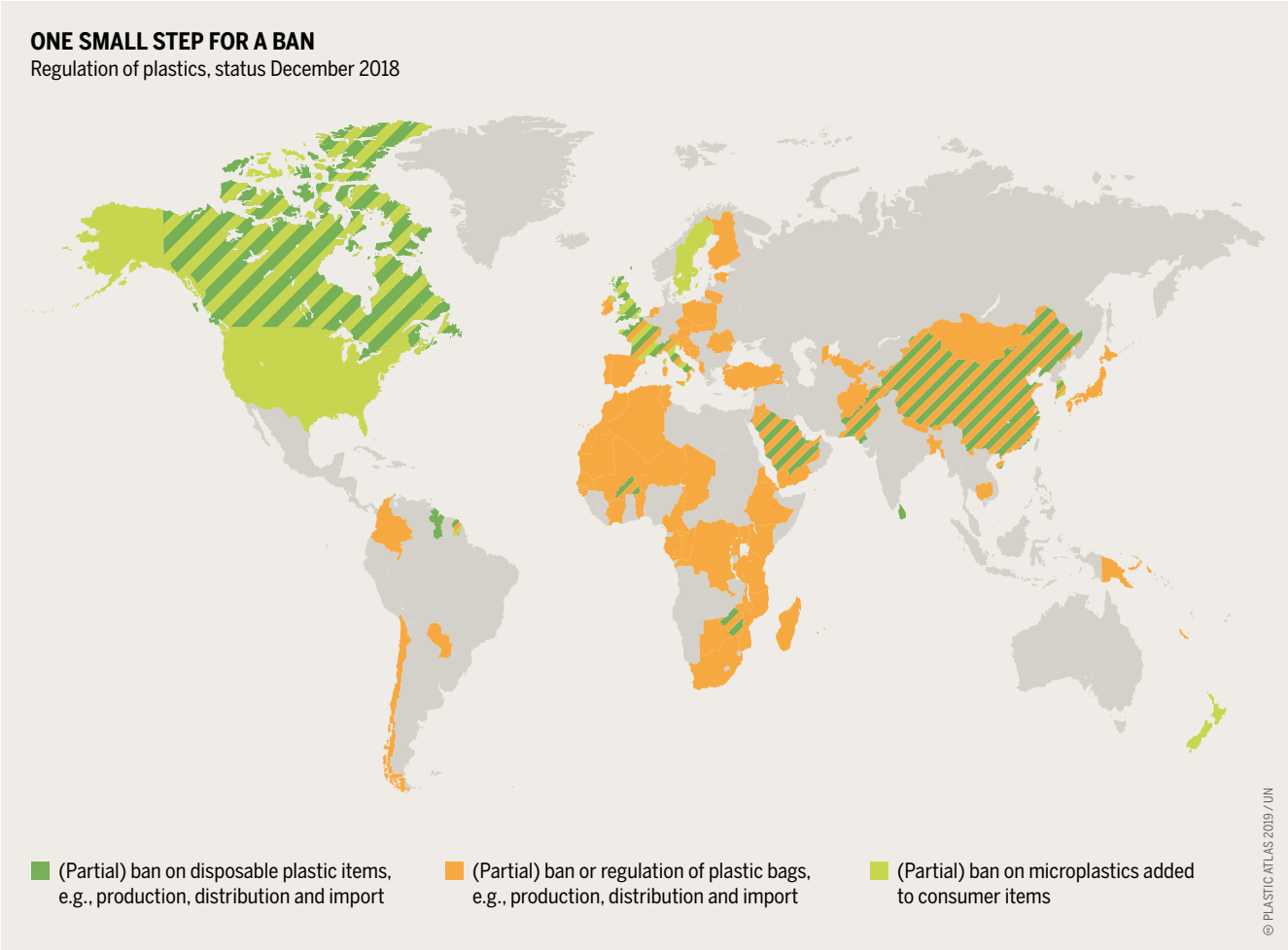
More recent agreements attempt to take a holistic approach to marine litter. The language used in the action plans of the G7 and G20 on marine pollution and garbage, and a resolution of the Third Session of the UN Environment Assembly (UNEA-3) in December 2017, at least give the impression that there is a lot of pressure to act. But none of these agreements are binding on their signatory member states.

But progress is being made, albeit slowly. As agreed upon at UNEA-4 in March 2019, an expert group is now developing options for action based on the UNEA resolution. That might possibly lead to a binding international convention on plastics. This would anchor global reduction targets in international law, and states would have to take responsibility for not doing enough to reach these targets.

Meanwhile, in May 2019 the parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal adopted stricter regulations on plastic waste. A new classification aims to ensure that dangerous and contaminated plastic waste can be shipped only with the consent of both the importing and the

Germany and Denmark introduced taxes on plastic bags in the early 1990s. Since 2004, developing countries have introduced more restrictions.





Measures differ markedly: North America regulates microplastics, while many countries in Africa and Asia have banned plastic bags.

exporting countries. This will make it more difficult to dispose of plastic waste in countries that have laxer environmental standards.

In January 2018, the European Commission proposed a strategy that identifies three key problem areas. First, the low levels of recycling and reutilization rates. Second, the entry of plastics into the environment; and third, the carbon dioxide emitted during the production of plastics. A central aim of this strategy is for all plastic packaging to be 100 percent recyclable by 2030. In December 2018, the European Council, Parliament and Commission, the three main decision-making bodies in the EU, initiated a ban on various single-use plastic articles, including straws and cutlery. They also agreed a series of other measures, such as a quota of 25 percent recycled material in PET bottles from 2025 on. Avoiding single-use plastic items is of special importance. Along with the USA, Japan and China, the European Union is one of the world's biggest producers of plastic waste.

At the national level, approaches have long been limited to the question of how to collect and recycle plastic waste. The concept of "extended producer responsibility" refers mainly to this. Since 1991, packaging producers in Germany have had to pay for the removal and recycling of packaging waste as part of a waste separation scheme known as the "Grüne Punkt", or "Green Dot". A symbol printed on each item of plastic packaging tells the consumer whether it can be recycled.

Increasing numbers of countries are trying to reduce the use of items such as plastic bags by imposing rules and bans. But most such rules are very narrowly defined. They either stipulate the thickness of the material the bag is made of—so only certain types of bags are banned—or they impose levies on bags. More comprehensive bans on plastic bags are to be found only in the global south, where the pressure on governments to do something is particularly high because plastic bags clog up drainage canals—as happens frequently in India and Bangladesh. But if cheap and viable alternatives do not exist, there is a danger that a black market for plastic bags will develop.

Various countries have attempted to regulate the inclusion of microplastics in cosmetics and the use of disposable plastic items such as polystyrene boxes and plastic cutlery. A few pioneers, such as Costa Rica and India, are striving for a general ban on disposable plastics.

But all these approaches do nothing to tackle the basic problem. Almost all the regulations are targeted at the waste disposal end of the chain, and put the onus on the consumer. Very few binding rules exist to force producers to cut back their production of plastic items or to develop products that can be recycled more easily. And current regulations fail to cover a large part of the plastics, or microplastics, that gets into the environment. The abrasion of automobile tires is an example: according to estimates, it accounts for around one-third of all microplastic emissions in Germany.

HOW THE PLASTIC-FREE MOVEMENT IS EXPOSING THE GIANTS

The global Break Free From Plastic civil society movement is working to stop plastic pollution for good. It is using public exposure and transparency to put corporations under pressure.

Drop into your local store and buy a snack or a drink. Most likely it will come in a package or container made of plastic—which you then have to dispose of somehow. The same is true of a wide range of consumer items. It is hard to make any purchase, large or small, without coming home with a pile of plastic packaging that will end up in the bin. Yet consumers are blamed for the waste problem. A new movement is showing where the fault really lies—with the global industry that produces and uses plastic.

For decades, industry has framed plastic pollution as a problem of litter and waste management. This framing is widely promoted globally, and unquestioningly accepted by governments and the public alike. It allows corporations to churn out throwaway plastic products and packaging while passing on the blame for plastic waste to consumers, and the responsibility for managing what is discarded to local authorities.

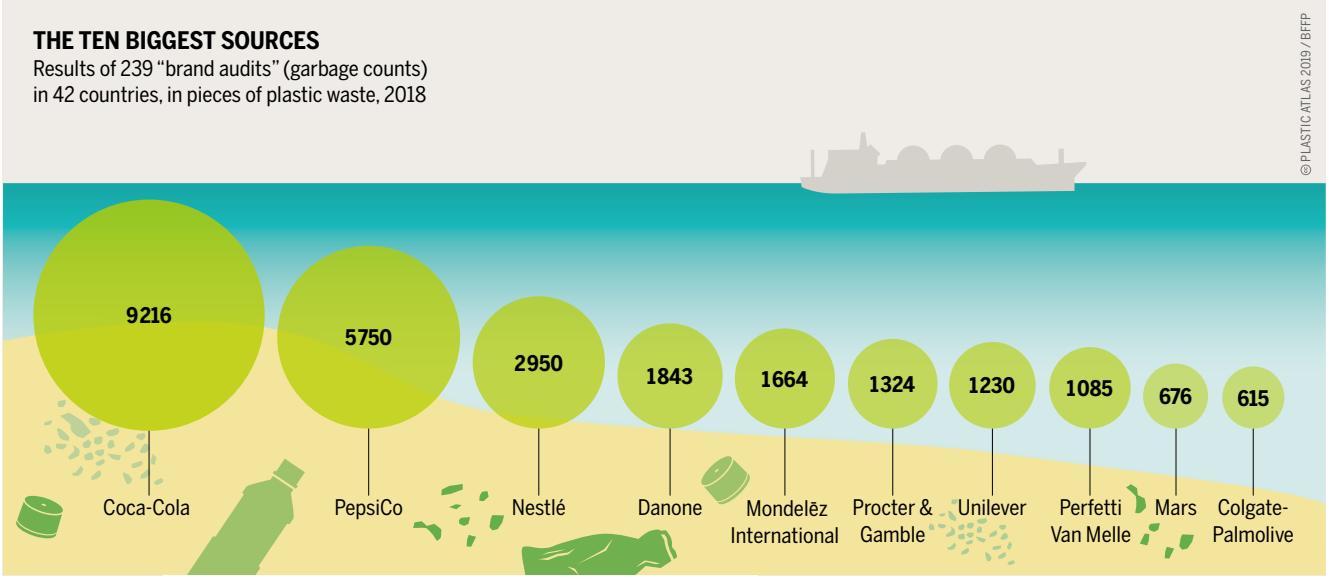
But grassroots and environmental organizations around the world have started coming together to expose and confront the plastics industry. Since its launch in 2016, a global movement called Break Free From Plastic (BFFP) has united more than 1,500 organizations and thousands of supporters across six continents. They are trying to put an end to plastic pollution by demanding massive reductions in the production and use of fossil-fuel-based plastics. By exposing how plastic pollution is a systemic problem that needs to be tackled at source, these groups are standing up to the plastics industry and are calling for transparency, accountability and action.

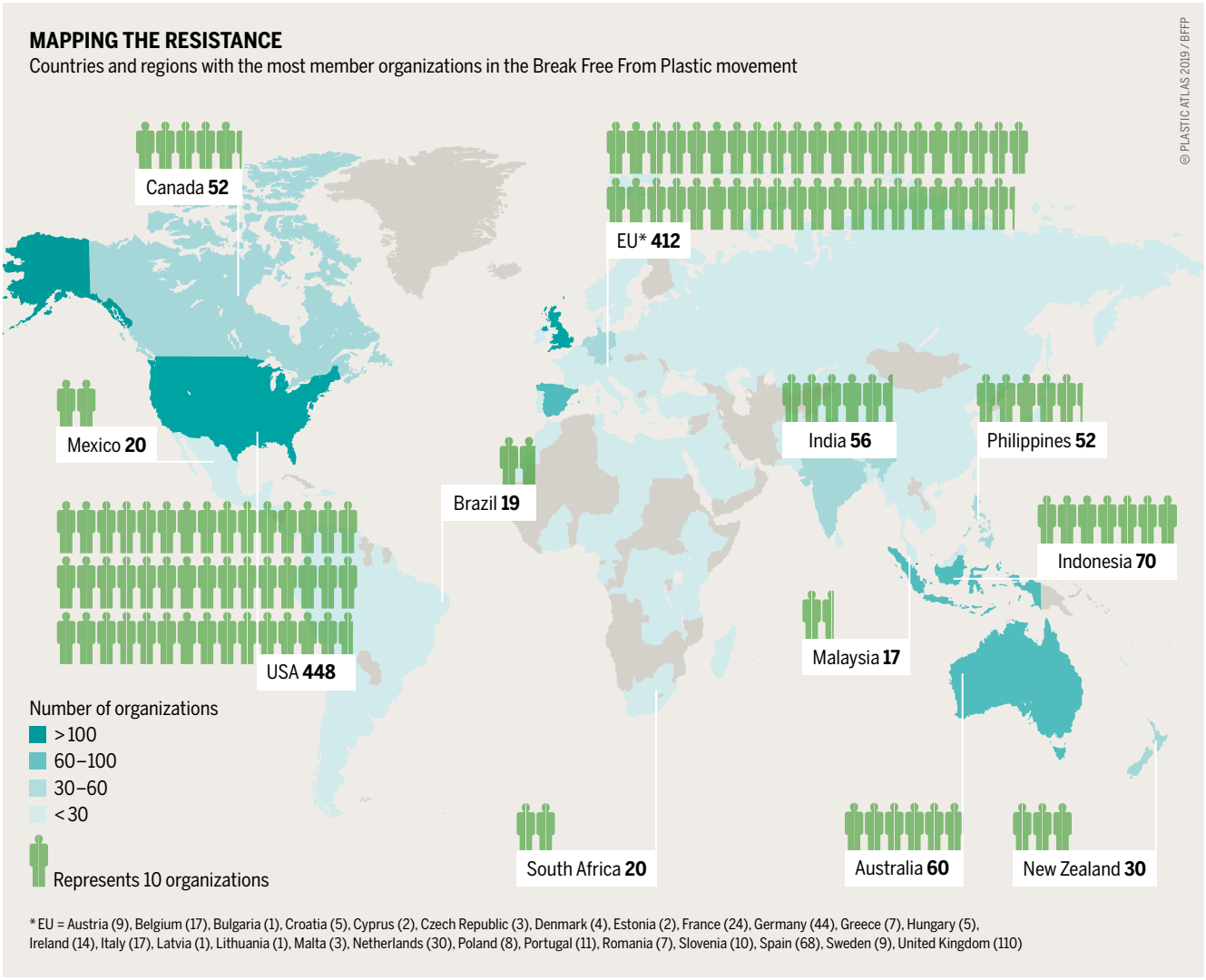
BFFP is the first movement in which groups all over the world, working at different stages of the plastics lifecycle, have come together under the same banner to work towards a shared vision. The goal is to achieve fundamental change by tackling pollution along the whole plastics value chain, focusing on prevention rather than cure, and advancing lasting solutions.

The challenge is enormous. The production, distribution and disposal of plastics involves a long list of the world's biggest companies, including oil majors like ExxonMobil, Chevron, Shell and Total, chemicals firms such as DowDuPont, BASF, SABIC and Formosa Plastics, consumer-goods giants such as Procter & Gamble, Unilever, Nestlé, Coca-Cola and PepsiCo, and waste-management firms like SUEZ and Veolia. Most, if not all, of these companies resist the call to reduce plastics production: accepting the need to do so would force them to abandon their optimistic growth projections, upend their ingrained business practices that depend on single-use plastics, and accept lower profits. Instead, these companies strive to keep throwaway plastics as part of people's everyday lives.

BFFP challenges industry on four fronts. First, it puts pressure on corporations to massively reduce the production and use of single-use plastics. Second, it unmasks the

In 2018, "brand audits" conducted by Break Free From Plastic collected a total of 187,851 pieces of plastic waste from locations around the world.





More than 1,500 organizations around the world are members of Break Free From Plastic. Most of them are in North America, Europe and Southeast Asia.

industry narrative around plastics, and reveals the truth. Third, it promotes zero waste cities, especially in Asia. And fourth, it continues to build and strengthen the plastic-free movement.

BFFP campaigns to get manufacturers, who have "outsourced" their pollution to consumers, to change their practices. BFFP and its partners conduct "brand audits," where waste is collected and classified according to the company brand from which it originates. Since 2017, the movement has conducted numerous such brand audits around the world: in Asia, Europe, Africa, North and South America, and Australia, popularizing the term "branded trash" and putting consumer-goods companies on the defensive. With their brands directly associated with trash, a number of multinationals have started pledging targets for eliminating some problematic types of items and increasing the collection and recycling of their packaging. That is progress, but such commitments still fall far short of what is required to dramatically reduce the amount of throwaway plastic that is being generated.

By putting a spotlight on the problematic and unnecessary plastics being churned out by companies, these brand audits expose the real actors behind the pollution, helping debunk the industry myth that consumers, and waste management systems—particularly in poor Asian countries—are the problem.

Brand audits do not just criticize: they also help advance solutions. In Asia, several BFFP member organizations are working with cities to establish environment and community-friendly waste management systems using audit data. Under the BFFP banner, at least 26 local governments in the region have pledged to become "zero waste cities." In Europe and the USA, BFFP members are enabling groundbreaking policy shifts against the disposable and throwaway culture fostered by industry.

In January 2019, under growing pressure, the industry formed the "Alliance to End Plastic Waste." An initial 30 companies pledged $1.5 billion for waste management and disposal infrastructure, particularly in Asia. But the same companies will invest over $89.3 billion on plastic expansion projects by 2030, further entrenching the production of fossil-fuel-based plastics.

Building and strengthening the movement is vital to be able to stand up to giant multinationals. The movement is new, but its membership and reach are growing organically, seeding a network of resistance to the plastic industry's ambitions, and helping to usher in a world free of plastic pollution.

STOPPING THE PROBLEM AT THE SOURCE

Recycling alone cannot solve the plastic crisis. New ideas are needed that tackle the roots of the problem. A growing movement is showing how that can work—and a few pioneering cities and towns are blazing the trail.

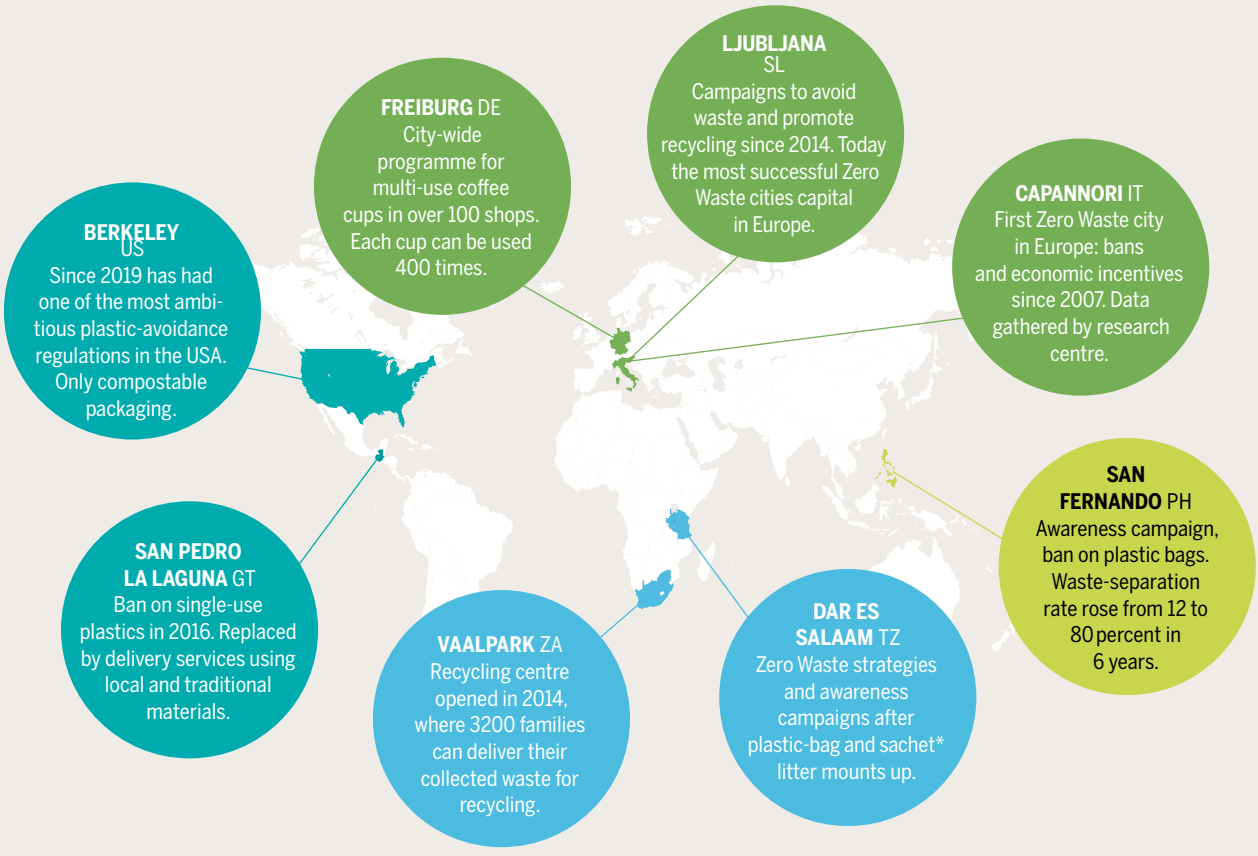
A movement called "Zero Waste" has emerged: its goal is to stop the tide of waste at its source. This means that products, packaging and materials are produced, consumed and recycled in a responsible manner. No waste is incinerated. Toxic materials do not end up in the ground, in the water or the air. Communities, visionary policymakers and innovative entrepreneurs are showing that it is possible to use resources efficiently, maintain a healthy environment, consume in a sustainable way, and at the same time create local jobs.

Nearly 400 municipalities in Europe, and an increasing number of local authorities worldwide, are adopting Zero Waste strategies. These are an effort to phase out waste—not by burning or landfilling it—but by creating systems that do not generate waste in the first place. The fight against plastic waste begins at the source: it means eliminating single-use plastics and promoting alternative distribution and delivery systems. It also means building on the growing interest in a Zero Waste lifestyle.

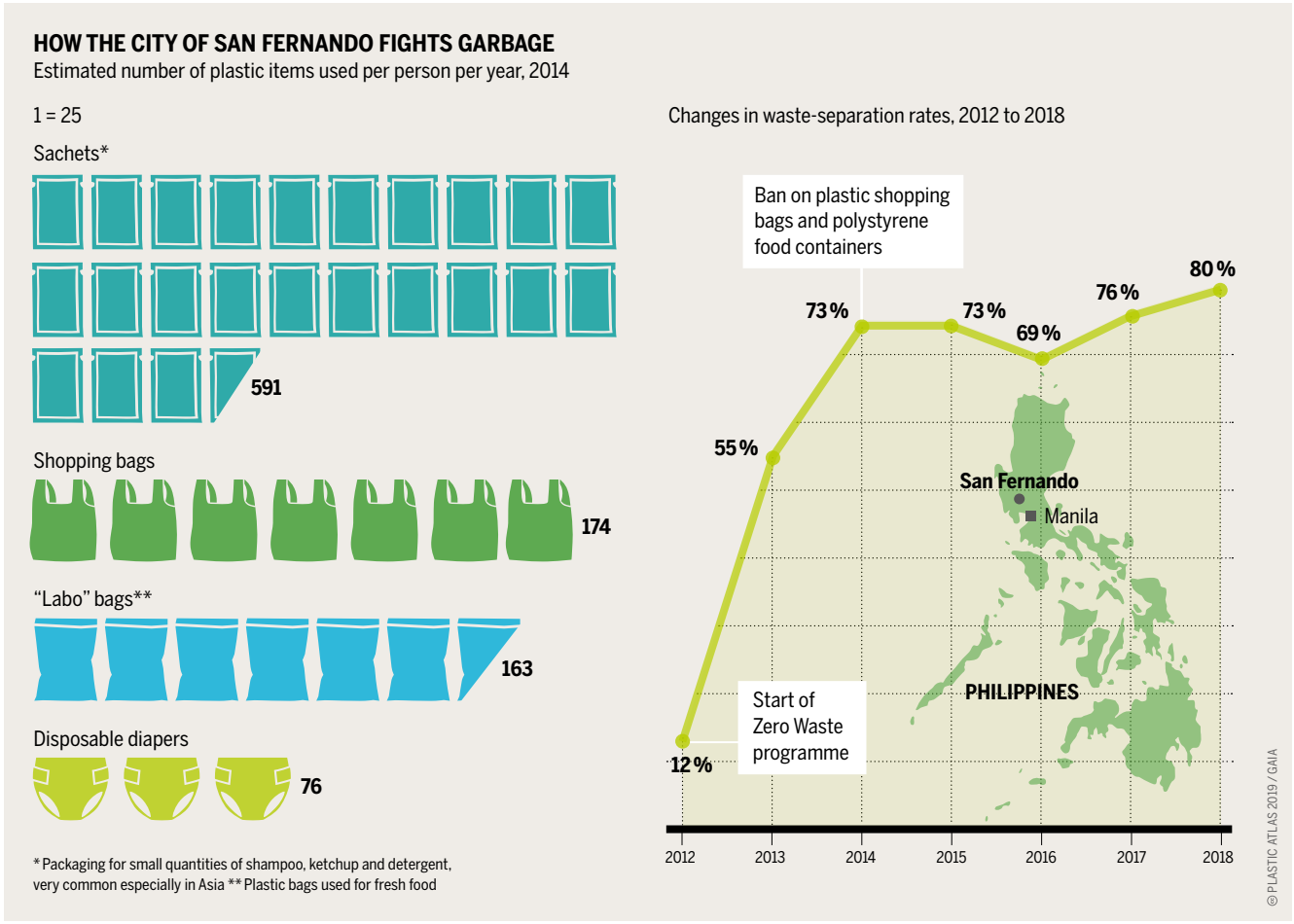
Capannori, in northern Tuscany, Italy, was the first town in Europe to set up a Zero Waste strategy in 2007, committing to sending zero waste for disposal by 2020. This municipality has developed a comprehensive approach: it aims to maximize material recovery by collecting different types of waste separately, and gives economic incentives to reduce waste at source. It strives to reduce residual waste in various ways. For example, it has opened packaging-free shops that sell

Zero Waste concepts are spreading across the globe. Some local authorities have been fighting the plastic crisis since the start of the millennium.

OVERFLOW BUFFER: ZERO WASTE STRATEGIES SHOW THE WAY
Overview of pioneering approaches to stem the tide of rubbish



DE=Germany, SL=Slovenia, IT=Italy, US=United States, PH=Philippines; GT=Guatemala; ZA=South Africa; TZ=Tanzania
* Packaging for small quantities of shampoo, ketchup and detergent, very common especially in Asia



San Fernando counted the waste it generated each day. It used the data to design its Zero Waste programme —from reduction to improved waste separation.

locally produced items, and installed public drinking water fountains to eliminate the need for bottled water. It has set up a reuse centre where people can take clothes, shoes and toys that they no longer need. These items are then repaired and sold to people on low incomes. The town also subsidizes washable diapers. It organises Zero Waste challenges to help citizens accept these initiatives and adopt new habits.

The results have been impressive. In the 10 years from 2004 to 2013, the amount of waste generated in Capannori dropped by 39 percent, from 1.92 kilograms to 1.18 kilograms per person per day. Even more impressively, the rate of residual waste per person fell from 340 kilograms per year in 2006 to only 146 kilograms in 2011. That is a fall of 57 percent. In the same year, the average person in Denmark threw away 409 kilograms of waste.

In the developing world, the spread of similar approaches is key to ensuring a just transition to a plastic-free economy. An example: in 2018, the city of San Fernando in the Philippines diverted 80 percent of its waste away from landfills by having a cooperative recycle it.

The city has taken a series of steps to further reduce its plastic-waste footprint. It has banned plastic shopping bags, affecting 9,000 businesses. It has set a levy on single-use packaging, and has made sure alternative options are available. It has achieved an 85 percent compliance rate among residents through continuous efforts to explain the approach: through house-to-house information, a regular radio show, dialogue with business groups, and individual meetings, for example with shopping malls that generate a lot of waste.

This has also been good for the city's finances. The annual cost of transporting solid waste to a landfill about 40 kilometers away has dropped by 82 percent. The savings have been used to hire more waste workers and improve waste-management facilities.

Capannori and San Fernando show that the path to Zero Waste must combine both "hard" and "soft" measures. "Hard" measures concern the waste-management system itself such as organic-waste management, the separate collection of different types of waste, decentralized and low-tech models, economic incentives, bans on certain materials, and waste minimization policies and practices. "Soft" measures include involving residents and businesses in all stages of policy development. This helps give rise to new business models, as well as generating savings that flow back to the community.

Plastics are so ubiquitous that it is unrealistic to expect to find a magic bullet; solving the plastic problem instead requires a holistic approach. Once this is identified, a self-reinforcing cycle is set in motion. When citizens post pictures of plastic-wrapped fruit and vegetables on social media and tag them with #DesnudaLaFruta (Spanish for "UndressTheFruit"), they promote a new plastic-free norm. Innovative business leaders help mainstream such Zero Waste forms of consumption. We only have to start questioning things that we have come to accept as normal.

TOWARDS BANNING SINGLE-USE PLASTIC BAGS IN TUNISIA

In order to fight the plastic pollution that Tunisia is experiencing given the increasing amount of plastic waste, a new governmental decree has been declared banning single-use plastic bags. This step was preceded by a series of procedures that paved the way for it, but the effectiveness of this decree is predicated on a strict implementation and a clear vision.

According to the United Nations report issued on 5 June 2018, the world uses nearly 5,000 billion single-use plastic bags (SUPB), which is equivalent to consuming approximately 10 million bags per minute. Many studies indicate that this has a severe impact on society and the environment. Since these bags are lightweight, they tend to fly and scatter in the natural environment. They clog running water pipes, which leads to floods in cities and the emission of unpleasant odors from sewage water. Additionally, these plastic bags are consumed by livestock, which leads to their entry into the food chain. It also breaks down into fine particles that are swallowed up by many marine creatures.

On 16 January 2020, a new governmental decree was published in the Official Gazette of the Republic of Tunisia (OGRT) to ban single-use plastic bags. The Governmental Decree No. 32 of 2020 was preceded by a number of measures that paved the way for it.

Given the seriousness of the situation and the environmental problems arising from the use of these bags, the Ministerial Council convened on 18 December 2015 to reduce the use of single-use plastic bags and replace them with other environmentally friendly bags. This initiative was launched in consultation with the leadership committee consisting of the Tunisian Union of Industry, Trade and Handicraft (UTICA) and the various relevant ministries, with the aim of agreeing on the ordinal text and definition as well as to determine the appropriate measures to promote the sector and support the industries affected by this ban.

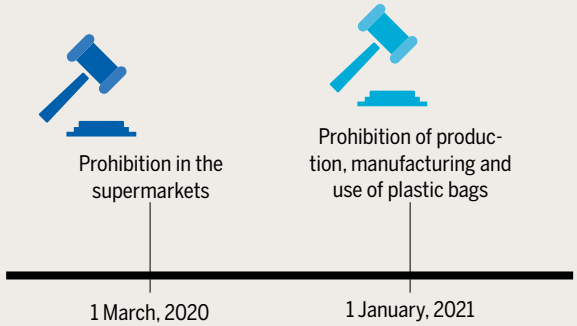
The decree, which was prepared by the ministerial departments, was subject to review and consultation and was sent to the Presidency of the Government to complete the procedures related to the issuance.

The first initiative to reduce the number of SUPB was implemented in supermarkets starting from the 1 March 2017, based on an agreement represented in a voluntary agreement concluded between the Ministry of Local Affairs and Environment and the UTICA in October 2016. Since then, SUPB are no longer available in supermarkets and have been replaced by reusable plastic bags.

As a result, a second initiative was implemented that included pharmacies that joined the campaign on 1 March 2018, based on the signing of an agreement by the Trade Union of the Retail Pharmacists of Tunisia (SPOT) in September 2017.

To reduce and mitigate the spread of plastic bags, Tunisia issued a decree.

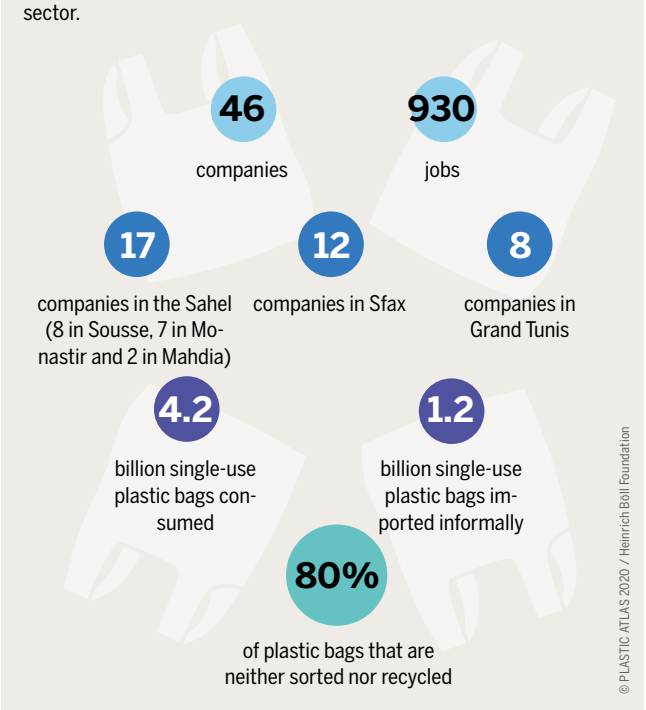
PROHIBITING SINGLE-USE PLASTIC BAGS WAS GRADUAL; FROM A SIMPLE AGREEMENT IN 2017 TO A GOVERNMENTAL DECREE RELEASED IN THE TUNISIAN GAZETTE ON 16 JANUARY, 2020.



Results of the diagnosis phase relating to the production of plastic bags aiming at launching a policy mitigating the use of packaging bags.

STATISTICAL DATA OF THE COMPANIES WORKING IN THE SECTOR OF SINGLE-USE PLASTIC BAGS

46 companies were approached to prepare the strategy to upgrade the sector.



KEY FACTORS FOR THE SUCCESS OF THE BAN ON SINGLE-USE PLASTIC BAGS (SUPB) IN TUNISIA

100% biodegradable

- Origin of the indicated raw materials
- Fair and strict regulations
- Compliant to Tunisian standard
- Well-defined collection and recycling system
- Raising awareness of citizens to reduce the use of bags
- Banning bags originating from the shadow economy
- Strict execution of the law
- Setting up monitoring indicators

The governmental decree of banning shall go hand in hand with some measures that may guarantee its implementation and will help protecting the environment.

What Is Stated in the Decree?

The decree identifies the types of plastic bags that are prohibited from being produced, exported, marketed, stored, and distributed free of charge or for a fee in the local market. This is for SUPB that are less than 40 microns or that have a capacity of less than 30 liters, and for primary packaging bags that are more than 15 microns thick, and biodegradable plastic bags.

However, the government decree has authorized the use of biodegradable bags provided that they bear the phrase "degradable bag" and the reference to the relevant technical standard or regulation. These bags must also meet the requirements related to biodegradation.

This ban took effect in commercial spaces from 1 March 2020, and will affect production, supply, marketing, and storage from 1 January 2021.

In order to ensure proper implementation of the decree, the Ministry of Local Affairs and Environment, in agreement with UTICA, conducted a study in 2017 that aims to diagnose the situation of SUPB production sector in order to find alternative solutions for the benefit of industrialists that result in a modernized strategic plan.

The diagnosis enabled a better understanding of the sector as well as the preparation of the sector modernization proposal and the allocation of resources to fund the program.

Since the decree aims to ban SUPB, it is worth preparing the necessary technical and legal framework to avoid circumventing the law. When it comes to the technical plan, two Tunisian draft standards, NT 22-44 (2000) relating to the SUPB reference standard and NT 22-45 (2000) relating to the weight of bags, are being finalized in consultation with the National Institute for the Standardization and Industrial Property (INNORPI) and other stakeholders.

On the legal level, a decision proposal is being prepared that sets the criteria for assessing the degradation of plastic bags and the regulatory mechanisms related to monitoring. This would regulate the control that the competent authorities carry out on the raw materials and degradable bags, and to put an end to the spread of bags from the unregulated and illegal sector.

In addition to the regulatory rules, the control of raw materials and biodegradable bags requires the presence of laboratories specialized in monitoring and specialized analyses. With this in mind, the Technical Center of Packaging (PACKTEC) and the International Center of the Technologies of Environment of Tunis (CITET) are preparing tests and analysis according to the NT 22.127 standard (equivalent to NFEN 13.432).

As for the production of reusable or biodegradable bags, many adjustments have to be made to the raw materials acquisition and manufacturing process. In conjunction with the issuance of the decree, it is worth putting in place a system for collecting degradable bags and urgently establishing industrial composting units.

There is no doubt that the Tunisian State has good intentions to confront SUPB. However, this is just the beginning of a long process. At an advanced stage, all plastic products, especially single-use plastic items, shall be included in the ban if the willingness to eradicate the plastic problem is strong.

Finally, it should be noted that addressing the phenomenon of the spread of plastic bags requires the preparation of a technical mechanism and strict legal regulations supported by effective mechanisms and strict control measures, in addition to the need to find urgent solutions for the informal and illegal sector.

TUNISIAN ISLANDS ARE SUFFOCATING WITH PLASTIC

Tunisia, with its sixty islands and islets overlooking the coast, suffers from a plastic plague that causes pollution that looms as far as the eye can see.

The island of Djerba, which hosts 117 hostels, is unique for its mass seasonal tourism, and it is a tourist destination of great importance, as the island received nearly 1.870 million tourists in 2018. However, this characteristic of being a tourist attraction has led to great pressure on the environment and natural resources. According to the municipality of Midoun and Houmet Souk, the volume of waste generated by hotels ranges between 35 and 40 percent of the total amount of waste that Djerba discharges annually, while plastic represents 11 percent of this waste.

The excessive production of waste, especially in the summer season, leads to an increase in plastic waste that scatters in nature and on beaches. This phenomenon intensified, especially after the closure of the controlled landfill in the Guellala area in 2012 and the disruption in the municipal system for waste collection. In the absence of a sustainable solution and a clear vision to solve the problem on the island of Djerba, the baling system that was proposed as a temporary solution in 2014 ended in April 2019 without preparing the ground for a lasting solution for waste treatment.

The cost of environmental degradation caused by domestic waste on the island of Djerba reached TND 14.1 million in 2014, which is equivalent to 1.1 percent of the gross national product of the island and 0.02 percent of the gross national product of Tunisia in 2014. Furthermore, the loss of opportunities that may have presented additional sources of revenue to the municipal budgets and to the public treasury (recycling, etc.) amount to TND 3.7 million (according to SWEEP-NET).

While the selective sorting process in hotels seems to be a simple matter in touristic islands, given that the various departments sort different kinds of waste, making the process a common practice requires proper organization and effectiveness by the involved actors to ensure achieving the desired results.

A positive factor is that waste sorting benefits the hotel sector. It enables reduction in waste collecting cost, backfilling and investing in technologies for waste recovery. It also creates new opportunities for waste collection and recycling companies and for tourism companies to obtain a trademark and environmental accreditation at the national and international levels.

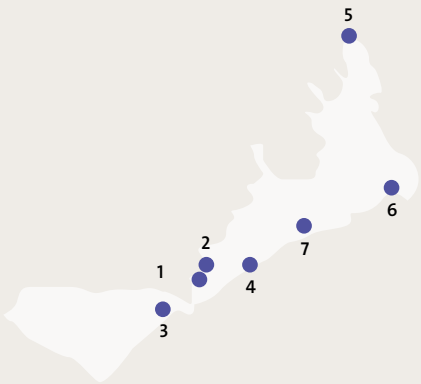
In this context, the Ministry of Local Affairs and Environment launched a project in 2018 that aims at starting the selective sorting at source in the entire island of Djerba, targeting the hotel and restaurant sector and the three municipalities of Djerba. While the communication plan of the selective sorting at source is being conducted, the operational aspect is still under discussion and very little progress has been noticed to date.

In parallel, pilot projects with a participatory approach were launched by the association of Amal Ghizen in 2019, aiming at raising awareness among citizens in the villages of Mezraya, Cedghiana and Guichaine in Houmet Souk in Djerba.

Kerkennah is an archipelago, with a perimeter of 160 kilometers, located about 20 kilometers away from Sfax. The island is hit hard by climatic change and is subject to a rising sea level and increased coastal erosion. In addition to this, the plastic problem has emerged in the last few years as a serious problem threatening the island and its marine ecosystem.

The following table displays the results of the samples and the extent of pollution on Kerkennah beaches according to the type of waste.

SAMPLING IN KERKENNAH



RESULTS OF THE SAMPLING PROCESS USING THE OSPAR METHOD IN PERCENTAGE

	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7
Plastic	75	71	94	86	65	81	74
Glass	3	2	2	1	2	0	18
Metals	16	18	2	7	13	5	4
Carton	3	5	0	2	5	4	2
Organic	0	2	0	0	0	0	0
Wood	1	1	0	0	0	1	0
Textile	1	0	0	1	0	4	0
Other	2	1	2	1	14	5	3

Source: Fieldwork by Wassim Chaabane and Amina Baccar Chaabane

QUANTITY OF PLASTIC WASTE THROWN IN UNCONTROLLED LANDFILLS, SEBKHAS, BEACHES AND COASTAL AREAS OF KERKENNAH

700 tons of plastic waste per year (bottles, bags and others) are thrown in uncontrolled landfills, sebkhas, beaches and coastal areas in Kerkennah.

The number of visitors increases during the tourist season leading to an increase in the volume of waste, which is estimated at 15 tons per day in the winter season, and from 30 to 35 tons per day in the summer. The waste collected on the island is buried in five random dumpsites due to the closure, for real estate reasons, of the Mellita controlled landfill, which was built since 2010. Likewise, the national system for the collection of recyclable materials "Eco-lef" suffers from mismanagement on Kerkennah Island as the volume of plastic has been limited in 2018 to only 7 tons (PET and PEHD), which corresponds to the amount collected by the private sector that operates outside Eco-lef.

Kerkennah Municipality lacks the financial and logistical resources to clean the coasts of the island, which is characterized by the scarcity of sandy beaches, which renders mechanical cleaning difficult. In order to identify the waste on the beaches of the Kerkennah Islands, sampling campaigns were conducted in the summer of 2019 on seven beaches of the Kerkennah Islands, using a method called OSPAR over a line of 100 meters from the shore of each station.

The identification process of the waste on the coasts of Kerkennah shows that plastic is the dominant material in all sample sites and is mainly represented in plastic bottles, caps and SUPBs, in addition to the strong presence of fishing waste, notably plastic nets and traps.

Today, there are many plastic fishing equipment such as nets and traps that fishermen lose or neglect, which leads to pollution of the sea, the decline of the beauty of the beaches, and harm to animals and plants to a fatal degree at times. The cheaper and more resistant plastic traps that are replacing traditional palm leaf traps are the best example of the rising dominance of plastic over fishing gear in Kerkennah and other coastal regions of Tunisia. These new equipment are usually manufactured by the fishermen themselves and then abandoned at sea after use for a certain time. Consequently, the plastic breaks down into fine particles causing the death of several marine mammals and fish.

According to the Food and Agriculture Organization (FAO), if the net is abandoned or lost at sea, it can continue fishing on its own for a period of months or sometimes years, killing an endless number of fish and other animals, especially since these nets need 600 years to completely disintegrate.

This pollution may have a serious impact on tourism and on the image of the place. Plastic pollution may also lead to contamination of the food chain when fish, plankton, and filtering organisms such as shellfish, ingest plastic particles.

In order to ensure the efficiency and sustainability of waste management in the Tunisian islands, dynamic strategies that take into account the location should be pursued. Additionally, the infrastructure for treating, evaluating and burying the waste collected on the islands should be prepared to carry out selective sorting at source.

The costs of waste management should be reviewed for all stakeholders to contribute to financial support for the authorities. The collection and recycling infrastructure on the islands should also be strengthened to support these activities. Given the high price of transportation, the State should support this activity to encourage small companies active in the sector and ensure their sustainability.

As for the Kerkennah Islands, where the plastic collection by the "Barbecha" is weak, the development of a system for recovering plastic bottles would represent a solution to increase the collection rate.

PLASTIC WASTE MANAGEMENT IN TUNISIA: TOWARDS A SHARED RESPONSIBILITY

Plastic, with its different sizes, presents an imminent threat to public health and one that is fatal for terrestrial and marine fauna and flora. The good management of plastic waste, which includes production, marketing, use, collection and recycling, is essentially linked to the economic policy, social aspects, and the environmental measures taken by the country.

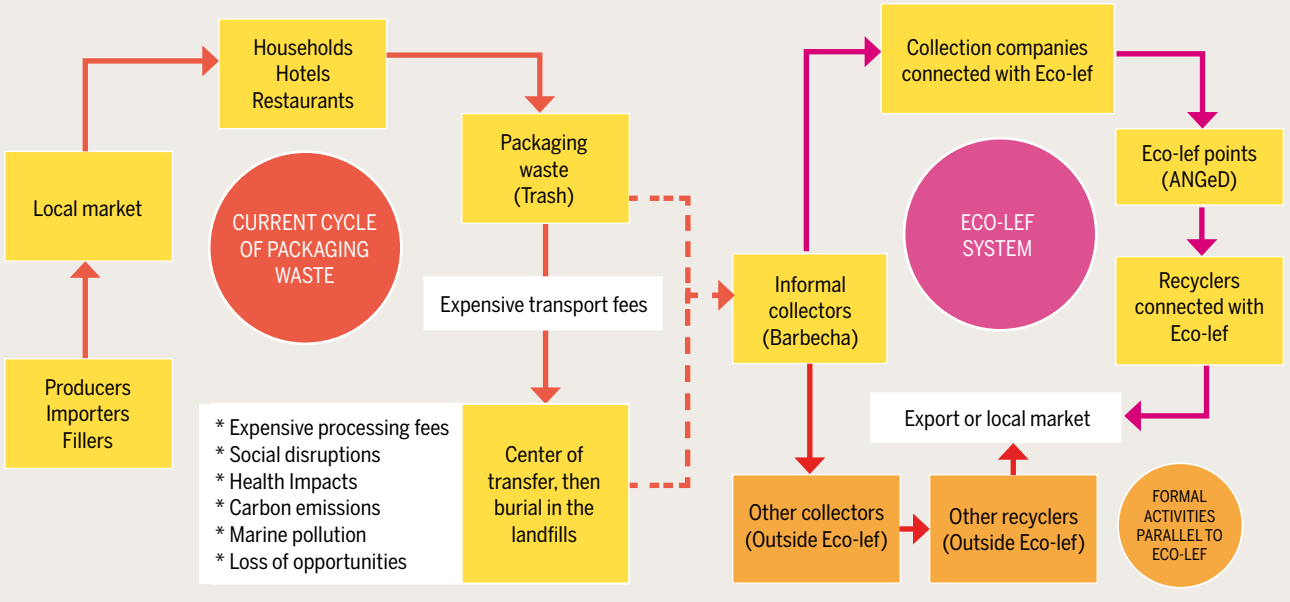
Since 1993, Tunisia has set up a national program for solid waste management in order to implement an integrated waste management strategy. Since its creation, the National Agency of Waste Management (ANGeD) started with rehabilitating the unauthorized dumps, establishing controlled dumps, and addressing emitted gas and leachate.

After the Revolution, waste management has been worryingly deteriorating in urban and rural areas, as reflected in the spread of black points due to the disruption in major waste collection operations, the sector's infrastructure, and the recycling chain. Nowadays, Tunisia produces more than 2.8 million tons of solid waste (9.4 percent of plastic waste), 95 percent of which is buried (according to ANGeD). Currently, the 8 operating landfills are coming to the end of their life and require alternative solutions that highlight waste recovery. The ANGeD currently manages a public system entitled "Eco-lef" which stands for the recovery and the diversion of used packages, in accordance with the provisions of decree no. 97-1102 dated 2 June 1997 laying down the conditions of recovery and management of packaging bags and used packages as modified by decree no. 2001-843 dated 10 April 2001.

On a practical level, the system encourages the private sector to collect packaging waste through establishing micro-enterprises specialized in collecting and selling the collected products to ANGeD. Most of the quantities are collected from households or landfills by rag pickers, known as "Barbecha". The agency ensures thereafter an equal distribution of these quantities to approved recyclers licensed by the system at a subsidized price. The selling conditions and prices are stipulated in an agreement related to collection and recycling, between both parties, namely ANGeD and the concerned company. Depending on the polymer type (i.e. plastic), 70 to 90 percent of the collected plastic waste is recovered. In the activity of recycling plastic materials, PET (transparent and flexible bottles) is generally collected,

The following table shows the possible cycles of packaging waste (including plastic) in Tunisia with 95 percent of landfilling and 4 percent allocated between Eco-lef and the active private sector outside the system (4 percent).

THE POSSIBLE CYCLES OF WASTE IN THE FORM OF PACKAGES IN TUNISIA



WHAT DOES ECO-LEF MEAN ?

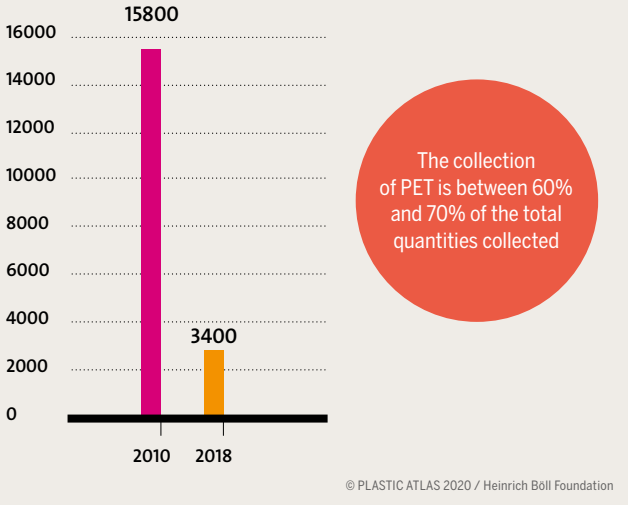
"ECO" stands for ecology, and "Lef" for packaging. It is a public system pertaining to the recovery of used packages, which came into being in 1998 following the application of the provisions of decree no. 97-1102 dated 2 June 1997.

WHY WAS THE ECO-LEF SYSTEM CREATED?

The ECO-Lef was created in order to:

* Reduce the landfilling of packaging waste
* Limit the negative impact resulting from leaving packaging waste in nature
* Promote recycling and packaging waste recovery

EVOLUTION OF RECOVERED QUANTITIES PER ECO-LEF
(IN TONNES)



Reduction in the quantity of packages collected within Eco-lef system

washed, and crushed on the spot and exported mainly to Turkey and some other countries such as Vietnam. As for PEHD (opaque caps and bottles), it is collected, washed, crushed, and transformed into raw materials in Tunisia.

Notwithstanding the big principles laid down in the law, there is currently no clear strategy in terms of sector development and no objectives regarding the results or the recovery rate to be achieved.

Created in 2001, Eco-lef is the first system for the management of packages in the MENA region and among the firsts in Africa. The system was built on a solid legal and an institutional basis. Today, and after twenty-three years of its activation, there is no doubt that it has contributed to the creation of a new first-order economic, social, and environmental sector. Nevertheless and despite all achievements and efforts, the performance and the governance of the current system is still very limited. In fact, very small quantities are collected compared to the massive quantity of plastic that continue to invade our environment at a stunning speed.

The Eco-lef system faces many challenges that are manifested not only by the decrease of collected quantities, but also by the decrease in the number of active recyclers and Eco-lef members. Today, there are only 70 institutions that are really active. The same applies to the number of Eco-lef collection points, which dropped from 63 points in 2010 to only 45 in 2018.

Obviously, the collapse did not spare the active collectors and Eco-lef members. In fact, only 180 remain according to 2018 calculations, whereas 230 were active in 2010.

Currently, the Eco-lef system is funded by voluntary contributions of some producers and by the support of the decontamination fund (FODEP) through a tax of 5 percent on turnover charged to importers and producers (funding based on the collected quantities and activities of each year). It is also worth noting that contracted producers of packages, in other words those with contracts with the agency, are not required to pay a specific amount since it is regarded as a voluntary contribution, especially in the absence of means of control. In addition, the payment is not flexible enough according to the needs of collectors and recyclers and the price of materials.

The organizational difficulties are mainly caused by the absence of selective sorting where the waste is produced. Even worse, the 8,000 informal collectors or "Barbecha" are not officially involved in the system, according to the ANGeD report, despite the key role they play by collecting 80 percent of recyclable waste.

In the same context, we notice that the consumer is not involved and therefore does not bear any responsibility.

Furthermore, the collection activity within the Eco-lef framework is related only to valuable materials (positive price on the market) such as beverage bottles type PET, PEHD, etc. However, the other types of packages are still not collected because of the absence of an appropriate infrastructure. Moreover, no incentive for innovation or for developing the recycling industry has been made in Tunisia. A large number of Eco-lef points have experienced equipment degradation, while other centers were taken over by the concerned municipalities without suggesting any alternatives.

In light of the current situation in Tunisia, we do not sense the absence of an overview of what is collected and of precise and reliable data of the packages placed on the Tunisian market.

The private sector is also active outside Eco-lef. It is prospecting new collection circuits and seeking to develop the plastic recycling and recovery. These activities are legal but represent a competition for the system. Unfortunately, there are no exact figures about collected plastic quantities by the private sector.

The Eco-lef sector needs to be refreshed and optimized to keep up with the new systems of extended producer responsibility (EPR) applied in developed countries. Under the EPR, manufacturers and distributors of trademarks, and importers who put waste-generating products on the market, should take charge of the organization and the funding of their packaging waste through an ecological system. Likewise, the EPR represents a chance for the market of collection and recycling in Tunisia as well as for the waste prevention at source through the improvement of the packaging design to make more recyclable products. The system will support municipal efforts in terms of waste management and will considerably reduce the costs of collection and treatment.

On a global scale, it has become very frequent that cities make strict decisions regarding single-use plastic. In Tunisia, the decentralization framework should start a real battle conducted by municipalities against plastic. In fact, the local authority can launch participative initiatives to reduce, sort, and recover plastic waste. It can even start to ban a few types of plastic by planning suitable programs and aim for long-term change.

ZERO MIKA OR THE DIFFICULTY IN GETTING RID OF PLASTIC BAGS IN MOROCCO

SOMETIMES, PASSING A LAW IS JUST NOT ENOUGH...

Four years after the ban on plastic bags in Morocco, one can notice that they are still used extensively. Efforts have been put into action to formalise this ban, but some of the approaches adopted since the law 77-15 was passed have had limited effects.

Morocco has created the image of being a country strongly committed to sustainable development, thanks to investment in renewable sources of energy and the organisation of the COP22 in 2016. Similarly, Morocco has also adopted a law to fight against plastic pollution. Beginning on 1 July 2016, the 77-15 law (commonly known as the Zero Mika Law) banned the production, import, sale or distribution of single-use plastic bags. Since then, the reality on the ground has shown that more than just a law is required to get rid of plastic bags. This is not surprising in a country that had the second highest per capita consumption of plastic bags in 2015.

Just before the Zero Mika law came into force, the communiqués from the Ministry for Industry stated that there were 26 billion plastic bags consumed each year in Morocco, or 800 bags per inhabitant. Plastic bags were used, and are still used, for a myriad of different purposes: to buy vegetables, buttermilk "lben", 200g of olives, as rubbish bin liners or even to cover old TV antennas since, apparently, it helps to better capture signal. It is in this context that the 77-15 law was passed in December 2015 with the total ban on plastic bags coming into force just 7 months later on the 1 July 2016. The passing of this law was met with strong resistance from the plastic industry and disbelief on the part of citizens who saw in this ban just another constraint to their day-to-day lives. Other countries, especially in Europe, have established less restrictive laws that announced the arrival of similar bans two years ahead of schedule in order to prepare public opinion and allow for a smooth transition for the industry.

A national communication campaign that lasted a month and a half was launched in June 2016 just a few weeks before the ban. The new law was also accompanied by a national campaign to collect plastic bags, organised by the Moroccan Coalition for Climate Justice (CMJC), a group of 150 NGOs that had the authorities' support. The majority of the bags collected were burned in cement factories or disposed in landfills. Until the end of 2016, the press reported on checks made on markets by authorities and the seizing of illegal stockpiles. Morocco was celebrated for its efforts, and visitors to the COP22 appreciated the cleanliness of its cities and countryside. In January 2017, the Ministry of Industry drew up a positive assessment stating that "since the coming into force of the law, the use of plastic bags has considerably been reduced: it has almost been eradicated from modern shops and the use of alternative products has seen an increase in smaller local shops."

At the same time as this ban, several alternatives were promoted. A support fund for the reconversion of companies was subsidised, to a maximum of 75.5 million MAD, so that they could produce paper bags, as well as woven and non-woven bags. These alternatives were called "environmentally friendly," despite the majority of them being made out of plastic. Non-woven bags are made of 100 percent plastic, using a polypropylene fabric, and are often called "fabric bags." Initially, they were sold by shopkeepers, but faced with customer dissatisfaction they are now given free of charge and have become just as disposable as the previous bags. More than three billion non-woven bags are produced in Morocco every year. 40 percent of financing from the support fund for the reconversion of companies went to non-woven bags and their production has increased by 56 percent since 2016.

In reality, the ban on plastic bags has had a particular effect on large supermarkets. However, since the start of 2017, plastic bags have progressively reappeared on markets and in small shops, which represent 80 percent of retail outlets in Morocco. In July 2018, on the second anniversary of the Zero Mika law, an investigation was carried out by the Zero Zbel Association and confirmed this idea. Carried out in 10 markets in Casablanca, Agadir and Tetouan, this investigation showed that customers on the markets still consumed large quantities of illegal plastic bags and that stall owners preferred to risk a fine than to risk losing their clientele if they didn't distribute plastic bags anymore. The main conclusion of this investigation was that efforts to check and punish must be concentrated on the informal sector producing plastic bags, which once again can be found everywhere in Moroccan markets, and not small shops that are at the end of the value chain.

In the days that followed the publication of the investigation results, the Ministry of Industry reacted positively and announced an amendment to the 77-15 law, which was adopted by the government in January 2019 (draft law 57-18). This amendment strengthened checks on manufacturers, targeted transparency on the import of raw materials that would be used to produce plastic bags and raised the amount of possible fines.

Despite these measures, plastic bags remain. This is clearly shown in the rush to purchase plastic bags that preceded the coming into force of the ban and continues to limit the efficiency of

the law. More participative decision-making, longer preparation times and a more significant effort to prepare citizens would surely have enabled the ban to be more efficient. The choice of promoting polypropylene alternatives also strongly limits the potential of reducing plastic pollution, which remains present in all its different forms. Real alternatives are there and are not costly, whether be it wicker

baskets, fabric bags, reusable rigid containers, or glass jars. It would be good to promote the use of effective and creative alternatives instead of continuing to subsidise alternatives that are, for the most part, still made out of plastic.

RESULTS OF THE INVESTIGATION CARRIED OUT BY THE ASSOCIATION ZERO ZBEL ON THE APPLICATION OF LAW 77-15

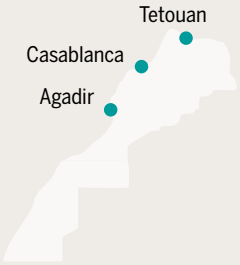
A PROJECT IN THE FIELD

The Study included:

5 days in the field

3 cities

8 markets



24 volunteers

KNOWLEDGE OF LAW 77-15 AND IMPACTS ON PLASTIC BAGS

90% of customers know law 77-15 exists

59% of people interviewed consider plastic bags to have a significant impact on the environment and health, while 18% consider them to have a moderate impact

People interviewed know of the 77-15 law. What is more, the public is, for the most part, aware of the negative impact of plastic bags

CHANGE IN CONSUMPTION OF PLASTIC BAGS SINCE LAW 77-15

49% of people interviewed consider that the consumption of plastic bags has remained the same or increased

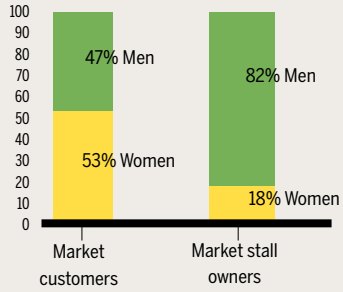
49% of people interviewed consider that the consumption of plastic bags went down but that they were still used

60% of market stall owners stated that more than 80% of their customers demand plastic bags

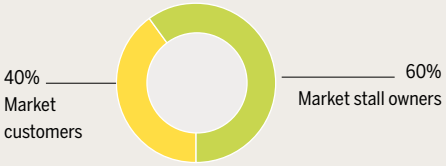
65% of customers said that they use between 5 to 15 bags every time they go shopping

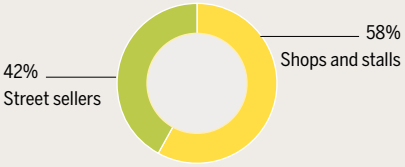
According to the statements of stall owners and customers at markets, it is clear that plastic bags are still casually used and this despite law 77-15 coming into force on 1st July 2016.

SURVEY OF MARKET STALL OWNERS AND CUSTOMERS



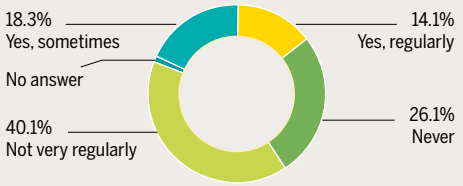
235 people surveyed





USE OF PLASTIC BAG ALTERNATIVES

Question to market stall owners:
Do you regularly have customers that use alternatives to plastic bags?



80% of market stall owners state that some (33%) or the majority (47%) of their customers who bring a basket (or similar) still pack their purchases in plastic bags.

In general, the use of alternatives to plastic bags remains limited. The majority of customers stated that they never or "infrequently" use alternatives. What is more, a large portion of customers who bring a basket (or equivalent) reportedly still use plastic bags.

A FORMAL SYSTEM... WITH INFORMAL CONNECTIONS

Plastic represents 10 percent of household waste in Morocco or around 690,000 tonnes a year. There is also a lot of plastic found in industrial waste (granules, industrial packaging waste...) and in waste produced by the agricultural sector.
Yet, only a very small portion of this is recycled.

Plastic waste of all sorts is the most visible form of waste in the countryside and nature in Morocco. Investigations carried out by the association Zero Zbel on beaches, mountains, and in the desert, on over 50,000 pieces of collected and categorized waste, showed that plastic waste is systematically the most common form of waste (on average 74 percent).

The plastic recycling sector in Morocco has a very limited number of formal actors (10 companies identified in 2015) that have been organized into professional associations and federations. There are, however, a multitude of informal actors who represent the vast majority of the industry (up to 85 percent of the turnover according to certain studies).

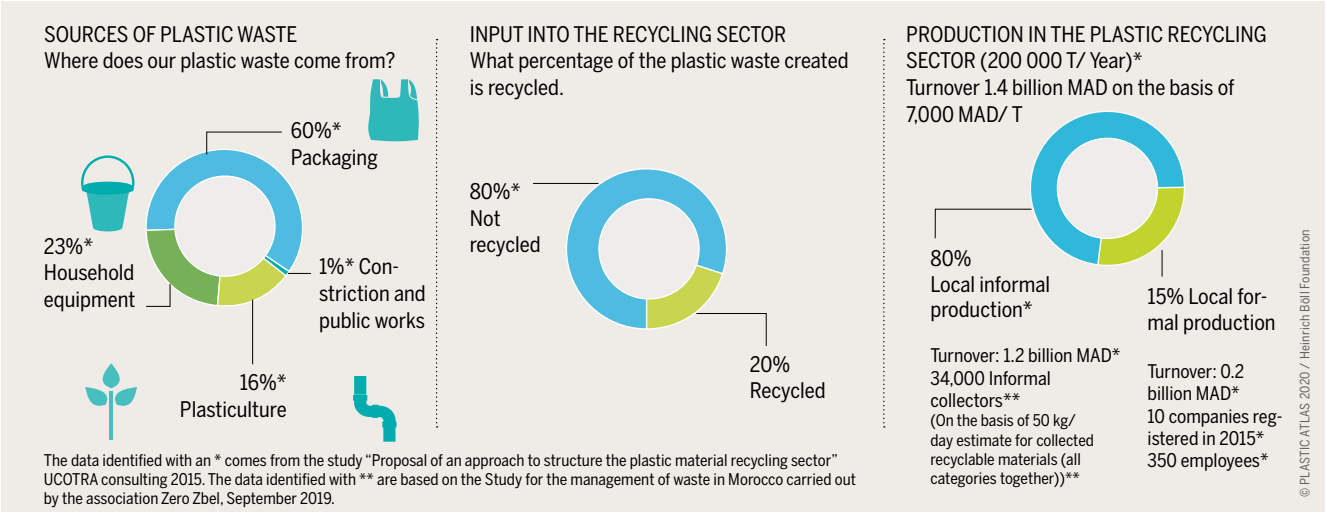
34 percent of plastic that gets sorted comes from landfills and 66 percent comes from cities, recovered at the level of household waste collection points by informal waste pickers, pejoratively called "Mikhala" or "Bou'ara." These men and women represent a fundamental pillar in the recycling sector since they are the only ones to enable the constant sorting of plastic waste needed to supply the industry. Yet, their working conditions are often incredibly harsh and unstable. Official figures estimate the number of informal waste pickers in Morocco to be between 7,000 and 10,000. According to estimates by the Zero Zbel Association, based on a calculation of the quantities recovered in the informal sector, there may be as many as 34,000. Several initiatives already aim to help organize these people into cooperatives to do the sorting work at the landfill, but those working in towns and cities have not been involved. Officially, twenty informal waste picker cooperatives exist, but even the most successful experience amongst them ends up sorting only 2 percent of the waste sent to the landfill where they work. Essentially, this is due to the time the waste spends in transfer centers, which reduces the quality of the recovered plastic, making it less viable for recycling. What is more, the lack of waste pickers' collectives makes it difficult to create a viable economic sector. The absence of organized plastic sorting systems at the source leads to plastic waste being dirtier in general, contaminated by leachate, fats, etc.

As a result the quality of the plastic is lower and recycling becomes more costly.

60 percent of plastic recovered for recycling comes from the packaging sector (bottles, tubs, caps, etc.). After sorting and collection by informal waste pickers, the waste is sold to semi-wholesalers, or directly to wholesalers in "guelssas" (intermediary depots) located in the city. The recyclable plastic material is then sold on to formal companies and, for the most part, exported abroad (France, Spain, Italy, Turkey, Asia...). A small part is recycled in Morocco, often at an uncompetitive price.

Given the difficulty of acquiring quality recyclable material (uncontaminated), the central role played by the informal circuit and the proven inefficiencies in sorting plastic waste, it becomes clear that reducing the dumping of waste and promoting the sorting of waste are the best means of significantly improving waste management in general and reducing plastic pollution in particular.

Efficient initiatives linking the decentralization of waste management and the integration of informal waste pickers already exist in many large cities of the global south (e.g. Manila, Bogotá, Buenos Aires...). These decentralized systems cost a lot less and are more efficient in creating jobs than systems based on sending waste to landfills and sorting af-



The data identified with an * comes from the study "Proposal of an approach to structure the plastic material recycling sector" UCOTRA consulting 2015. The data identified with ** are based on the Study for the management of waste in Morocco carried out by the association Zero Zbel, September 2019.

terwards. The city of San Fernando in the region of Manila in the Philippines made the decision to create small sorting centers by neighborhood and to employ former informal waste pickers to collect and sort. The cost of managing household waste was reduced by 70 percent, as 80 percent of waste was sorted for recycling. Only 20 percent ended up being buried in landfills.

In Morocco, it is essential to put in place a system that enables the sorting of waste at the source. On the one hand, officially authorizing informal waste pickers to recover recyclable waste in urban areas would enable their integrate into the recycling economy (formal system), to improve sanitary, environmental and economic conditions for their activities and to supply recycling factories with clean and cheap raw materials to transform. On the other hand, involving households would help people better understand and participate in transforming the relationship we have with waste.

In any case, prevention is better than cure. This means that it is essential and necessary to employ measures to reduce plastic waste early on to avoid pollution afterwards. In financial terms, preventing plastic pollution would be decidedly cheaper than trying to mitigate its ensuing external negative effects.

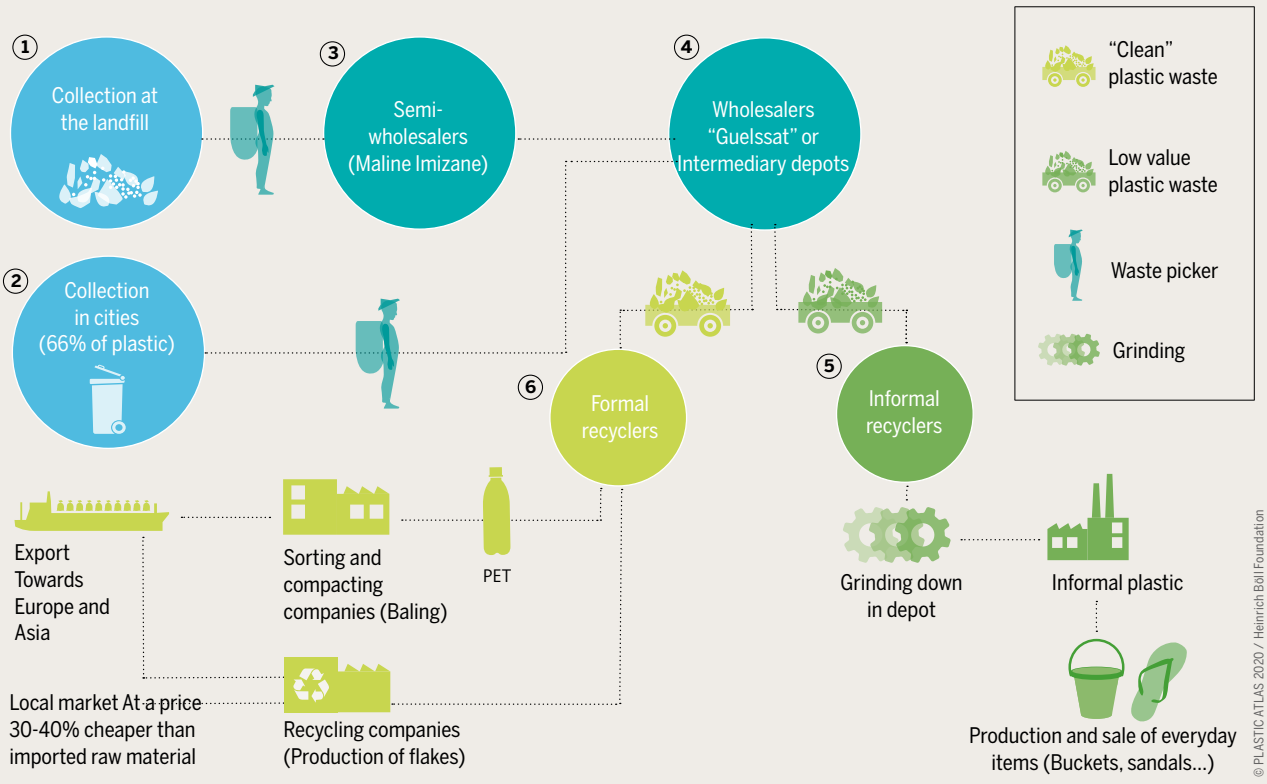
This way, legislators as well as citizens have a major role to play in order to encourage producers and distributors to sell their products without single-use packaging (in bulk or through reusable packaging), to effectively eliminate bags and disposable plastic products, promoting systems of refundable containers or any other viable and sustainable alternatives.

The government is also responsible. The existing eco-tax on factory production, sale, and import of plastic materials, which came into force in 2014 with a fixed rate of 1 percent ad valorem in the 2016 budget, must be reviewed and its funds used in a way that leads to a tangible impact on reducing plastic pollution. Creating systems of broader responsibility for producers is also needed to promote the design of environmentally friendly products for Moroccan consumers. This means that the state must encourage producers, though tax advantages and a regulatory framework establishing specific responsibilities, to choose to create "greener" consumable products, all while promoting alternatives such as refundable packaging systems, bulk selling of products and family offers.

Today, it goes without saying that the collection-sorting-recycling sector in Morocco is dominated by the informal sector, which accounts for about 90 percent. This sector provides 34,000 low-skilled and often illiterate workers with a means of living and opportunities for personal and professional development. Nevertheless, the sector harbors many uncertainties which do not encourage extensive investment. The lack of professionalization penalizes the competitiveness of the entire Moroccan plastic sector on the international market. The reasons that hinder the development of this sector are many, and they can only be fully engaged with through multi-party contributions and a national debate including all the relevant stakeholders.

THE COLLECTION AND RECYCLING SYSTEM FOR PLASTIC WASTE IN MOROCCO

Sold at 4 MAD per kilo to wholesalers in the city or semi-wholesalers at the landfill, plastic waste is sorted and follows 2 different circuits depending on its quality. Low value waste (5) is ground down then sold on to informal plastic producers, who primarily make items for day-to-day use (buckets, sandals...), which are sold on the local market. Plastic that is used in the formal sector is of a higher quality (6). PET is taken to sorting and compacting companies before being exported in bales. While the rest goes to local recycling companies, where the plastic is ground down, transformed into granules and exported for around 7,000 MAD/T, or sold on to the local market at prices that are 30% to 40% cheaper than imported raw materials.



PALESTINE: SOLID WASTE MANAGEMENT UNDER OCCUPATION

Palestinians face many difficulties in solid waste management due to the policies of the occupation, but waste amounts are increasing due to both population growth and consumption patterns. This calls for better management and a concerted effort among all sectors to find solutions to this problem.

Being under Israeli military occupation, for 53 years now, Palestinian governmental bodies are struggling to solve the problem of solid waste. In the West Bank, settlements are encroaching onto Palestinian communities, not only confiscating land and natural resources along the way, but also stripping away Palestinian control and jurisdiction, whatever of it remains anyway. Since the establishment of the Palestinian National Authority (PNA or PA) in 1994, Israel has used the newly established authority as a scapegoat to spare itself the burden of providing the essential services –its duty under international humanitarian law– like collection and disposal of solid waste. At the same time, Israel maintained its absolute control over every aspect of Palestinians' lives. However, with a growing Palestinian population –now around five million in the West Bank and Gaza Strip–trash has been piling up. This has left the PA scrabbling to find solutions amidst a plethora of complications, restrictions and an overall messy geopolitical situation.

General Overview on Waste

In 2019, Palestinians generated nearly 4,333 tons of solid waste per day or a total of around 1.58 million tons the entire year, which is equivalent to around 0.87 kg/capita/day (0.9 kg/c/d in the West Bank and 0.7 kg/c/d in Gaza). These amounts, which include East Jerusalem, are projected to increase by around 4 percent annually due to both population growth and current consumption patterns. About 65 percent of municipal waste (MW) is disposed in sanitary landfills, while the remaining is disposed in predominantly random/illegal dumping sites that are a constant source of pollution to the Palestinian environment. Despite the success in managing to close 52 random dumping sites between 2010 and 2016, tens more still exist, taking up hundreds of dunums of land (1 dunum is 1,000 square meters). Add to that the dangerous phenomenon of illegal burning of electronic waste in order to extract raw materials such as metals from wires; an activity that is spreading toxins at alarming rates in many areas, such as Ithna in Hebron.

There are currently five major sanitary landfills in Palestine, three in the West Bank (Jericho Landfill in Jericho, Zahret Al-Finjan in Jenin, Al Menya in Bethlehem), and two in the Gaza Strip (Sofa (Al Fakhari) and Johr Al Deek). Additionally, in 2018, a dumpsite in Beit Anan in the Jerusalem area was turned into an engineered landfill; thought small, it has helped absorbing some of the waste from the surrounding areas as well as from Ramallah and Al-Bireh. The increasing amounts of municipal solid waste is forcing these landfills to function over-capacity and threatening environmental standards on their grounds and on the surrounding environment. If additional ample spaces are not made available, whether by adding cells to the existing landfills or by constructing new ones, they can no longer qualify as being "sanitary". This is vital especially when considering that the National Strategy for Solid Waste Management in Palestine (NSSWM) 2017—2022 set a target to increase the coverage of sanitary landfills from 53 percent in 2017 to 100 percent by 2022.

Furthermore, the waste arriving from the illegal Israeli settlements exacerbates the already dire situation of these overburdened landfills. Currently, there are over 200 Israeli settlements in the West Bank housing a settler population of more than 620,000. While there are exclusively-Israeli landfills operating in the West Bank, Al Menya Landfill for instance receives waste from the nearby settlements. Additionally, waste from settlements is illegally dumped in numerous random sites, mostly located near Palestinian communities, and with no monitoring or accountability. In September 2016, Afaq Magazine revealed that Israeli toxic organic and non-organic waste is dispersed over thousands of dunums west of the Jordan River and North of Jericho. It also revealed that toxic Israeli compost and contaminated waste is being dumped in open lands near Al-Auja Spring in Jericho, pausing the threat of pollution to the soil and springs in the area. Furthermore, sources of the same magazine indicate that more than half of the electric waste generated in Israel is disposed in the West Bank.

The issue with external sources of waste does not stop here. Israel has been systematically transferring its hazardous waste into the West Bank. In December 2017, the Israeli human rights organization B'Tselem revealed the operation of 15 waste treatment facilities in the West Bank. These facilities process hazardous waste and dangerous substances such as medical waste, solvent waste, oil waste, metals, electronics and batteries, as well as sludge. Although the facilities are intended to treat waste, B'tselem says it is still a polluting industry that could have implications on the environment and public health. The report describes Israel's actions as turning the West Bank into a "sacrifice zone" where Israel's strict environmental regulations do not apply and where the cost of random disposal is much cheaper, thus allowing Israeli businesses to profit illegally at the account of Palestinians. Palestinian authorities have been trying to challenge the illegal transfer of this hazardous waste through the multitude of international conventions and treaties ratified by the State of Palestine in recent years. Most importantly, they have submitted several complaints and reported numerous violations

to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

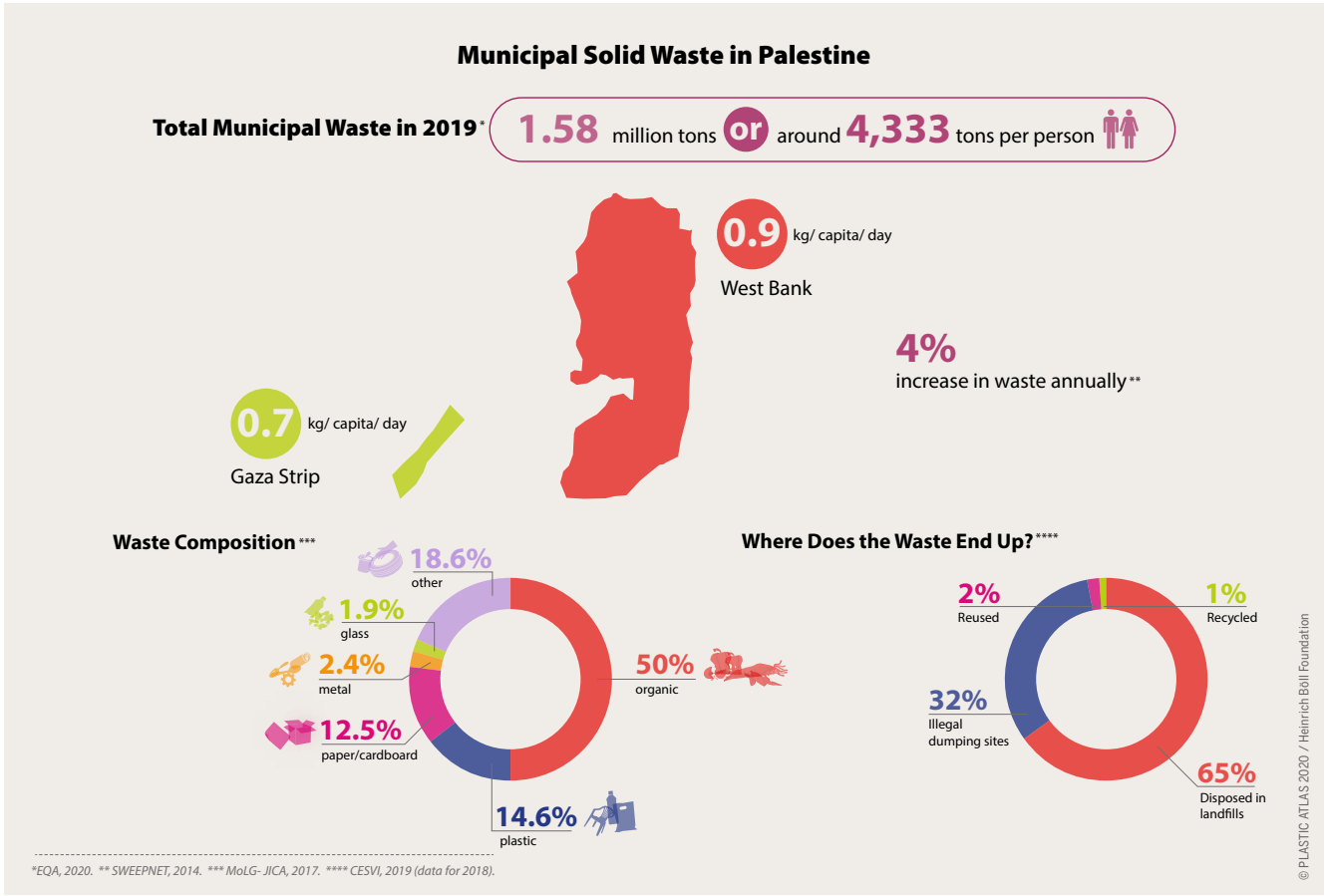
The Legal Framework between Theory and Practice

At the legislative level, the PA has achieved substantial progress in regulating solid waste management. The most relevant laws are: Local Authorities Law No.1 (1997), Environment Law No.7 (1999) amended in 2013, Public Health Law No.20 (2004), modified Palestinian Basic Law 2005 Article (33), Medical Wastes Management cabinet decision No. 10 (2012), Joint Services Councils (JSCs) Bylaw approved by cabinet (2016), Solid Waste Management cabinet decision No. 3 (2019), and most recently there are two new draft laws expected to be adopted, one on construction and demolition waste and the other on hazardous waste. While issuing these laws along with a number of strategic plans is a step in the right direction, implementation and enforcement on the ground are very weak. National strategies and plans can be characterized as being overambitious, as many of their targets are often not met. Take for instance the target in the National Development Plan (NDP) 2014-2016 to increase the percentage of recycled solid waste to 25 percent by 2016, which according to the NSSWM 2017-2022 made up less than 1 percent in 2017. The latter once again set a new and overly ambitious goal to reach 30 percent by 2022. This indicates a serious problem at the managerial level due to administrative, financial, and technical reasons. Among the financial issues is the inability of service providers to collect service fees, achieve cost recovery, or abandon the dependency on international donor funds.

The aforementioned however, is by no means the only hurdle for the development of the sector. Israel's permit regime in the occupied Palestinian territory (oPt), which extends to all aspects of life including which areas Palestinians are allowed to access or not, remains the main impediment to the implementation and operations of infrastructural projects. All projects in the West Bank have to be approved by the Israeli Civil Administration (CA), which deliberately delays many vital infrastructural projects, and rejects some altogether. For example, Rammun Landfill in the Ramallah and Al-Bireh Governorate was proposed in 2003 with pledged funding from the German Development Bank (KfW). Until today, it has not been implemented yet due to issues with the CA's approval.

In Gaza, due to the Israeli blockade imposed since 2007, restrictions on the entry of materials have prevented the implementation of vital infrastructural projects, not only in solid waste, but also in water and electrical power. These Israeli policies have persisted despite condemnations by the international community and the heavy involvement of international donors in such projects. The population, over two million, entrapped in Gaza is already suffering from an environmental catastrophe in an area that has been deemed "unlivable". There must be stronger action by the international community not only to stop the environmental deterioration in Gaza, but also to give the Palestinians justice and their right to self-determination.

The Palestinian Local Authorities Law No.1 (1997) delegates all responsibilities for solid waste management to Local Government Units (LGUs), a reference to local bodies such as municipalities and village councils, under the supervision of



the Ministry of Local Governance (MoLG). Their responsibilities include the collection, transportation, sanitary disposal and recycling (if any) of municipal waste. As there were so many of these local bodies, some of which simply are too small and/or with insufficient capacities to take on the responsibility of solid waste management by themselves, many used the option provided in the aforementioned law and merged together to form joint service councils (JSCs). Today, there are 13 JSCs operating in the West Bank (including East Jerusalem) and 2 in Gaza. In refugee camps, the situation is a bit different, as the United Nations Relief and Works Agency for Palestine Refugees (UNRWA) is the one responsible of waste collection and transportation. In recent years, UNRWA has faced financial difficulties that led to the temporary stoppage of solid waste services on many occasions, resulting in the unbearable accumulation of waste, evident even to cars driving by the camps.

What About Recycling and Reuse?

Attempts for waste sorting and recycling in Palestine have been marginal. It is estimated that only 1 percent of all solid waste is currently being recycled. In a 2010, around a quarter of recycling in Palestine was that of plastic (Musleh & Khatib, 2010). This percentage is increased to 3 percent when including recovered or reused materials. Nonetheless, there is an exceptional potential for recycling and composting not only to help solve the problem of the increasing amounts of solid waste but also for improving cost recovery and generating new job opportunities. This is especially true when considering that biodegradables and recyclables constitute the majority of solid waste generated in Palestine.

The current recycling and reuse sector in Palestine is relatively small and significantly informal in nature. It includes recycling of glass, plastic and paper/cardboard, hence producing raw materials for local industry but more so for industries in Israel and abroad. The reuse of metal is also taking place, but mostly unaccounted for in the municipal waste stream as it is being diverted through its purchase by travelling trucks that are roaming the streets to collect it from households and institutions. There are some successful examples of waste separation and recycling such as the one in Al Menya Landfill, where some waste materials such as plastic, metal, cardboard and glass are transferred for recycling as well as organic waste that is turned into low quality compost used at the landfill. These types of efforts must however be ramped up to increase the percentage of recycled waste especially that most other current projects are pilot ones and have not achieved the results hoped for at the national level.

As most of the recyclable waste is mixed with other municipal waste, there must be increased efforts for separating waste to encourage further recycling. There are 15 transfer stations in Palestine, receiving about half the waste gathered by JSCs. Recycling policies and the concept of the 3 Rs (reduce, recycle, re-use) are mentioned in official documents, however separation at source is not implemented sufficiently and waste minimization is nearly non-existent. Separation at the household level is needed more than ever in order to avoid the contamination of recyclables when mixed with other municipal waste. However, more importantly, what is needed is a change in consumption patterns arising from the current economic system, and awareness on the need to reduce waste. As has been professed in many parts of this Plastic Atlas, we cannot recycle our way out of the plastic and solid waste problem. Palestinians can actually refer back to the sustainable lifestyle of their ancestors and the rich traditional knowledge and practices that were intrinsically environmentally friendly.

Additionally, organic waste, which makes up around 50 percent of the total municipal waste can be decreased dramatically with simple practices such as composting for gardening at the household level, where possible or on larger scales. Furthermore, plastic is a global problem that is getting worse by the day, and it is contaminating our environment and damaging entire ecosystems. Despite political constraints, Palestine must be part of the global effort to confront the plastic problem. This can only be achieved through a consorted effort by governmental bodies, civil society organizations, and environmental and social activists to raise awareness on the issue at the community level, urging people to refuse the use of plastic in their daily activities, and to reduce waste in general. In parallel, manufacturers and traders must be urged to abandon plastic, moving to more environmentally-friendly materials. They must also be held responsible for their contribution in flooding the market with plastic.

Initiatives

In recent years, awareness on the issue of waste has been on the rise, and many Palestinian community-based initiatives have emerged. Their wide-ranging campaigns and activities have revived the spirit of volunteerism and promoted local-community-supported solutions to big problems. These initiatives are tackling the solid waste issue through different approaches and means, all of which are inspiring. They can be placed in the following categories: volunteer groups leading awareness and cleanup campaigns in both rural and urban areas; initiatives and enterprises on recycling paper/cardboard and plastic, as well as engineers producing building materials from construction waste and the rubbles of destroyed building; individuals or start-ups conducting entrepreneurship projects and creating mobile applications and platforms for material recycling and reuse; artists initiating projects for upcycling of all sorts of materials; individuals and groups raising awareness through blogs and other social media platforms; and finally civil society organizations and community-based groups carrying out awareness campaigns. Additionally, other environmental and agroecology activist groups are also contributing to a discourse that promotes waste reduction and adoption of a more sustainable lifestyle.

These initiatives may be small and may not be able to solve the solid waste problem by themselves, but they give hope for better awareness and a collective consciousness on the issue of waste. We can only wish that their work culminates in a joint effort among all sectors, as well as a stronger political will to address the problem of waste and other environmental issues in Palestine.

IN JORDAN, GOVERNMENTAL MEASURES ARE LIMITED TO SOLID WASTE, ALBEIT SHY INITIATIVES FOR SORTING AND RECYCLING

In light of the absence of governmental plans and programs for waste management in Jordan, sorting and recycling processes for plastic waste are limited to individual initiatives by activists and environmental organizations. Solid waste rates have increased to about 1.662 million tons annually, despite the existence of legislations that regulate this process.

Jordanians do not pay much attention, as they dispose of plastic waste in random ways, to the "catastrophic" effects of their behavior on the environment; an act that may be fatal to animals and marine organisms and even leads to the destruction of nature. Plastic and solid municipal waste, be it from domestic, industrial, or medical sources, finds its way to containers disbursed in residential neighborhoods in various regions of the Kingdom, often without sorting and later without recycling, only to be left to its fate in nature until it is buried in landfills. With the expansion of cities and urban areas in different parts of Jordan, municipal solid waste increases by the day. According to estimates by the Ministry of Local Administration, the volume of waste received at the 19 landfills scattered in various regions of the Kingdom was approximately 1,662,939 tons in 2019. Organic waste constitutes approximately 50 percent of the total waste volume, while the plastic recyclables constitute 16 percent, paper waste 15 percent, and metal waste is 2 percent, all according to the second State of the Environment Report for 2016.

Trivial as it may seem, the situation is alarming given the high rates of population growth, which reached 2.2 percent as a result of forced migrations to Jordan that occurred in the recent period, as well as the increase in industrial activities. All of this leads to enormous volumes of different kinds of waste from agricultural, municipal, construction, and industrial sources, as well as from ports. The health crisis that swept Jordan and the rest of the world since the end of 2019 only exacerbates the challenges that the waste management sector is witnessing in the Kingdom. Statistics by the waste treatment department at the Greater Amman Municipality (GAM) indicate that incoming waste to the east Amman transformational station has reached 29,855 tons, due to the response to this pandemic, in the period between 17 March and 10 May 2020.

Despite the negative impact of plastic waste on natural resources such as soil and water, the official statistics issued by various authorities in Jordan fall short from mentioning the annual quantities, let alone detailing them. The study prepared by the Royal Marine Conservation Society of Jordan (JREDS) remains the only study that specifies the extent of this problem, but it is limited to Aqaba Governorate only. The study deals with the garbage collected on beaches and from the sea during clean-up campaigns and indicates that approximately 7 tons of solid waste were collected in the 2015 campaigns, over 65 percent of which was plastic waste. In 2016, 3 tons of waste were collected. The outcome of the 2017 campaign came out with a bit more than 450 kilograms of waste. This significant decline in the weight of collected waste came as a result of the increased number of campaigns organized periodically by JREDS reaching about 20 campaigns per year in addition to the diversification of targeted collection sites in each campaign. JREDS is not alone in this mission, as it partners with Aqaba Special Economic Zone Authority (ASEZA) through projects implemented for that purpose, along with partnerships with local organizations.

The reason for the lack of statistics on this type of waste in the Kingdom could be attributed to the fact that official interest is limited to plastic shopping bags. In 2017, the Ministry of Environment had issued a regulation regarding "biodegradable plastic shopping bags". However, the enforcement of the regulation, which bans the production, import, and circulation of black plastic bags except for those used for waste collection and agricultural seedlings, came almost two and a half years late. In December 2019, in coordination with the industrial and trade sectors, the Minister of Environment, Dr. Saleh Al-Kharabsheh, issued a ban on black plastic bags that could be implemented immediately. This came as a surprise to many in the plastic production sector. Although they support the Ministry's move to protect both public health and the environment, their concern stems from the fact that converting their production lines to manufacture these types of biodegradable bags needs time. However, some citizens expressed their fear that merchants would take advantage of this decision by imposing additional, possibly high, prices on plastic shopping bags, especially if they were made from paper. These concerns did not impede a number of inspection campaigns by the Ministry of Environment on establishments that produce, trade, or import shopping bags. According to statistics by Jordan Food and Drug Administration (JFDA), more than 30 million plastic bags are thrown every year in Jordan, an average of 584 bags per person. These bags are manufactured by more than 400 factories, of which 200 are properly licensed.

Despite the various legislations enacted by several government agencies to address solid waste, primarily plastic, be it through its sorting or recycling in order to mitigate its

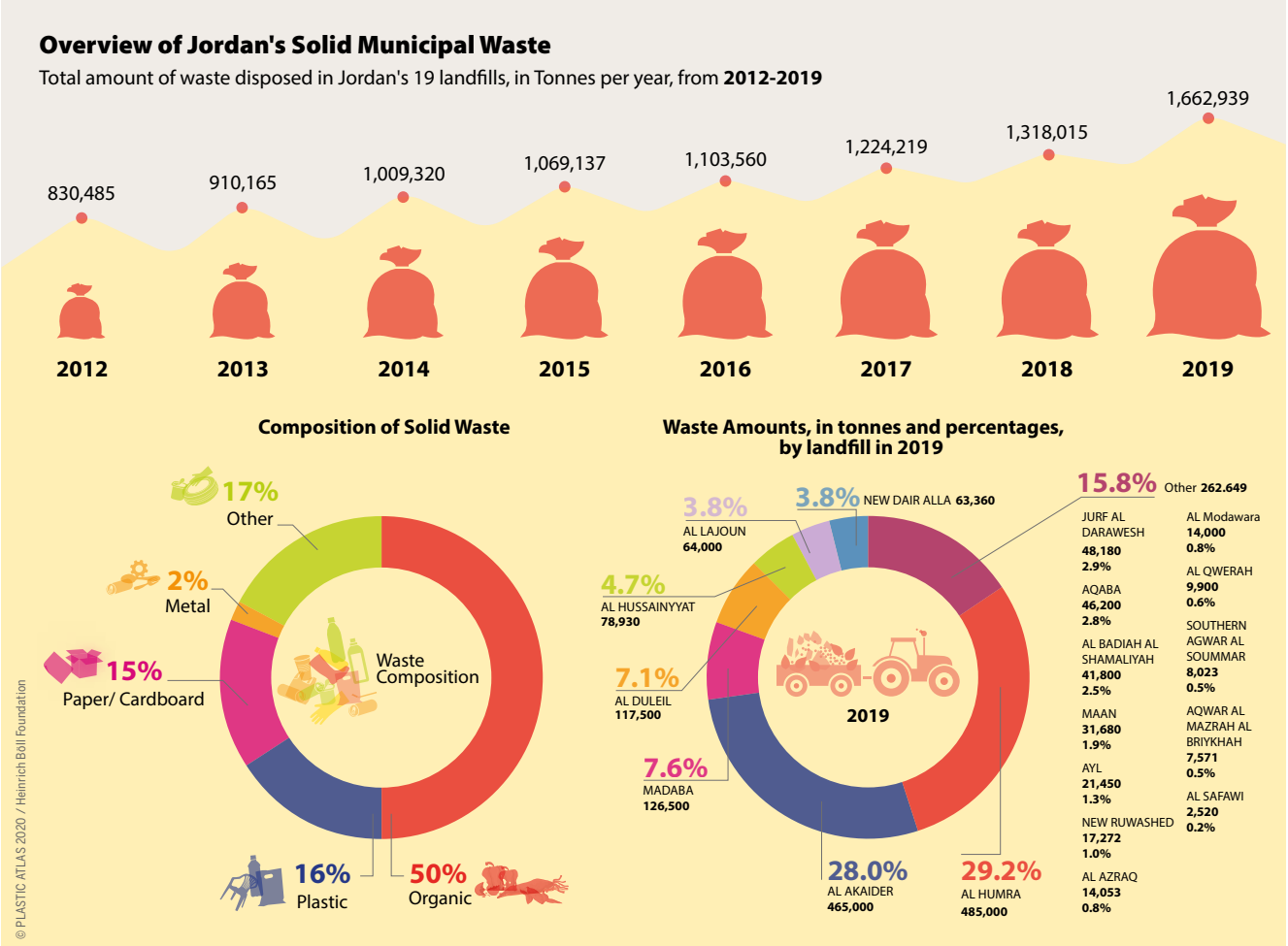
environmental and health impacts, the problem persists. This is due to limiting the efforts of governmental and private entities in Jordan to managing municipal solid waste only. At the top of these bodies is the Ministry of Environment, which is responsible of planning and developing policies and legislative frameworks, while also monitoring the environmental performance of each of the practices and methods used in the disposal phase. The responsibility for this mission is shared with the Ministry of Local Administration through the 100 municipalities affiliated with it and that are spread out through the Kingdom's different governorates, in addition to the 21 joint services councils. The responsibility for waste management in the capital, Amman, is part of the tasks assigned to GAM. ASEZA is responsible for these matters within the boundaries of Aqaba Governorate.

Realizing the importance of waste management in light of pressures resulting from the increasing quantities of waste, the Ministry of Local Administration launched the National Strategy for Solid Waste Management in 2015, which the government adopted as a developmental plan until 2024. The Strategy aims to upgrade and advance solid waste management systems as well as to improve fiscal management and technical operations towards optimizing the use of the available resources by reducing costs and improving the quality of services provided by the municipalities. In order to ensure full implementation of the Strategy, the Ministry of Environment developed a short-term implementation plan based on policies and indicators as well as topics, all identified through the development of practical steps and measurement tools especially designed for it.

Experts and specialists believe that the regulatory and legislative measures adopted by the Ministries of Local Administration and Environment are insufficient, as they fall short from addressing the issues of sorting and recycling on the one hand, and alleviating the environmental and health problems caused by plastic and other waste on the other. However, everyone is awaiting the implementation of the waste management law that the parliament approved at the beginning of 2020. For the first time, the provisions of this law allow to form higher steering committee for waste management to be headed by the Minister of Environment.

When heading south, namely to the Aqaba Governorate, the situation is completely different. ASEZA, which issued in 2001 the Regulation for the Protection of the Environment in the Aqaba Special Economic Zone, is responsible for taking measures related to waste collection as well as for preparing regulations for the construction of stations and landfills. This Regulation reveals to tourists and citizens who set foot in the city the keen interest in the cleanliness of neighborhoods and streets. In 2015, the Prime Minister's approval of a regulation for waste collection and general hygiene in Aqaba Governorate supported the ASEZA's efforts to manage waste, at a time when a regulation on plastic bags was already being enacted.

Apart from legislations and laws enacted by the government and the authority, sorting and recycling projects are



also on the agenda of some of the official bodies, but in general, they do not target plastic waste. GAM is implementing the project "Climate and Resource Protection through Circular Economy (separated collection at source)", funded by the German government and in cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), in three neighborhoods in the capital, Amman. The project aims to improve the solid waste management system by encouraging separated collection of waste at source. Among the governmental initiatives to develop the solid waste management sector in Jordan, it is worth mentioning the cooperation with international bodies to improve the infrastructure through implementing several projects, including the establishment of 11 stations for sorting purposes, recycling, and the production of organic fertilizer.

Nonetheless, plastic waste recycling remains limited to individual efforts by civil society organizations, some citizens, and environmental activists. According to a report published by the Environment and Development Magazine in May 2020 on the Jordanian experience in the field of solid waste management, theoretically, had Jordan recycled its plastic waste, it would have been able to recover 187,000 tons annually from this material. The untapped energy in solid waste is estimated at 4 percent of Jordan's oil consumption, bearing in mind that Jordan collects more than 95 percent of its waste, while the Arab world collects on average no more than 50 percent of its waste, according to the same report.

Among the successful individual youth initiatives in the field of separated collection and recycling in Jordan, a team of engineers launched a mobile phone application in early February 2020. The app aims at collecting plastic, paper, and cardboard waste, for recycling. This application, which is called "Green Go" and is the first of its kind in Jordan, includes a set of guidelines and steps to be followed by the individuals, companies, institutions, and others to set a permanent account though which a waste collection vehicle can be requested. The service currently reaches three governorates, namely Mafraq, Amman, and Zarqa. Irbid will be added at a later stage.

Such individual initiatives and those implemented by a number of civil society organizations in Jordan intersect with governmental strategies, regulations, and instructions issued to manage the solid waste sector. However, they focus more on waste separated at source as well as recycling of plastic and paper waste, among other materials. At the same time, such initiatives demonstrate serious intention among citizens, especially the youth, to find creative technical and technological solutions to deal with the problem of plastic waste in the Kingdom in order to preserve the environment. This is how Jordanians join the ranks of many in their generations around the world, who are launching campaigns and initiatives to protect their livelihoods and planet.

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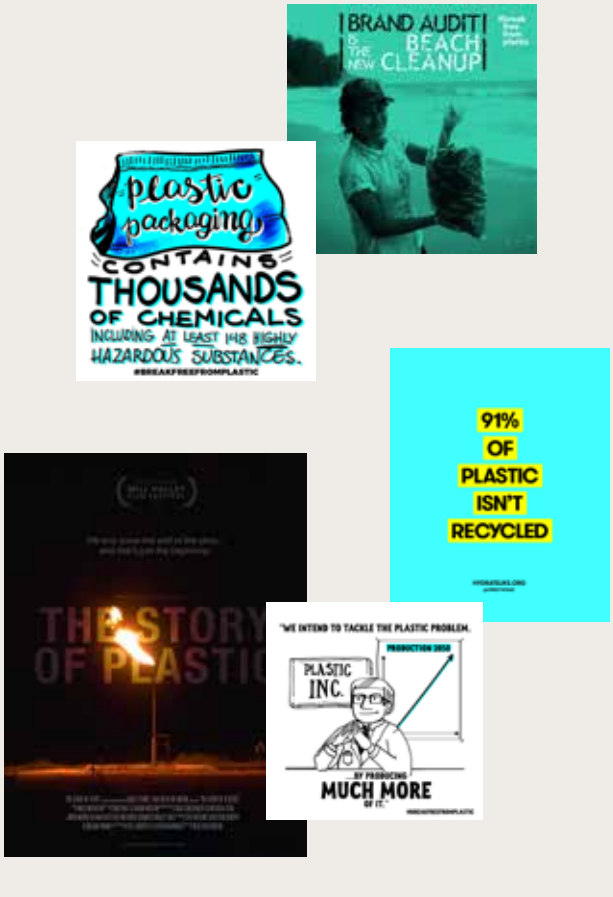
BREAK FREE FROM PLASTIC



Break Free From Plastic is a global movement envisioning a future free from plastic pollution. Since its launch in September 2016, over 1,500 organizations from across the world have joined the movement to demand massive reductions in single-use plastics and to push for lasting solutions to the plastic pollution crisis. These organizations share the common values of environmental protection and social justice, which guide their work at the community level and represent a global, unified vision. Sign up at www.breakfreefromplastic.org.

We believe in a world where the land, sky, oceans, and water is home to an abundance of life, not an abundance of plastic, and where the air we breathe, the water we drink and the food we eat is free of toxic by-products of plastic pollution.

In this world the principles of environmental justice, social justice, public health, and human rights lead government policy, not the demands of elites and corporations. This is a future we believe in and are creating together.

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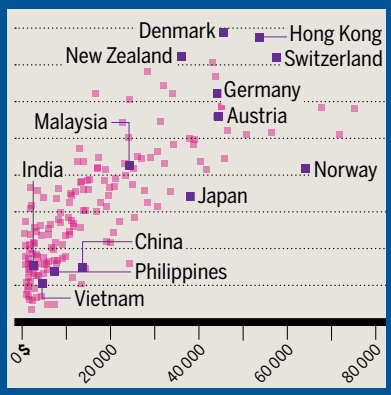

Since 2000, more plastics have been produced than in the 50 years before.
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Just a few major corporations produce most of the world's plastics.
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Plastics alone could consume between 10 and 13 percent
of the earth's remaining carbon budget for staying below 1.5 degrees.
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Many of the chemicals in plastic have an effect on human health.
The consequences may be both serious and long-term.
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We only have to start questioning things that we have come to accept as normal.
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