From
the People of Japan

Synopsis:
PLASTICS IN TÜRKİYE

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Synopsis: Plastics in Türkiye

In the last century, since the invention of the first synthetic plastics in the early 1900s, the plastics industry has developed rapidly, making plastic materials and products an indispensable part of human life with the production of new resins and materials over time. By saving energy and water in their production processes, plastics have created less pollution compared to their alternatives; they have also created more affordable options by requiring far fewer resources compared to their alternatives (paper, metal, or glass). Plastics are durable, yet lightweight and thus save weight in cars, aircraft, packaging, and pipework. On the other hand, given the longevity and stability of plastics in the environment, one can expect them to be present for a long time, which likely contributes to the global spread of plastics. Plastic pollution has created much concern due to its escalating rise and impact on all environmental compartments especially on marine ecosystems. In addition, plastic items may decompose to convert into microplastics upon disintegration, release toxic additives into the water or soil upon deterioration and microplastics become a vector for toxic organic chemicals making them readily available for marine organisms.

Due to long-distance transportation in various systems, plastic pollution has become a worldwide problem that transcends borders. Marine litter has many different causes and is both a transboundary global concern and a local problem. Especially since marine litter spreads to all oceans, it is a problem that needs to be addressed globally for which the governance solutions are complicated. There is a rising international commitment to rethink and assess the usage of plastics over their entire life cycle.

1. Plastics at Global Level

Plastics began to be more widely used after the 1950s. Global plastic production increased from around 1.5 million tonnes in 1950 to 367 million tonnes in 2020[1]. In the future, it is expected to double again over the next 20 years[2]. In addition, European plastic production reached 55 million tonnes in 2020. According to the latest data, China's share of global plastics production continues to grow (reaching 32% in 2021), while Europe's share - which reached 57.2 million tonnes in 2021 - continues to decline (hitting 15%)[3]. Also, the plastic industry employs more than 1.5 million people across the European Union and generated a turnover of approximately 405 billion euros in 2021[4].

430 million tonnes of plastics are produced globally each year[5], with approximately half of this volume going to disposal applications, or products that are thrown away within a year of purchase. As shown In Figure 1.1, global plastic production is 90.8% fossil based and only 9.8% of this production relies on sustainable sources.

1 Plastics Europe, Plastics-the Facts 2022. Retrieved November 21, 2022, from https://plasticseurope.org/knowledge-hub/plastics-the-facts-2021/
2 The New Plastics Economy, Rethinking of the future of plastics. Retrieved November 21, 2022, from https://www3.weforum.org/docs/WEF_The_New_Plastics_Economy.pdf
3 Plastics Europe, Plastics-the Facts 2022. Retrieved November 21, 2022, from https://plasticseurope.org/knowledge-hub/plastics-the-facts-2021/
4 Plastics Europe, Plastics-the Facts 2022. Retrieved November 21, 2022, from https://plasticseurope.org/knowledge-hub/plastics-the-facts-2021/
5 OECD (2022), Global Plastics Outlook: Policy Scenarios to 2060, OECD Publishing, Paris. Retrieved February 25, 2023, from https://doi.org/10.1787/aa1edf33-en

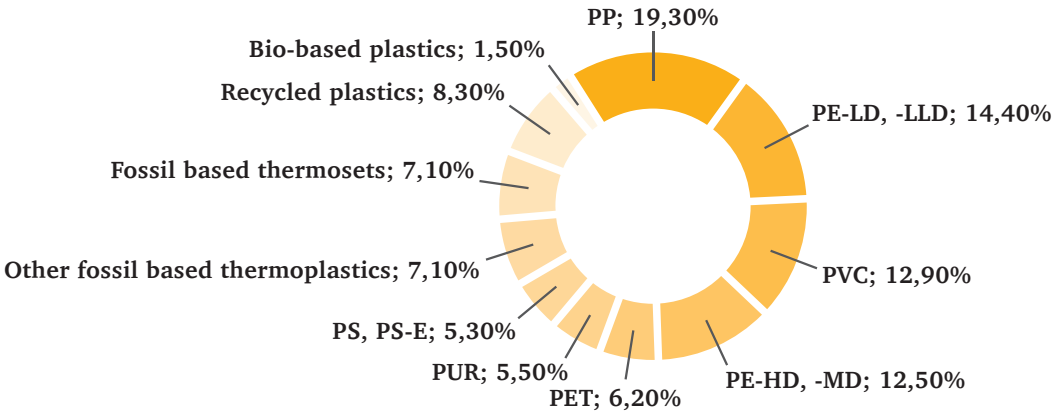

Figure 1.1 Global Plastic Production by Type[6]

2. Plastics in Türkiye

2.1. Plastic Raw Materials

The two key categories of plastics used in Türkiye are polyolefins (commodity plastics) and engineering plastics. Polyolefins (commodity plastics) include materials such as polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), and polyethylene (PE). These materials individually include many sub-divisions. For example, PP contains homopolymers and copolymers, PVC covers stiff and plasticized groups, PS is used to describe general purpose PS and toughened PS (TPS – thermosetting PS, or IPS – impact polystyrene, or HIPS – high impact polystyrene) and PE includes low-density polyethylene (LDPE), linear low-density polyethylene (LLDPE) and high-density polyethylene (HDPE). The importance of commodity thermoplastics cannot be over-emphasized as approximately 80% of all plastics used fall into this category (Table 2.1).

Table 2.1 Main Applications for Polyolefins (Commodity Materials)[7]

Plastic Type	Applications
LDPE (low-density polyethylene)	Cling film, carrier bags, agricultural film, milk carton coatings, electrical cable coating, heavy-duty industrial bags, stretch film, industrial packaging film, thin-walled containers, heavy-duty medium and small bags
HDPE (low-density polyethylene)	Crates and boxes, bottles (for food products, detergents, cosmetics), food containers, toys, petrol tanks, industrial wrapping, film, pipes, and houseware

6 Plastics – the Facts 2022. (2022). Plastics Europe. Retrieved February 26, 2023, from https://plasticseurope.org/knowledge-hub/plastics-the-facts-2022/
7 PAGEV, Plastics Manufacturers, Research, Development and Educational Foundation, https://pagev.org

Plastic Type	Applications
PP (polypropylene)	Food packaging (including yoghurt, margarine pots, sweet and snack wrappers), microwave-proof containers, carpet fibers, garden furniture, medical packaging and appliances, luggage, kitchen appliances, pipes, textiles (ropes, thermal underwear, and carpets), stationery, plastic parts and reusable containers of several types, laboratory equipment, Loudspeakers, automotive components, polymer banknotes
PET (Polyethylene terephthalate)	Bottles for beverages (soft drinks, fruit juices, mineral waters), carbonated drinks, cooking and salad oils, sauces and dressings and detergents, wide mouth jars, tubs for jams, preserves, fruits & dried foods, trays for pre-cooked meals, pasta dishes, meats and vegetables, long life confectionery, extra oxygen barrier (beer, vacuum packed dairy products cheese, processed meats, Bag in Box wines, condiments, coffee, cakes, syrups)
PS (Polystyrene)	Packaging (Eggs and dairy products, meat, fish and poultry, cold drinks or carry-out meals), appliances (refrigerators, air conditioners, ovens, microwaves, hand-held vacuum cleaners, blenders), consumer electronics (housing for TVs, IT equipment, media enclosures, cassette tape housing, and clear jewel boxes to protect CD's and DVD's), construction (Insulation foam, roofing, siding, panels, bath and shower units, lighting, plumbing fixtures), medical (disposable medical applications, tissue culture trays, test tubes, petri dishes, diagnostic components, and housing for test kits), other (consumer goods, toys, electric lawn and garden equipment, kitchen and bath accessories and other durable goods)
PU (polyurethanes)	Building insulation, refrigerators and freezers, furniture and bedding, footwear, automotive, coatings and adhesives, and others
PVC (polyvinyl chloride)	Building (window frames and other profiles, floor and wall coverings, roofing sheets, linings for tunnels, swimming pools, and reservoirs), piping (including water and sewerage pipes and fittings, and ducts for power and telecommunications), coatings (including tarpaulins, rainwear, and corrugated metal sheets), insulation and sheathing for low voltage power supplies, telecommunications, appliances, and automotive applications. packaging, pharmaceuticals, food and confectionery, water and fruit juices, labels, presentation trays, automotive applications (cables, underbody coating, and interior trimmings), medical products (blood bags, transfusion tubes, and surgical gloves), leisure products (garden hoses, footwear, inflatable pools, tents)

Engineering plastics consist of polymers that put forward a mixture of properties, including superior strength, stiffness, robustness, and resistance to wear, resistance to chemical attack, and heat resistance. There are five major materials included in this group, and they include polyamides (nylons), acetals, polycarbonates, thermoplastic polyesters, and modified polyphenylene oxide (also known as modified polyphenylene ether or PPE) (Table 2.2).

Table 2.2 Main Applications for Engineering Thermoplastics (Technical Plastics)[8]

Plastic Type	Applications
ABS (acrylonitrile-butadiene-styrene)	Housings for vacuum cleaners, kitchen appliances, telephones, toys, automotive, electrical/electronics, white goods, computer/communication electronics
LCP (liquid crystal polymers)	Coatings, composites, additives, electrical motor components, electronic applications
PBT (polybutylene terephthalate)	Automotive headlights, wipers, industry applications, electronic control modules, gear housing, steering-angle sensors, door control devices or airbag connectors, universal applications (Strips for window frame profiles, fiber optical cables)
PEEK (polyetheretherketone)	Substitute metal in gears, seals, and supporting rings in various automotive applications, aircraft, industrial pumps, valves and seals, silicon wafer carriers, connectors, sterilizable surgical instruments, medical implants
PMMA (polymethyl methacrylate)	Roofs and conservatories, the automotive industry (exterior and interior lighting, instrument covers, spoilers, and mirror housings), light guide panels, lenses for mobile phones, rear projection, and touch screens, illuminated signs, street lighting, and industrial lamps
PA (polyamide)	Automotive oil pan, transmission cross beams, air intake manifolds crash-active engine covers, photovoltaic connectors, cordless hammer drills, control modules for washing machines, circuit breakers dowels
PSU/PPSU (polyarylsulfone)	Automotive industry (headlights and interior reflectors), electrical and electronics (fuse encapsulation), water fittings pump impellors baby bottles microwave dishes thin hollow fibers for water treatment
PC (polycarbonate)	Automotive (mirror housings, taillights, turn signals, back up lights, fog lights, and headlamps), packaging (bottles, containers, and tableware), appliances and consumer goods (electric kettles, fridges, food mixers, electrical shavers, and hairdryers), electrical and electronics (cell phones, computers, fax machines)
PI (polyimide)	Electronics industry for flexible cables, insulating film on magnet wire, medical tubing, PI film on magnet wire, digital semiconductor and microelectromechanical systems, chips, hot gas filtration
POM (polyoxymethylene)	Consumer items, expresso coffee brewing machines, children's toys, electrical industry, gas meters, disposable applicators, medical technology, fuel tank modules, gear wheels, loudspeaker grills
PPA (polyphthalamide)	Electrical and automotive industry (connectors, switches, electrical insulation), motor insulators, water heater manifolds, valve bodies for showers, fuel modules, fuel cut-off valves, thermostat housings air coolers
PPS (polyphenylene sulfide)	Injection mold applications (under-the-hood automotive parts power train components, pumps, fuel system components, surface mounts), electrical/electronic components, blower, and pump parts, protective and non-stick coatings, surgical devices, power tools, films and composites, fuel cells, diesel fuel cars

8 PAGEV, Plastics Manufacturers, Research, Development and Educational Foundation, https://pagev.org

Plastic Type	Applications
PVDF (polyvinylidene fluoride)	Aerospace, biotechnology, electronics industries (robotics, sensors, and electrical wire insulation), hollow fibers, flat sheet, and tubular membranes for the medical and food and beverage industry
TPE-E (thermoplastic polyester elastomer)	Automotive and household appliances, snowmobile tracks, catheters, electrical cable jacket/inner insulation, headphone cables, sport equipment
UHMWPE (ultra-high-molecular-weight polyethylene, sometimes shortened to uh)	Automotive headlights, wipers. electronic control modules, gear housing, steering-angle sensors, door control devices, airbag connectors, strips for window frame profiles, fiber optical cables
Epoxy resins	Paints and coatings, adhesives, industrial tooling and composites, electrical systems and electronics, consumer and marine applications, aerospace applications, biology, art
EPS (Expanded polystyrene)	Building & Insulation, packaging applications (Eggs, meat, fish, and poultry, cold drinks or carry-out meals), electronic goods cushioning, crash helmets - protecting the heads and potentially the lives of cyclists
Polytetrafluoroethylene (PTFE)	High-performance automotive, aircraft bearings, seals, flame retardants, coatings on kitchen products, linings of piping and chemical tanks, cable coating in the telecommunications and computer industries, implantable parts, and catheters

The yearly production capacity of PETKİM, which is the only petrochemical plant in Türkiye, is 350 thousand tons of LDPE and 96 thousand tons of HDPE. On the other hand, PETKİM has a production capacity of 144,000 tons of PP, and 150,000 tons of PVC per year.

There are two polystyrene producing plants in Türkiye and these are RAVAGO and ASCHEM. The total annual polystyrene production capacity is 210 thousand tons.

PET Resin with specifications to be used in bottle production is manufactured by Köksan, Meltem Kimya, and Indorama companies in Türkiye. On the other hand, SASA has a production capacity of 110 thousand tons of textile-type PET. The current production capacity of these companies is at a level of about 790,000 tons of PET resin per year.

On the other hand, there are many companies in Türkiye operating as producers and traders of engineering plastics. The main engineering plastics consumed in Türkiye are ABS, PA, PA6, Polyalkylene glycol (PAG-G), PBT, PC, Poly Cyclohexylenedimethylene Terephthalate glycol (PCT-G), PEEK, PMMA, POM, PPA, Polypropylene copolymer (PPC), Polypropylene homopolymer (PPH), Polyphenylene Oxide (PPO), Polypropylene Random Copolymer (PPRC), PPS, PTFE, Styrene-acrylonitrile (SAN), Thermoplastic polyester elastomer (TPE), Tripropylene glycol monomethyl ether (TPM), Thermoplastic Polyurethane (TPU), UHMW. The total production capacities of engineering plastic materials are expected to be 250 thousand tons.

In 2022, it is estimated that a total of 1 million 740 thousand tons of plastic raw materials were produced, including 1 million 530 thousand tons of polyolefins (LDPE, HDPE, PP, PVC, EPS, GPPS, and PET) and 210 thousand tons of engineering plastics. In 1 million 530 thousand tons of polyolefins production, PET constituted 44% which was followed by LDPE at 20%, EPS at 13%, PP and PV at 8% each, HDPE at 5%, HIPS and GPPS at 1%.

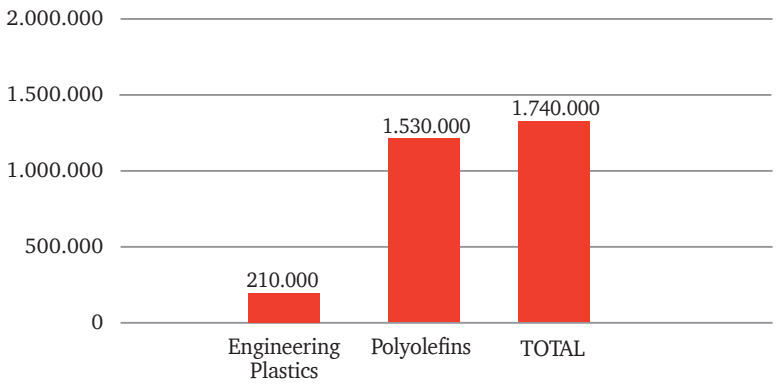

Figure 2.1 Plastic Raw Material Production in 2022

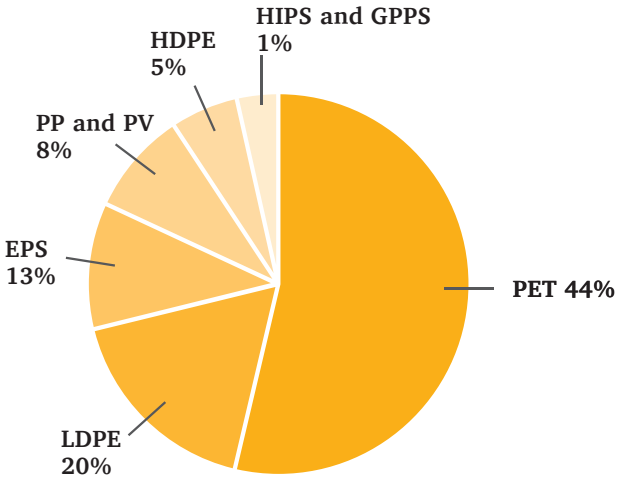

Figure 2.2 Polyolefins Production

In 2022, a total of 8 million 432 thousand tons of plastic raw materials is imported, including 7 million 185 thousand tons of polyolefins and 1 million 247 thousand tons of engineering plastics[9].

In 2022, a total of 1 million 991 thousand tons of plastic raw materials is exported, including 1 million 531 thousand tons of polyolefins and 460 thousand tons of engineering plastics[10].

Total domestic consumption of plastic raw materials is 7 million 455 thousand tons of which 7 million 151 thousand tons is polyolefins and 305 thousand tons is engineering plastics in 2022[11].

9 Turk Stat (www.tuik.gov.tr) and ITC, Trade Statistics (www.intracen.org)
10 Turk Stat (www.tuik.gov.tr) and ITC, Trade Statistics (www.intracen.org)
11 PAGEV, Plastics Manufacturers, Research, Development and Educational Foundation

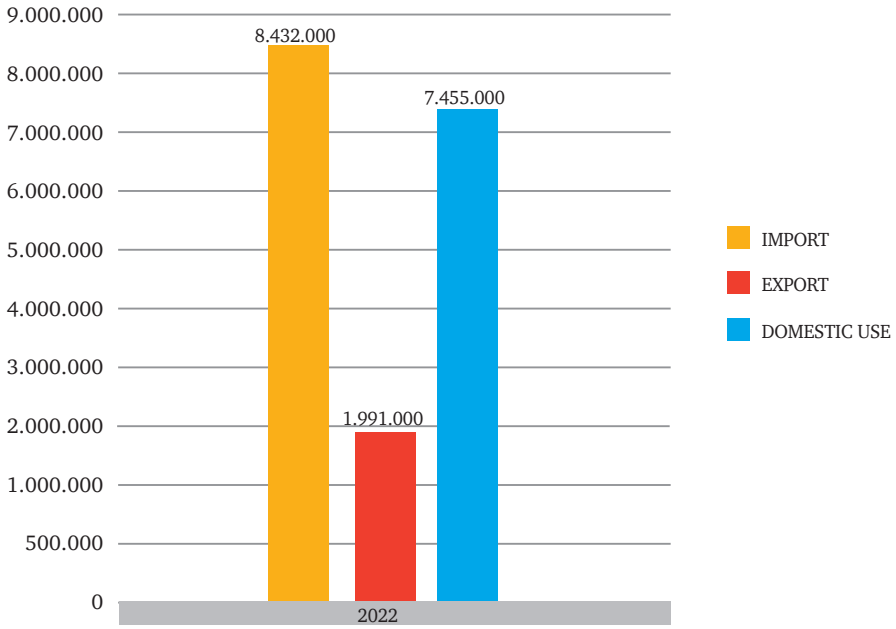

Figure 2.3 Import, Import and Consumption of Plastic Raw Materials in 2022

Of all the plastics, the use of PET is highest in the packaging sector, PP is highest in the electrical and electronics industry, engineering plastics is highest in the automotive sector, PVC is highest in the construction sector and LDPE is highest in agriculture and textile sectors in the year 2022.

2.2. Plastic End Products Industry

Similar to global operations, the plastic products manufacturing industry is a sector that generally produces intermediate goods, which provides material input to many different industries from agriculture to construction, textile to automotive in Türkiye. In addition to the manufacturing industry, the plastic sector is also a very important supplier, especially for construction, agriculture, durable consumer goods, automotive and electronics, and the service sector with products such as packaging materials, etc. The fact that the plastic sector is directly and significantly affected by the situation in oil prices and that the basic inputs are provided from an oligopoly market in the international arena can be listed as other common features of the two sub-sectors. In addition to intermediate goods, the plastic sector plays a role in facilitating daily life with the final products that it produces.

With a focus on the manufacture of plastic plates sheets, tubes, and profiles (NACE code 22.21) we can find filaments in the form of rods and profiles, hard, flexible, and non-reinforced tube pipes, hoses, and products such as plates, film, and strips. On the other hand, the manufacture of plastic packaging material (NACE code 22.22) involves products used in many different industries such as bags, boxes, rollers, coils, crates, carboys, and bottles. Manufacture of plastic construction materials (NACE code 22.23) includes products widely used in the construction industry such as door and wall coverings, bathtub, sink, warehouse, tank, barrel, door-window case, and elements, prefabricated structures are included. Finally, the manufacture of other plastic products (NACE code 22.29) includes plastic products used in multi-oriental sectors such as textiles, furniture, and office supplies in addition to kitchen utensils.

In the last 10 years covering the period of 2012-2022, the plastic end products sector in Türkiye grew by 4% on an average amount basis and 4% on a value basis per year and reached 10.5 million tonnes and 44.2 billion dollars capacity in 2022.

Table 2.3 Plastics End Products Production in Türkiye[12]

	2012	2015	2020	2021	2022	CAGR*(%) 2022/2012	% Increase 2022/2021
Million Tonnes	7.4	8.1	10.0	10.3	10.5	4	2
Billion $	30.2	31.0	35.7	40.3	44.2	4	10

*CAGR: Compound Annual Growth Rate

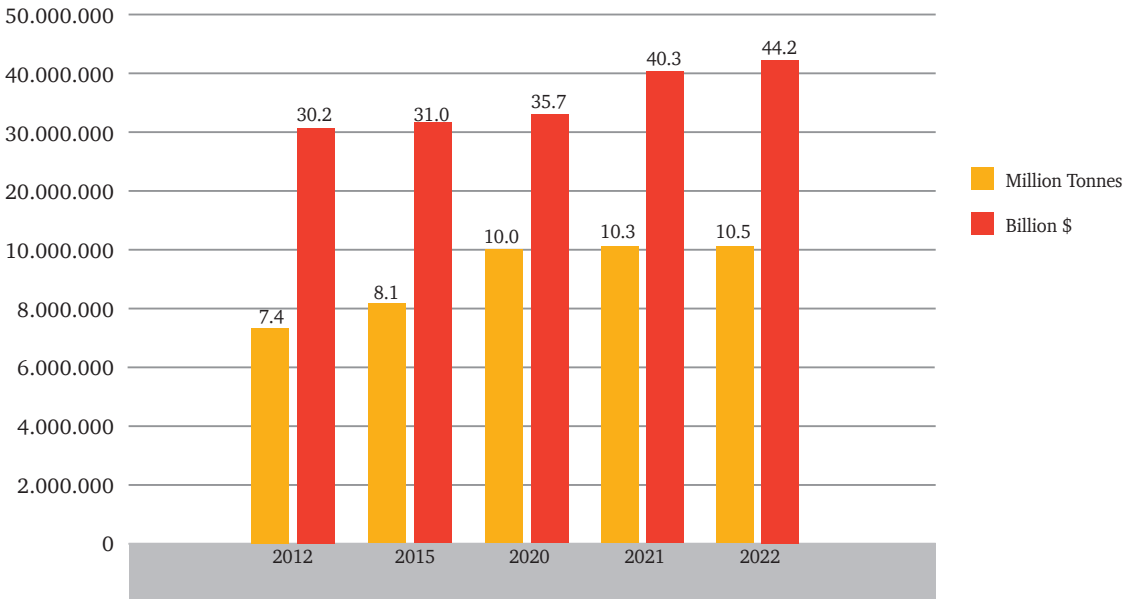

Figure 2.4 Plastics End Products Production in Türkiye

In 2022, Türkiye's total imported plastic end products have an amount of 708,000 tonnes while 2.7 million tonnes of plastic end products have exported[13].

In 2022, Türkiye was the second country in Europe and the sixth in the world after Germany in terms of its plastic processing capacity. In addition, Turkish plastic product manufacture took a share of 2.6% of the total global plastic production. Despite this, due to insufficient raw material production, the Turkish plastics industry is also dependent on imports in terms of raw materials. In the last five years (2017-2022), the total imports of the Turkish plastic products industry increased by 6% on an annual average amount and 9% on a value basis; whereas, the total exports of the Turkish plastic products industry increased by 9% on the amount and 13% on a value basis.

Around 14,000 enterprises operate in the plastics industry in Türkiye. However, most of them consist of micro companies at the workshop level with 1-5 employees. The number of companies operating at the fabrication level with employees of 10 or higher is around 6,400.

Among the companies operating at the fabrication level, 29% of them are operating in packaging, 25% in building and construction, 12.5% in household goods, 8.6% in textiles, 8.1% in electrical–electronics, and 7.1% in the automotive sector subgroups.

12 PAGEV, Plastics Manufacturers, Research, Development and Educational Foundation (www.pagev.org.tr)
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13 Turk Stat (www.tuik.gov.tr) and ITC, Trade Statistics (www.intracen.org)

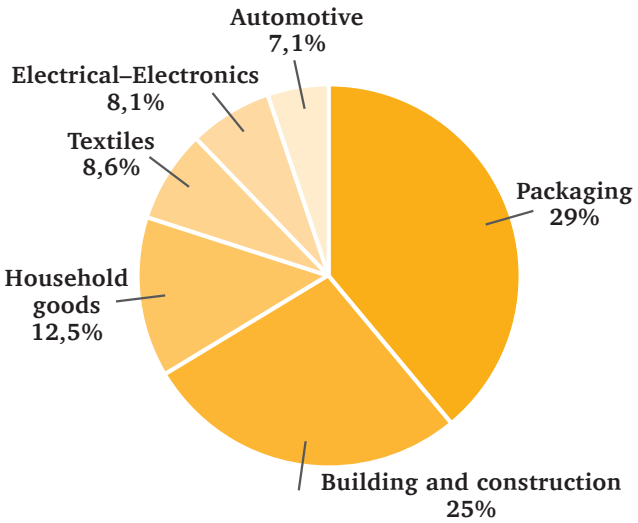

Figure 2.5 Firms Operating At The Fabrication Level

The plastic industry value chain is not only constituted by the manufacturers of plastics. When the sector is examined as a whole the value chain can be divided into several broad segments as below.

- **Raw material suppliers are the firms** that supply petrochemical and chemical feedstocks and additives,
- **Plastics producers are the manufacturers** that manufacture several types of plastic resins,
- **Plastics compounders are the producers** that prepare plastic formulations by mixing and/or blending polymers and additives into process-ready pellets,
- **Plastics machinery manufacturers are the industries** that manufacture the machinery used in the industry,
- **Plastics converters** are the industries that form plastic resins and compounds into finished products,
- **Plastic product distributors/users original equipment manufacturers (**OEM), retailers, etc. who put plastic products onto the market,
- waste management companies, recyclers, and energy-from-waste operators and
- **Polymer Processing Society** companies promote scientific understanding and technical innovation in polymer processing by providing a discussion forum for the worldwide community of engineers and scientists in the field.

On the other hand, 97% of the companies operate in 10 provinces where industrial sectors are concentrated in. Istanbul, Izmir, Ankara, Konya, Bursa, Kocaeli, Gaziantep, Adana, Manisa, and Kayseri, constitute the provinces with the highest concentration of plastic product manufacturing companies.

In the last 10 years covering the years 2012-2022, the total domestic consumption of the Turkish plastic products sector grew by 2.8% on an average amount basis and 3.4% on a value basis per year, reaching 8.5 million tonnes and 40.2 billion dollars in 2022. respectively[14].

The leading sectors that shape domestic plastic consumption in Türkiye are packaging and construction materials, similar to the global situation and the EU. The other forefront sectors using plastics are electrical and electronics, automotive, textile, and agriculture.

14 PAGEV, Plastics Manufacturers, Research, Development and Educational Foundation (www.pagev.org.tr)
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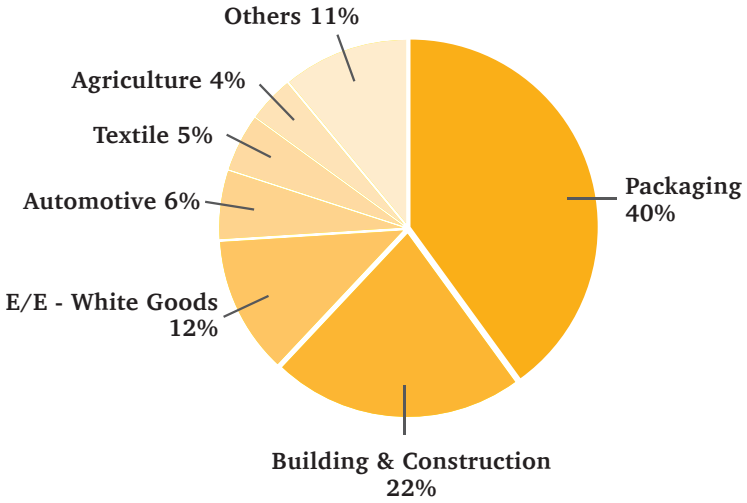

Figure 2.6 Distribution of Consumption to Sub-Sectors[15]

3. Global Plastic Pollution

The high generation rate of plastic pollution is not only due to ever-growing plastic production globally but the ill-management of plastics during and after use. For this matter, unless some drastic changes in how plastics are made and managed are achieved, the problem will keep on growing. In management, one major concern is the insufficiency of recycling rates and the use of recycled content compared to the amount of production, which ends up producing increasing quantities of waste.

According to Plastics Europe data, around 25.8 million tonnes of plastic waste are generated in Europe every year. Less than 30% of such waste is collected for recycling.

Ellen MacArthur Foundation estimates the ocean will contain more plastic by the year 2050 than fish by mass if manufacturing and pollution continue at their current rates[16]. Although there are many unknowns regarding the expected effects of plastic pollution building up in the ecosystem, it is widely accepted that this waste does not belong in the oceans and may even constitute a threat to the planetary boundaries once it has reached[17].

A total of 6.3 billion tonnes of primary and secondary (recycled) plastic waste was produced between 1950 and 2015, of which 9% was recycled, 12% was burned, and the remaining 79% was either dumped in landfills or discharged into the environment[18].

In fact, the majority of plastic litter puts marine life in particular at risk. Plastics account for the majority of marine litter for two reasons. First of all, plastic is being utilized in an increasing number of consumer and industrial products due to its durability, affordability, and malleability. Secondly, plastic products disintegrate into smaller particles rather than biodegrading. Plus, thermosets and synthetic polymers, commonly known as plastics, are the largest and most permanent parts of marine litter, accounting for at least 85% of total

15 PAGEV, Plastics Manufacturers, Research, Development and Educational Foundation (www.pagev.org.tr)
From pagev.org/turkiye-plastik-sektoru-2021-gerceklesmeleri-ve-2022-beklentileri, Accession date: 7 January 2022
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marine waste[19]. According to estimates, 19-23 Mt of plastic waste entered the worldwide aquatic ecosystem in 2016, with yearly plastic waste reaching up to 53 Mt by 2030[20]. By 2060, it is predicted that 155-265 million tons of plastic will have accumulated in the environment, with microplastics making up 13.2% of this total weight[21].

Aquatic ecosystems are very important for understanding and managing plastic pollution. Plastics that become waste cause pollution by mixing with aquatic ecosystems for various reasons. Most of the marine litter and plastic pollution originates on land as a result of urban and stormwater runoff, building, littering, insufficient waste disposal and management, sewer overflows, industrial activity, tire abrasion, and illegal dumping[22]. Furthermore, plastic comes from marine activities, including ship operations and fishing vessels including fishing gear, nets and lines.

According to estimates, macroplastics are one of the main sources of secondary microplastics and marine plastic pollution, and they have a direct negative impact on ecosystem health and human well-being[23]. When macroplastics degrade in the ocean, they release microplastics, synthetic and cellulosic microfibers, hazardous substances, metals, and micropollutants into the water and soil, eventually making their way into marine food webs[24].

Some of the effects of macroplastics on the environment[25] include harm and death due to plastic entanglement and the swallowing of marine birds, mammals, fish, and reptiles. Also, the transportation of non-native marine organisms to new environments on plastic litter, the suffocation of the seabed, stopping gas exchange, and deliberately creating hard ground, because of sinking plastic litter.

Microplastics are plastics less than 5 mm in length and are extremely challenging to track. They come in the shape of fibers, granules, or fragments.

The risk of environmental damage from microplastic accumulation is the highest among all size classes. Their bioavailability rises because of their small size, giving them the potential to affect many more species than larger objects. According to recent estimates, there are 4.85 trillion of microplastic particles floating about in the waters[26].

Microplastics have been known for more than a decade to transport a variety of toxic chemicals, metals, and micropollutants into open surface waters, where they can be consumed by a wide range of fauna[27]. Microplastics come from a variety of sources, including primary sources like tire dust, plastic pellets, and microfibers from synthetic textiles, as well as secondary sources such the fragmentation of bigger, macroplastic items that are already present in the environment[28].

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24 McGlade, Jacqueline & Fahim, Irene & Green, Dannielle & Landrigan, Philip & Andrady, Anthony & Costa, Monica & Geyer, Roland & Gomes, Rachel & Hwai, Aileen & Jambeck, Jenna & Li, Daoji & Rochman, Chelsea & Ryan, Peter & Thiel, Martin & Thompson, Richard & Townsend, Kathy & Turra, Alexander & Maes, Thomas. (2021). From Pollution to Solution: A Global Assessment of Marine Litter and Plastic Pollution. United Nations Environment Programme, 10.13140/RG.2.2.33577.31845
25 Cole, M., Lindeque, P., Halsband, C., & Galloway, T. S. (2011). Microplastics as contaminants in the marine environment: A Review. Marine Pollution Bulletin, 62(12), 2588–2597. https://doi.org/10.1016/j.marpolbul.2011.09.025
26 Eriksen, M., Lebreton, L. C., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., Galgani, F., Ryan, P. G., & Reisser, J. (2014). Plastic pollution in the world's oceans: More than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. PLoS ONE, 9(12). https://doi.org/10.1371/journal.pone.0111913
27 McGlade, Jacqueline & Fahim, Irene & Green, Dannielle & Landrigan, Philip & Andrady, Anthony & Costa, Monica & Geyer, Roland & Gomes, Rachel & Hwai, Aileen & Jambeck, Jenna & Li, Daoji & Rochman, Chelsea & Ryan, Peter & Thiel, Martin & Thompson, Richard & Townsend, Kathy & Turra, Alexander & Maes, Thomas. (2021). From Pollution to Solution: A Global Assessment of Marine Litter and Plastic Pollution. United Nations Environment Programme, 10.13140/RG.2.2.33577.31845
28 PEW Charitable Trusts and SystemIQ. "Breaking the Plastic Wave: A Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution," 2020.

Microplastics are divided into two categories based on these sources: primary and secondary microplastics[29]. While primary microplastics are plastic types that were originally produced in small pieces, secondary plastics are formed because of the wearing down of macroplastics by various factors. Table 3.1 shows sources of primary and secondary microplastics.

Table 3.1 Sources of Primary and Secondary Microplastics[30]

Types of Microplastics	Sources
Primary Microplastics	Occupational abrasives
	Certain pharmaceuticals (e.g., dental tooth polish)
	Cleaning products/personal care items
	Drilling lubricants
	Raw ingredients (nurdles) and by-products of the process
	Incorrect handling and disposal
Secondary Microplastics	Dumping plastic garbage and general littering
	Abandoned fishing equipment
	Abrasion in facilities and locations for recycling and landfills
	Fibers those synthetic fabrics releases
	Ship-produced waste
	Fibers from personal care products
	Substance made of organic waste
	Using paint that contains synthetic polymers found in compost additives and abrasion when removing paint

Plastic pollution is a global problem as are all forms of pollution by their very nature. Given the longevity and stability of plastics in the environment, these particles could be present for a considerable amount of time, which likely contributes to the global spread of plastics. Due to long-distance transportation in various systems, plastic pollution is a worldwide problem that transcends borders. Numerous and complex factors work against efforts to manage and reduce the harmful environmental effects of plastic pollution, including political and economic ones, a lack of commitment on the part of governments and stakeholders in the global plastic economy, divergent views among scientists, and underreported or ignored polluters[31]. Marine litter has many different causes and is both a transboundary global concern and a local problem. Especially since marine litter spreads to all oceans, it is a problem that needs to be addressed globally. Marine plastic pollution is a transboundary issue, like many environmental issues, hence the governance solutions are complicated. Acting is necessary for environmental, health, economic, and social reasons. As a result, there is a rising international commitment to rethink and assess the usage of plastics over their entire life cycle. In addition to consumption, reuse, and end-of-life management, there is a particular emphasis on the inputs and removal of plastics from the environment in this list, which also includes design and manufacture.

The dilemma of responsibility is particularly difficult when plastic pollution occurs in Areas Beyond National Jurisdiction which is a worldwide concern. The well-known “Pacific Garbage Patch” for instance, is one of five areas where marine waste accumulates. It is situated in the Pacific’s east and west halves[32].

29 Crawford, C. B., & Quinn, B. (2019). Microplastic pollutants. Elsevier.
30 European Parliament. Retrieved January 21, 2023, from https://www.europarl.europa.eu/RegData/etudes/STUD/2020/658279/IPOL_STU(2020)658279_EN.pdf
31 Iroegbu, A. O., Ray, S. S., Mbarane, V., Bordado, J. C., & Sardinha, J. P. (2021). Plastic pollution: A perspective on matters arising: Challenges and opportunities. ACS Omega, 6(30), 19343–19355. https://doi.org/10.1021/acsomega.1c02760
32 Vince, J., & Hardesty, B. D. (2016). Plastic pollution challenges in marine and coastal environments: From local to global governance. Restoration Ecology, 25(1), 123–128. https://doi.org/10.1111/rec.12388

4. Policy Approaches and Key Instruments

The EU has started to show efforts to support environmentally sound plastic waste management at the forefront of their policies. The Green Paper on a European Strategy on Plastics in a Circular Economy is launched with the purpose of a broad reflection on possible responses to the public policy challenges posed by plastic waste which were not specifically addressed in the EU waste legislation. The follow-up to the Green Paper was an integral part of the wider review of the waste legislation that was completed in 2014.

Circular economy, which improves resource use by minimizing the extraction of natural resources, maximizing waste prevention, and optimizing the environmental, social, material, and economic values throughout the life cycles of materials, components, and products, rather than the current linear economy approach started to be the main governing policy. The EU Commission adopted the policy "A European Strategy for Plastics in a Circular Economy" in December 2015; which was followed by the "European Green Deal" which is a growth strategy that is aiming to move the EU closer to becoming the first continent to be climate neutral. The First Circular Economy Package aims to close production life cycles with more recycling and reuse, bringing shared benefits for both the environment and the economy. The EU Circular Economy Action Plan lists several areas to focus on; one of them being named as "priority areas" and under which the plastics are listed. The EU common targets included 65% recycling and a maximum of 10% landfilling for municipal waste by 2035 and 70% recycling for packaging waste by 2030. There are specific rates listed for different types of packaging waste such that 30% for wood packaging waste, 55% for plastic packaging waste, 60% for aluminum packaging waste, 75% for glass packaging waste, 80% for ferrous metal packaging waste and 85% for paper/cardboard packaging waste. Following this, a growing number of European nations have created complementary national plans in tandem with the Union's initiatives.

With the requirements of the Circular Economy Package European Parliament adopted amendments on related legislation including The Waste Framework Directive (2008/98/EC), The Landfilling Directive (1999/31/EC), The Packaging Waste Directive (94/62/EC), The Directives on End-of-Life Vehicles (2000/53/EC), Directive of Batteries and Accumulators and Waste Batteries and Accumulators (2006/66/EC), and Directive on Waste Electrical and Electronic Equipment (2012/19/EU) in 2018. The common goal of the directives is to improve European waste management with the promotion of the responsible and wise consumption of natural resources while maintaining, preserving, and improving environmental quality. In addition, the "waste hierarchy" concept which takes waste prevention into priority in all management approaches has become the major focus of the directives.

In the European Union, 80 to 85% of marine litter measured as beach litter was found to be plastic, with 50% of it being single-use plastic items. Initiated by this finding, another critical step taken by the EU was to regulate single-use plastics. The Single-Use Plastics Directive was proposed in May 2018 and was accepted in June 2019 with the full title of Directive (EU) 2019/904 of the European Parliament and the Council on the Reduction of the Impact of Certain Plastic Products on the Environment, and went into effect on July 3, 2021. This Directive is a comprehensive effort to control plastic pollution from land to sea, after examining the potential pathways toward plastic pollution reduction. The single-use plastics that the Directive targets are cotton bud sticks, cutlery (forks, knives, spoons, chopsticks), plates, straws, beverage stirrers, sticks to be attached to and to support balloons, food containers made of expanded polystyrene (EPS), cups for beverages made of expanded polystyrene, and oxo-degradable plastics. The Single Use Plastics Directive defines specific measures that apply to certain product categories. For this Directive to be effectively applied, the existence of items that can replace these ones are highly critical. In addition to Extended Producer Responsibility programs, the restrictions include full prohibitions on certain single-use plastic products.

Then the European Commission released its New Circular Economy Plan in March 2020. The New Circular Economy Action Plan under the EU Green Deal outlines the actions to be taken across the entire usage

of products. As a policy framework, the plan aims to identify how to implement legislation, reporting, documentation, and strategic support to facilitate the adoption of the circular economy in product value chains by taking full-cycle measures.

Another relevant move European Parliament did was the amendment of Directive 94/62/EC which seeks to reduce the consumption of lightweight plastic carrier bags and aimed at reducing the amount of usage and the impact of packaging and packaging waste on the environment by passing Directive (EU) 2015/720. The Directive requires the member states should ensure annual consumption does not exceed 90 lightweight plastic carrier bags per person by December 31, 2019, and 40 lightweight plastic carrier bags per person by December 31, 2025, or comparable weight-based objectives. These restrictions may not apply to very lightweight plastic carrying bags. As part of the European Green Deal and the new Circular Economy Action Plan, European Commission put forward a revision of the Packaging and Packaging Waste Directive in November 2022. The initiative's objective is to ensure that all packaging is reusable or recyclable in an economically feasible way by 2030. The aim is to reinforce the essential requirements for packaging to ensure its reuse and recycling, boost the uptake of recycled content, and improve the requirements' enforceability. Measures are also envisaged to tackle over-packaging and reduce packaging waste.

4.1. International Treaties Relevant to Plastics and Türkiye's Involvement

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

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 in Basel, Switzerland, and entered into force on 5 May 1992[33]. The Convention has the motivation to respond to the demand to stop toxic waste exports from developed countries to developing countries. The Convention stands on three pillars as the main aims[34]:

- hazardous wastes reduction at the source and the promotion of environmentally sound management wherever the ultimate disposal is;
- restriction of transboundary movement of hazardous wastes except where it is perceived in accordance with the principles of environmentally sound management; and
- a regulatory system in place for cases where transboundary movements are permissible.

Basel Convention defines waste as "substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provision of a national law". The Convention was established to provide an international legal framework to tackle the transboundary movement of hazardous waste. Based on the concept of "prior informed consent" (PIC), it requires as a prerequisite that, before export takes place, the authorities of the State of export notify the authorities of the prospective State(s) of import and transit, providing them with detailed information on the planned transport. One of the most important aspects of the Convention is that it requires its parties to manage their hazardous wastes (and other wastes) in an environmentally sound manner, with approaches starting from prevention and minimization, as well as treatment and disposal as close as possible to their place of generation. At the time it was signed, Basel Convention did not include any specific terms for the transboundary movement of plastics.

As of 2022, there are 53 signatory countries and 183 parties to the Basel Convention. Türkiye signed the mentioned Convention on 22 May 1989 and became a party on 22 June 1994. It is forbidden by Environmental Law to import hazardous waste into Türkiye. Certain non-hazardous wastes can be imported by industrial facilities with a recycling license given by the Ministry of Environment, Urbanization and Climate Change.

33 Basel Convention Official Web Page http://www.basel.int/, Retrieved 10 December 2022
34 Thapa, K. Vermeuten, J. V., Deutz, P and Oleyide, O. "Transboundary movement of waste review:From binary towards a contextual framing, Waste Management and Res., 1-16, 2022.

Waste can be imported under control procedures only for recycling purposes, import for disposal purposes is prohibited.

Over the years, plastic production and pollution generated by plastic waste have become a challenging issue. The Plastics pollution problem in general, and especially in the marine environment kept growing dramatically at the same time and created a global concern. For that matter, plastic has become one of the popular transboundary waste streams.

To offer a possible solution to growing plastic pollution and transboundary movement, the Convention was amended with the purpose of specifically confronting plastic waste in 2019. With the amendments of annexes of the Basel Convention and the establishment of a Plastic Waste Partnership, the Convention took a leading role in the fight against plastic pollution[35].

The amendments to annexes include changes in Annexes II (waste requiring special attention), VIII (wastes presumed hazardous and subject to PIC), and IX (wastes presumed to not be hazardous and not subject to PIC). In Annex VIII, the amendment is about the insertion of a new entry, A3210 that explains the scope of plastic wastes presumed to be hazardous and therefore subject to the PIC procedure mentioned above. The amendment to Annex IX, is the introduction of a new entry, B3011, replacing the existing entry, B3010, that clarifies the types of plastic wastes that are presumed to not be hazardous and, as such, not subject to the PIC procedure. The third amendment is the insertion of a new entry, Y48, in Annex II which covers plastic waste, including mixtures of such wastes unless these are hazardous (wastes under A3210) or presumed to not be hazardous (wastes under B3011). The new entries became effective as of 1 January 2021.

The plastic waste amendments to Annexes II, VIII, and IX to Basel Convention entered into force for Türkiye on 10 February 2022 by UN depository notification C.N.51.2022.TREATIES-XXVII.3. The import of mixed plastic wastes was prohibited with the addition of HS Codes of mixed plastic wastes to the list of “import prohibited wastes” in Communiqué on Import Inspection of Wastes under Control in terms of Environmental Protection (Product Safety and Inspection: 2021/3), which was published in the Official Gazette No. 31351 (bis. 4) of 31 December 2020 and entered into force on 01 January 2021 and in this framework, the plastic waste amendments to Annexes II, VIII, and IX to Basel Convention have been implemented in Türkiye as of 01 January 2021. In accordance with Ministerial Circulars, the contamination of imported plastic waste is limited to 1%, and additional specifications were established for the recycling plants importing plastic waste, especially with HS Code 3915.10.00.00.00. At the same time, a quota has been introduced for the import of non-hazardous wastes since 2020. The plastic waste import quota was determined as 50% of the annual recycling capacity of the importer in 2022 and is being put into use gradually.

The Plastic Waste Partnership which is established by the Conference of the Parties to the Basel Convention in May 2019 is a common platform involving stakeholders from governments, international organizations, NGOs, and industry around a common goal of eliminating the leakage of plastic waste into the environment. The Plastic Waste Partnership functions to organize its stakeholders to deal with plastic pollution in several arenas by:

- Developing strategies to strengthen policy and regulatory frameworks within countries;
- Guiding the improvement of collection, separation, and sound management of plastic waste; and
- Motivating innovations toward increasing the durability, reusability, reparability, and recyclability of plastics.

The Partnership creates a collaborative environment promoting the sharing of experiences, best practices, and technologies toward the common goal of eliminating the plastic waste problem. The Partnership currently has

35 Wingfield, S. and Lim, M. “The United Nations Basel Convention’s Global Plastic Waste Partnership: History, Evolution and Progress”, in Microplastic in the Environment: Pattern and Process, Michael S. Bank (ed.), Springer, 2022.

210 representatives from Parties to the Convention, its regional centers, the private sector, civil society, and intergovernmental organizations[36]. Membership is open to Parties and other stakeholders dealing with the different aspects of prevention, minimization, and management of plastic waste.

4.1.2. Stockholm Convention

Persistent organic pollutants (POPs), a class of highly hazardous pollutants, have some common and highly hazardous properties such as remaining intact for exceptionally long periods, being widely distributed in the environment, bioaccumulating in organisms, and being toxic to humans and ecosystems.

In response to this global problem, The Stockholm Convention on Persistent Organic Pollutants was adopted by the Conference of Plenipotentiaries on 22 May 2001 in Stockholm, Sweden. The Convention entered into force on 17 May 2004. The Stockholm Convention, as a global treaty, requires its parties to take measures to eliminate or reduce the release of POPs into the environment[37].

The Convention listed twelve chemicals initially as POPs which belonged to the categories of pesticides, industrial chemicals, and by-products. Then in 2017, the list was amended, and new chemicals were added. All these chemicals are currently put into 3 annexes of the Convention.

Plastics themselves are not included in POPs, however, some POPs are used as additives in a large amount of plastic and other polymers which are found for example in electronics, vehicle and other transport uses, and buildings and construction materials. Additives are intentionally added to plastic polymers during their production stage or afterwards to improve their properties such as density, durability, flexibility, strength, processability as well as coloring, anti-microbial or antioxidant agents[38]. For this reason, plastic wastes may contain potentially hazardous substances, including additives such as plasticizers and flame retardants, or may be contaminated by hazardous substances, and as such may pose a risk to human health and the environment, including marine ecosystems.

The main substances of concern in plastics include flame retardants, perfluorinated chemicals (PFOS), phthalates, bisphenols, and nonylphenols. Flame retardants are a group of additives used in plastics and textile products to reduce flammability and prevent the spread of fire. They are used in a number of consumer products including electronic devices, furniture, transportation products, insulation foams, etc. The main retardants used in plastics include brominated flame retardants (BFRs), phosphorous flame retardants, short, medium, and long-chain chlorinated paraffins, boric acid, hexabromocyclododecane (HBCD), and Dechloranes. PFOS and related substances have been listed under the Stockholm Convention since 2009.

Phthalic acid esters or phthalates, on the other hand, are a family of additives used as plasticizers. They add fragrance to products and make them more flexible. But some phthalates have been defined as endocrine disruptors, even at low concentrations. Bisphenols are a group of chemical compounds with two hydroxyphenyl functionalities. They are present in many polycarbonate plastic products (including water bottles, food storage containers and packaging, sports equipment, and compact discs), and epoxy resin liners of aluminum cans. Bisphenols are frequently used as a developer in thermal paper such as cash register receipts. Bisphenol A (BPA) is the most representative chemical of the bisphenol group and is one of the most commonly produced chemicals worldwide. Nonylphenols (NP) are intermediate products of the degradation of a widely used class of surfactants and antioxidants: nonylphenol ethoxylates (NPE)[39]. NP and NPE are used for many applications such as paints, pesticides, detergents, and personal care products, and can also be used as antioxidants and plasticizers in plastics.

36 Wingfield, S and Lim, M, "The United Nations Basel Convention's Global Plastic Waste Partnership: History, Evolution and Progress", in Microplastic in the Environment: Pattern and Process, Michael S. Bank (ed.), Springer, 2022.
37 Stockholm Convention Official Web Page, http://chm.pops.int, Retrieved December 10, 2022.
38 Crawford, C. and Quinn, B. Microplastic Polutants, 2017, Elsevier, Amsterdam, Netherlands.
39 Engler, R. E. (2012) The Complex Interaction between Marine Debris and Toxic Chemicals in the Ocean, Environmental Science and Technology, 46, 12302-12315.

As discussed, even though a number of chemical additives of plastics have been identified as Persistent Organic Pollutants (POPs) and are now listed under the Convention, many chemicals are still used due to exemptions.

The Convention was signed by Türkiye on May 23, 2001, and passed the approval of the Grand National Assembly of Türkiye as Law No. 5871 on April 14, 2009 (Official Gazette: 14.04.2009, No.27200) and was accepted by the Council of Ministers and published on July 30, 2009 (Official Gazette: 30.07.2009, No.27304). The Convention officially entered into force for Türkiye on 12 January 2010.

4.1.3. Minamata Convention

Mercury is one of the rare metals that is in liquid form at room temperature and has many uses in daily life. Mercury can also be used in the production of vinyl chloride monomer (VCM) which is mainly used to produce PVC (a plastic mostly used in construction, window frames, and other applications). The global demand for PVC continues to grow rapidly, especially in developing economies. In countries where coal may be used as a cheap feedstock, the carbide-based process was widely used in the past, relying on a mercuric chloride catalyst to produce VCM. The PVC industry is now one of the two largest consumers of mercury in the world due to this process.

As a response by the world's nations to the abundant evidence of the negative effects of mercury pollution on human health and the environment, the Minamata Convention on Mercury entered into force on 16 August 2017. The Convention includes provisions to control the supply, trade, and use of mercury.

In Annex B of the Convention where description of the manufacturing processes in which mercury or mercury compounds are used; Part II is related to vinyl chloride monomer production. This part emphasizes measures that need to be taken by the Parties as the reduction on the reliance of mercury, limits on the use of mercury, and limitations on emission of mercury are defined, and support for research on mercury-free catalysts is recommended[40].

Since the 1960s, scientists have been searching for a mercury-free catalyst for the production of the monomer vinyl chloride (VCM). With the aforementioned annual global production of PVC, it's urgent to find sustainable catalysts for the production of the monomer, on the other hand, switching to a new system on the global scale seems to be a difficult task[41]. Currently, promising mercury-free processes are available; one mercury-free process option is based on ethylene, which uses oil or natural gas as a feedstock[42].

On February 15, 2022, the "Law on the Approval of the Minamata Convention on Mercury with the Declaration" was accepted in the General Assembly of the Grand National Assembly of Türkiye, and the Parliamentary approval regarding the process of the State of the Republic of Türkiye becoming a party to the mentioned Convention was completed, it was published in the Official Gazette on February 24, 2022 and entered into force.

40 Minamata Convention on Mercury, Text and Annexes, UNEP, 2019, https://mercuryconvention.org/sites/default/files/2021-06/Minamata-Convention-booklet-Sep2019-EN.pdf, Retrieved March 7, 2023.
41 Kaiser, S. K.; Fako, E.; Surin, I.; Krumeich, F.; Kondratenko, V. A.; Kondratenko, E. V.; Clark, A. H.; López, N.; Pérez-Ramírez, Performance descriptors of nanostructured metal catalysts for acetylene hydrochlorination. J. Nat. Nanotechnol. 2022 DOI: 10.1038/s41565-022-01105-4
42 Manufacturing processes in which mercury or mercury compounds are used Information provided stakeholders (IPEN), https://mercuryconvention.org/sites/default/files/documents/submission_from_government/compilation_10_processes.pdf.

4.1.4. Montreal Protocol

The Montreal Protocol on Substances that Deplete the Ozone Layer is a multidimensional and multiparty environmental agreement aiming to regulate the production and consumption of nearly 100 man-made chemicals referred to as ozone-depleting substances (ODS). Those chemicals are such that if released into the atmosphere, there is the potential to damage the stratospheric ozone layer. The substances controlled by the treaty are listed in Annexes which are A (Chlorofluorocarbons-CFCs, halons), B (other fully halogenated CFCs, carbon tetrachloride, methyl chloroform), C (Hydrochlorofluorocarbons-HCFCs), E (methyl bromide) and F (hydrofluorocarbons-HFCs). This Protocol is adopted on 16 September 1987 and it is to date one of the rare treaties to achieve universal ratification[43].

The Montreal Protocol, to which 196 countries are parties, is recognized as the most successful multilateral agreement on the environment. In 1990, with the main objective being to assist developing country parties with an annual level of consumption of ozone-depleting substances less than 0.3 kilograms per capita to comply with the control measures of the Protocol, the Multilateral Fund for the Implementation of the Montreal Protocol (MLF) was established[44]. The fund was generated with the contributions of developed countries.

Türkiye became a party to the Protocol on 19 December 1991 and accepted all its amendments[45]. Montreal Protocol was modified by Kigali Amendments in Kigali-Rwanda in 2016 after a few prior amendments, to phase down HFCs, which were introduced as non-ozone-depleting alternatives to support the timely phase-out of CFCs and HCFCs. Proposal of Law on approval of the Montreal Protocol Amendment (Kigali Amendment – 2016) which was agreed on the 28th Meeting of Parties was approved by the Grand National Assembly of Türkiye and published in the Official Gazette dated March 11, 2021, numbered 31420. A relevant regulation, The Regulation on the Substances Depleting the Ozone Layer, was published in Official Gazette by number 30031 on 7 April 2017.

The phasing down of production and consumption of these chemicals will be in a stepwise manner and around different timetables for developed and developing countries. This way, developed and developing countries have equal but differentiated responsibilities, and both have binding time-targeted and measurable commitments[46].

Even though the Protocol is specific to the ozone-depleting substances, it can act as a model global treaty for the control of other environmentally widespread pollutants. A recent study in the literature suggests a new international legally binding instrument to prevent land-based sources of marine plastic debris may be based on the primary elements of the Montreal Protocol due to the fact that the oceans being a common pool analogous to the atmosphere. The power of the Montreal Protocol has been identified as being the most successful multilateral agreement in resolving a global environmental issue, possibly due to its level of participation, the global cooperation generated and the targets achieved, as well as serving as an example of industry taking responsibility for the environmental impacts of the products they produce. Stemming from this point, it is argued as “Can it also serve as a model to regulate the environmental impacts of plastic products?”[47]. Another study also suggests that there are important similarities between plastic pollution and the pollutants addressed by the Montreal Protocol and the Paris Agreement. Like ozone-depleting chemicals, plastics consist of entirely synthetic materials. And like the greenhouse gases that result from the combustion of fossil fuels, there is an important economic dimension to plastics. These similarities might suggest that a treaty addressing plastics could simply follow one of the existing models implying the Montreal Protocol[48].

43 UNEP Montreal Treaty Official Web Page, https://www.unep.org/ozonaction/who-we-are/about-montreal-protocol, Retrieved Feb. 2, 2023.
44 Multilateral Fund for the implementation of Montreal Protocol, http://www.multilateralfund.org/default.aspx, Retrieved March 8, 2023.
45 Ministry of Environment, Urbanization and Climate Change, https://ozonturkiye.csb.gov.tr/uluslararasi-protokoller-i-101939, Retrieved,March 8, 2023.
46 UNEP Montreal Treaty Official Web Page, https://www.unep.org/ozonaction/who-we-are/about-montreal-protocol, Retrieved Feb. 2, 2023.
47 Raubenheimer, K and McIlgorm, A, Is the Montreal Protocol a model that can help solve the global marine plastic debris problem? Marine Policy, 2017, 322-329.
48 Kirk, E. A and Popattanachai, M Marine plastics: Fragmentation, effectiveness and legitimacy in international lawmaking, Review of European, 2018, 27, 222-233.

4.1.5. Work under the United Nations Environment Assembly (UNEA) on marine plastic litter and microplastics

The UN Environment Assembly (UNEA) is made up of 193 UN Member States and acts as the key global forum for discussing and agreeing on environmental issues. With this commitment, UNEA has passed four resolutions on marine litter since 2014[49]. The stepwise developments happened in four chronological stages as summarized in Figure 4.1. At the first UNEA meeting in 2014, the nations agreed on marine plastics and microplastics as a global emerging threat that negatively impacts the marine environment and requested UNEP to provide a report on this. The need for more research on the problem was also noted. UNEP released the report "Marine Plastic debris and microplastics: Global lessons and research to inspire action and guide policy change" in 2016. With this report significant scientific knowledge on marine litter and microplastics was attained[50].

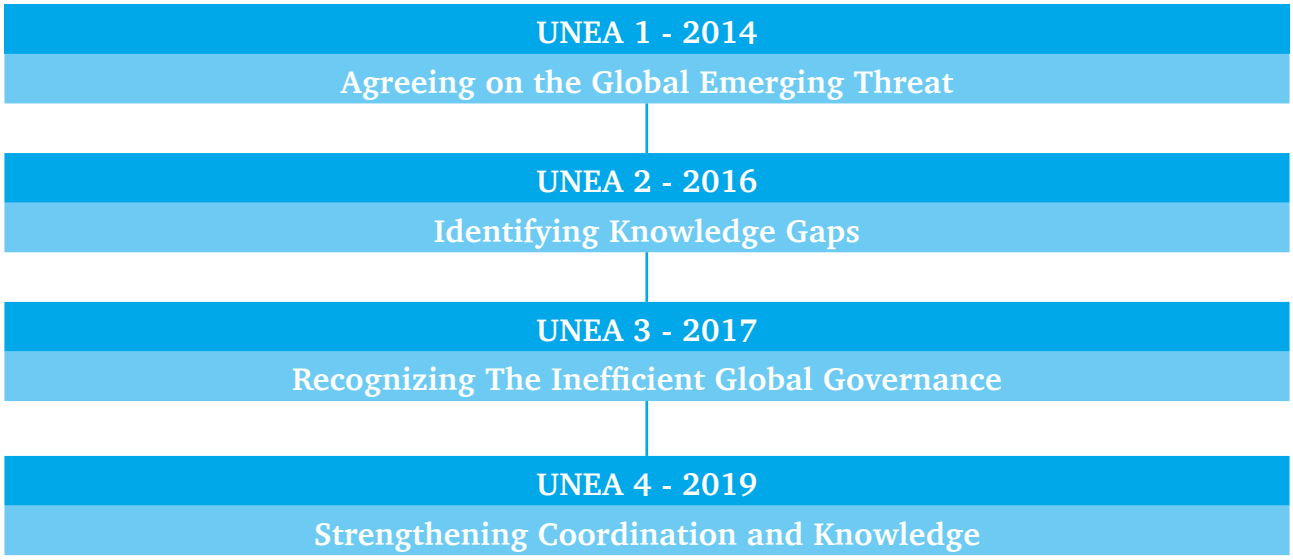

Figure 4.1 UNEA's chronological development of resolutions on marine litter

Once the report "Marine Plastic debris and microplastics: Global lessons and research to inspire action and guide policy change" was launched, the parties gained a better understanding of marine plastic debris and microplastics and the fact that plastics "are found in all compartments of the marine environment." In addition, the knowledge on the slow degradability of plastics, negative effects on marine life and ecosystems due to their potential to adsorb and emits chemicals and their ability to spread harmful organism as well as their continuous movement from land to sea by rivers, surface runoff, and sewage outfalls, etc. motivated a resolution calling for a comprehensive assessment of the effectiveness of governance strategies at every level and approaches to combat marine plastic debris and microplastics by the parties. Around these discussions, the resolution of UNEA 2 in 2016 stressed the importance of prevention and environmentally sound management and approaches such as product life cycle, the polluter pays principle, and the "three Rs" (reduction, reuse, and recycling)[51].

At UNEA 3 in 2017, emphasis was placed on the high, fast-growing levels of marine plastic litter, as well as their expected negative impacts on nature, society, economies and the role of increasing production and consumption of plastic. Several sectors were highlighted, such as fisheries, maritime transport, recreation,

49 Unea Resolutions on Marine Litter, https://unea.marinelitter.no/, Retrieved Feb. 27, 2023.
50 Unea Resolutions on Marine Litter, https://unea.marinelitter.no/, Retrieved Feb. 27, 2023.
51 Unea Resolutions on Marine Litter, https://unea.marinelitter.no/, Retrieved Feb. 27, 2023.

and tourism. The effectiveness of global and regional governance was scrutinized and the study, "Combating marine plastic litter and microplastics: An assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches", showed that there are critical gaps in the global governance of marine litter and microplastics and there is no existing global framework effectively dealing with marine litter and microplastic. The parties agreed on a long-term global zero-emission vision, which means that no plastic litter or microplastic should enter the oceans. An expert group was established to provide recommendations for global solutions. UNEP was asked to play a stronger role in combatting marine plastic litter by implementing regional and national action plans and to support with facilitations and secretariat functions to the expert group[52].

The fourth UNEA meeting in 2019 acknowledged that increasing plastic marine litter and microplastics keep being a serious and global problem, with widespread effects. It also noted that microplastics regardless of being added into products or generated during their lifecycle, represent a concern for the food chain, human health, and food safety. In this meeting, the parties decided that the expert group that had been established at UNEA 3 to continue its work. The resolution also asked UNEP to increase both scientific and technological knowledge about the marine plastic problem. In addition, the need for gathering more information on policies and actions and the importance of coordination and collaboration were stressed. The parties called for global coordination and governance to implement previous relevant UNEA resolutions, highlighting the immediate need for a strengthened science-policy interface. The need for more data and effective monitoring on land and sea was also declared. The resolution asked member states to work in a multi-stakeholder platform within UNEP collaboration as well as cooperation with the private sector to foster innovation in product design and reduce the discharge of plastics and microplastics into the marine environment. The resolution asked UNEP to elaborate guidelines on plastics use and production, through the 10-Year Framework on Programs on Sustainable Consumption and Production Patterns[53].

4.1.6. UNEA 5 and the Final Decision on Plastics

After the four meetings carried out and the critical resolutions delivered, UNEA assembled its session known as UNEA 5.2 in Nairobi, Kenya in early 2022, a year after the fifth Assembly took place in 2021 known as UNEA 5.1. In the 2022 meeting, UNEA made a historical move after discussions and negotiations leading to two critical developments. The first one is an internationally legally binding instrument by 2024 to end plastic pollution and the second one is an agreement to establish a science-policy panel on chemicals and waste and to prevent pollution. During the closing session, governments adopted a resolution titled, "End Plastic Pollution: Towards an internationally legally binding instrument". By this resolution, the Assembly agreed to set up an Intergovernmental Negotiating Committee (INC) to draft a legally binding agreement by 2024. The agreement is expected to address the full lifecycle of plastics, including production, design, and disposal, as well as the design of reusable and recyclable products and materials. The first session of the INC to develop an international legally binding instrument on plastic pollution, including in the marine environment, took place in Punta del Este, Uruguay in November 2022. Türkiye attended this first Committee meeting and was officially represented by the Ministry of Environment, Urbanization and Climate Change. The second session of the Committee will take place in Paris, France in May 2023.

Uruguay Meeting hosted more than 2500 attendees from across the Globe, and both the representatives of the individual countries as well as representatives of regions, groups of countries, United Nations entities, intergovernmental organizations and non-governmental organizations, Food and Agriculture Organization of the United Nations; the secretariat of the Basel, Rotterdam and Stockholm conventions; the United Nations Global Compact and the World Health Organization all made statements. Türkiye attended this Committee meeting and was officially represented the by Ministry of Environment, Urbanization and Climate Change. Statements and declarations were made by the Turkish delegates expressing the views, approaches, and vision on this global challenge.

52 Unea Resolutions on Marine Litter, https://unea.marinelitter.no/, Retrieved Feb. 27, 2023.
53 Unea Resolutions on Marine Litter, https://unea.marinelitter.no/, Retrieved Feb. 27, 2023

The main topics of the meeting were core obligations, control measures, and voluntary approaches, as well as national action plans; means of implementation, including capacity-building, technical assistance, and finance; support for monitoring and evaluation of progress in, and effectiveness of implementation and national reporting; aspects, including scientific and technical cooperation and coordination, research and awareness-raising; stakeholder participation and action; standard articles on final provisions and sequencing and recommended further work. On the last day of the meetings, a decision on the draft provisional agenda of the second session of the Intergovernmental Negotiating Committee was adopted[54]. Türkiye has been contributing to the Plastic INC negotiations to prepare an internationally binding agreement by following them closely.

4.1.7. Strategic Approach to International Chemicals Management (SAICM)

The Strategic Approach to International Chemicals Management (SAICM) is a voluntary multi-stakeholder multi-sectoral global policy framework[55]. Since its initiation in 2006, SAICM has aimed to achieve the sound management of chemicals throughout their life cycle so that by the year 2020, chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health.

Since SAICM aims to achieve the sound management of chemicals that are produced and used in daily life and seeks ways to minimize significant adverse impacts on the environment and human health throughout their life cycle by the year 2020, it publishes routine policy briefs that cover the different aspects of safe chemicals management. One of these briefs is the *"Plastics and Chemicals of Concern in Consumer Products Policy Brief"* that was published in July 2020. This policy brief provides some key lessons learned since 2006 that SAICM's stakeholders may consider in moving forward beyond 2020[56].

The policy brief notes that plastic production is growing exponentially and so are the levels of plastic waste. It highlights that plastic products are used in diverse sectors such as packaging, construction, transportation, healthcare, textiles, and electronics. Durable products, ranging from construction materials to medical devices make up nearly half of the global plastics market, while packaging products are the largest uses of single-use plastics. The policy brief adds that some plastics contain chemicals that are considered to be harmful to health and the environment. During the manufacturing of plastics, other chemicals are often used for a variety of reasons, such as initiators, catalysts, solvents, and a wide range of additives for enhancing polymer properties and prolonging plastics' life. These chemicals may also be released from plastics during the various recycling and recovery processes. Phthalates, poly-fluorinated chemicals, bisphenol A (BPA), brominated flame retardants, and antimony trioxide are among these additives and are considered harmful to health and the environment[57].

Sectors that especially create concern for the exposure of additive chemicals are highlighted in the brief as toy production, electrical and electronics, construction, and textile sectors. For example, 90% of toys in the market are noted to be made of plastic. Similarly, 20% of materials used in electrical and electronics equipment are plastics and about 21% of the 47 million tonnes of plastic used in Europe goes into the construction sector[58]. Chemicals of concern often enter the lifecycle of these products during the production phase and remain even through the recycling process. The policy brief also focuses on microplastics as a new concern to be addressed and emphasizes the textile sector being one of the sources of plastic microfiber release. Attention was also called upon the intentionally added microplastics to some products such as some detergents and maintenance

54 UNEP Intergovernmental negotiating committee to develop an international legally binding instrument on plastic pollution, including in the marine environment, First session, https://wedocs.unep.org/bitstream/handle/20.500.11822/41841/UNEPINC.1-14Reportupdated.pdf?sequence=1&isAllowed=y, Retrieved 5 March 2023.
55 Official SAICM web page, http://www.saicm.org/About/Overview/tabid/5522/language/en-US/Default.aspx, Retrieved March 4, 2023
56 SAICM, saicmknowledge.org, https://saicmknowledge.org/sites/default/files/publications/FINAL_Policy_Brief_plastics%20and%20CoCs%20in%20consumer%20products_july30.pdf, Retrieved, March, 4 2023.
57 SAICM, saicmknowledge.org, https://saicmknowledge.org/sites/default/files/publications/FINAL_Policy_Brief_plastics%20and%20CoCs%20in%20consumer%20products_july30.pdf, Retrieved, March, 4 2023.
58 SAICM, saicmknowledge.org, https://saicmknowledge.org/sites/default/files/publications/FINAL_Policy_Brief_plastics%20and%20CoCs%20in%20consumer%20products_july30.pdf, Retrieved, March, 4 2023.

products, agriculture and horticulture products, medical products, food supplements, paints, oil and gas, adhesives, 3D printing materials, and printing inks.

The policy brief also emphasizes measures to reduce chemicals of concern through legislation and information system tools such as regulations, standards, and certification mechanisms, and ensuring brands control suppliers to enable compliance; holistic tools that consider the entire value chain such as life cycle assessment tools and eco-innovation; production tools that seek to minimize exposure and focus on cleaner and responsible production and chemical leasing; and consumption tools that focus on consumer behavior, including sustainable public procurement and ecolabels.

In consideration to address plastics and chemical additives in products, the policy brief suggests three approaches[59]:

- Strengthening scientific and technological knowledge with regard to chemical additives in plastics,
- Increasing traceability and reliability of information sharing along value chains and strengthening commitments and standards to phase out chemical additives in plastics and
- Coordinating actions across the value chains of plastic products.

4.1.8. Waste Shipment Regulation

The EU has a system to supervise and control shipments of waste within its borders, and with countries that have signed the Basel Convention. Yet, toxic waste from Europe has been exported and dumped in developing countries on several occasions. The original EU Waste Shipment Regulation dates back to 2006 and includes rules for transporting waste across borders for the EU. The main aims of the EU rules on waste shipments are environmental protection, and to reduce the risks to human health. Additionally, they aim to establish greater legal clarity and pursue harmonization in the area of transboundary shipments of waste. With the new developments in the EU such that the adoption of the European Green Deal in December 2019 and the rules on shipment of plastic waste introducing the rules on the export, import, and intra-EU shipment of plastic waste entering into force in early 2021, the Commission proposed new regulations and amended a number of old regulations. One of the regulations amended and proposed was the Waste Shipment Regulation. Along with the European Green Deal perspective, Commission put forth the idea of circular economy and zero pollution ambitions by proposing stronger rules on waste exports, a more efficient system for the circulation of waste as a resource and determined action against waste trafficking[60]. Waste exports to non-OECD countries are aimed to be restricted and only allowed if third countries are willing to receive certain wastes and are able to manage them sustainably. Waste shipments to the OECD countries will be monitored and can be suspended if they generate serious environmental problems in the country of destination. Under the proposal, all EU companies that export waste outside the EU should ensure that the facilities receiving their waste are subject to an independent audit showing that they manage this waste in an environmentally sound manner. For this proposal to enter into force, it must be adopted by the European Parliament and the Council[61].

4.1.9. Expectations from OECD and member states

Established by the OECD, OECD Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Operations (OECD/LEGAL/0266), aims at facilitating the trade of recyclables in an environmentally sound and economically efficient manner by using a simplified procedure as well as a risk-based approach to assess the necessary level of control for materials. Wastes exported outside the OECD area, whether for recovery or final disposal, do not benefit from this simplified control procedure[62]. The OECD

59 SAICM, saicmknowledge.org, https://saicmknowledge.org/sites/default/files/publications/FINAL_Policy_Brief_plastics%20and%20CoCs%20in%20consumer%20products_july30.pdf, Retrieved, March, 4 2023.
60 European Comission, https://ec.europa.eu/commission/presscorner/detail/en/ip_21_5916, Retrieved 5 March 2023.
61 European Comission, https://environment.ec.europa.eu/topics/waste-and-recycling/waste-shipments_en#timeline, Retrieved March 8, 2023.
62 https://www.oecd.org/env/waste/theoecdcontrolsystemforwasterecovery.htm

Control System is based on two control procedures applied to wastes under two broad lists: the Green list and the Amber list of wastes. Wastes subject to these control procedures are listed in Appendices 3 and 4 to the OECD Council Decision as:

1. Green Control Procedure: for wastes (Appendix 3) presenting low risk for human health and the environment and, therefore, are not subject to any other controls than those normally applied in commercial transactions, and

2. Amber Control Procedure: for wastes (Appendix 4) presenting sufficient risk to justify their control.

Wastes exported outside the OECD area, whether for recovery or final disposal, do not benefit from this simplified control procedure. Rather, the transboundary movement of such wastes is typically covered by the Basel Convention. The two international agreements, Basel Convention and OECD Council Decision are nevertheless closely interlinked, and the waste categorizations under the OECD Decision are harmonized with the waste lists in the annexes to the Basel Convention. As mentioned above, the transboundary movement of plastic wastes are incorporated into the Basel Convention and the Annexes of it in 2019. After a series of discussions and meetings, the classification of the wastes in question in the OECD Decision and the resulting modifications to Appendices 3 and 4 of the Decision were agreed upon. Accordingly, starting from 1 January 2021, the following is applicable:

- Hazardous plastic wastes, namely those covered by new Basel entry A3210, are listed under Appendix 4, Part II of the OECD Decision as new OECD entry AC300, and therefore subject to the Amber control procedure under the OECD Decision.
- For other plastic wastes, namely those covered by new Basel entries B3011 and Y48, each OECD Member country retains its right to control the plastic waste in question in conformity with its domestic legislation and international law, as no consensus was reached on the controls to be applied within the OECD system. Corresponding text is incorporated into Appendix 3, Part I and II; and Appendix 4, Part I of the OECD Decision[63].

4.2. Zero Waste Resolution

The main purpose of Zero Waste is to increase the efficient use of resources, minimize the generation of waste, and achieve better balance among the environment, economy, and society. Zero waste is committed to sending nothing to landfills harmonized with the scope of Sustainable Development Goals (2015) 11.6, 12.4, 12.5 and the New Urban Agenda (2016) 71, 74, 123 approved by the UN General Assembly and the vision of transitioning to a circular economy.

On 14 December 2022, the United Nations General Assembly adopted a resolution titled **"Promoting zero waste initiatives to advance the 2030 Agenda for Sustainable Development"** at its seventy-seventh session to proclaim 30 March as International Day of Zero Waste, to be observed annually[64]. Türkiye, alongside 105 other countries, put forward the resolution.

The resolution stresses the urgency of taking immediate actions towards the long-term elimination of plastic pollution in marine environments, including through promoting national action plans to work towards the prevention, reduction and elimination of marine litter and plastic pollution from all sources, and promoting sustainable consumption and production approaches, including resources efficiency and life - cycle approaches, in which products and materials are designed in such a way that they can be reused, remanufactured or recycled and therefore retained in the economy for as long as possible, along with the resources of which they are made, and the generation of waste is avoided or minimized.

63 Full Summary of the amendments of the OECD Council Decision, https://www.oecd.org/environment/waste/Full_summary_of_the_amendments_to_the_OECD_Council_Decision.pdf, Retrieved March 5, 2023.
64 https://digitallibrary.un.org/record/3994818

Important role of cities and rural areas in sustainable and the environmentally sound management of waste, including by the application of local and national zero-waste initiatives, which can contribute to reducing pollution, including plastic pollution in marine and other environments, climate change mitigation and adaptation, conservation and the sustainable use of biodiversity and the services provided by ecosystems, the protection of the marine environment, enhancing food security and improving human health is underlined.

Within the Resolution; set up of an advisory board of eminent persons, for a period of three years, to promote local and national zero-waste initiatives through, inter alia, the dissemination of best practices and success stories is requested. More over, the United Nations Environment Programme is invited to include a dedicated section on zero-waste initiatives, including on activities and experiences of such initiatives in the next iteration of the Global Waste Management Outlook. The continuation of the discussion on zero-waste initiatives within the relevant United Nations entities, within their work on sustainable consumption and production is recommended.

4.3. Policy Framework In Türkiye

In addition to becoming a signatory of the abovementioned international treaties and following EU legislation, Türkiye also puts effort to activate own legislations to minimize plastic pollution and its potential harms to the environment and public health.

Together with the systematically renewed 5-Year Development Plan, Türkiye has the National Action Plan for Waste Management, the Climate Change Action Plan, the Climate Change Strategy, the National Green Deal Action Plan, and EU Integrated Environmental Approximation Strategy as the source of policies tackling plastic pollution.

Türkiye has also developed the new **National Waste Management and Action Plan** (2023-2035) taking into account the international standards, national circumstances and priorities, and the appropriate European Union regulatory framework ensuring that the national waste management strategy must meet the requirements of sustainability and integrative action.

It is aimed via NWMAP; to determine the strategies and establish relevant action steps in order to manage the generation of waste until 2035 in accordance with sustainable development goals. The plan includes principles for efficient use of limited resources, prevention of waste generation by reducing waste, reuse of waste, inclusion of wastes in recycling and recovery processes, and disposal of non-recoverable wastes with appropriate methods. The NWMAP (2023-2035) identifies key targets for a more efficient resource and waste management system.

- Recycling rate to be increased by 60% by 2035.
- Separately collected at the source of packaging waste rate to be increased by 70% as of 2031.
- Performing studies on the restriction of using single-use plastics by 2024.
- Putting an end to accepting waste to dump sites by the end of 2023.

The Environmental Law of 09.08.1983 and No. 2872 is the foundation of environmental protection. The goal of the Law is to protect and improve the environment by making better use of land and natural resources in both rural and urban areas. The Law also aims to stop pollution of water, land, and air.

In 2006, 2018, and 2020, the Law was changed significantly, as shown below:

- Law amending the Environment Law - O.G./26.04.2006 - 5491
- The Law amending Environmental Law and Other Laws - O.G./29.11.2018 - 7153

- The Law on the Establishment of Turkish Environment Agency and amending Other Laws - O.G/24.12.2020 - 7261

The Environmental Law with these amendments, determines the rules regarding the following issues:

- General rules for environmental protection
- Polluter pays principle and extended producer responsibility
- Waste prevention, reduction, recycling, reuse, and environmental awareness practices
- Recovery contribution fee to be charged for packaging including plastics and other products listed in the Law
- Labeling rules of packages
- Deposit refund system
- Charging of plastic bags

In particular, important changes were made regarding environmental protection, reduction of the use of plastic bags or packaging and single-use materials, promotion of renewable resources and clean technologies, market-based mechanisms and economic instruments/incentives such as taxes, recovery contribution fee, deposit system, emission fees, and carbon trade. The introduction of the recovery contribution fees was made to plastic bags, tires, batteries, certain electrical and electronic appliances, oils, medicine, and packaging materials (plastic, metal, composite, glass, wooden) as a reflection of the "polluters pays" principle and extended producer responsibility. Another important step taken with the law amendment is the regulation on the mandatory use of waste or recycled materials obtained from waste, which will greatly contribute to circularity.

In December 2020, a new law regarding the establishment of the Turkish Environment Agency (Law no. 7261) came into force. The main activities of the Turkish Environment Agency (TÜÇA) are establishing and operating the deposit refund system and enhancing resource productivity through zero waste and the circular economy.

Table 4.1 In line with EU legislation, Türkiye developed/amended a number of regulations including

Regulation on the Reception of Waste from Ships and the Control of Waste	26.12.2004
Regulation on Landfill of Waste	26.03.2010
Regulation on Waste Management	02.04.2015
Procedures and Principles on Plastic Bags Fees	09.01.2019
Zero Waste Regulation	12.07.2019
Regulation on Recovery Contribution Fee (GEKAP)	31.12.2019
Regulation on Control of Packaging Waste	26.06.2021
Regulation on General Principles of Waste Pre-Treatment and Recycling Facilities	09.10.2021
Rules and Procedures on Zero Waste Practices and Civic Amenity Centers	31.12.2021
2022/6 Ministerial Circular on Waste Pickers	28.03.2022
Regulation on the Management of Waste Electrical and Electronic Equipment	26.12.2022
Regulation on the Restriction of the Use of Certain Harmful Substances in Electrical and Electronic Equipment	26.12.2022

Zero Waste Project has been initiated in 2017 in Türkiye. The municipal waste recycling rate, which was 13% in 2017, increased to 27.2% and 30.13% in 2021 and 2022. In order to implement the Zero Waste Project more efficiently and to prepare for the transition to the circular economy, the **Zero Waste Regulation** was published in 2019. The Regulation defines the concept of zero waste, and also communicates the collection of waste as packaging waste, biodegradable waste and other waste. Also, the regulation sets out the roles and responsibilities of local administrations, institutions, and organizations in the zero-waste management system, while determining the technical and physical conditions for the separate collection and processing of waste.

Rules and Procedures on Zero Waste Practices and Civic Amenity Centers determine the separate collection and zero waste implementation procedures. The regulation is one of the most important regulations that take measures for disposable products and waste reduction. According to the Regulation, places that provide food and beverage services such as cafeterias, restaurants, etc. are obliged to ensure that reusable products are preferred instead of single-use materials such as plates, forks, knives, spoons, and glasses.

In addition, materials such as straws and wet wipes should be provided only when requested by the customers, but in package orders materials that will cause waste such as disposable plates, forks, knives, spoons, glasses, and straws should be provided.

Ministerial Circular on Waste Pickers (2022/6) is regulated in order to improve the existing conditions in the transition period until source seperation and zero waste implementations becomes widespread within the country and ensure the registration of waste pickers by the municipality of the region where they operate.

Regulation on General Principles of Waste Pre-Treatment and Recycling Facilities determines additional technical requirements and enables to improve the physical conditions of pretreatment and recycling facilities including plastic waste recycling facilities. It is ensured that high-quality flakes and granules are obtained from the plastic waste processed in these facilities and used as raw materials in the industry.

Regulation on Landfill of Waste aims to prevent environmental contamination by reducing the harmful impacts of potential leachate and landfill gas on soil, air, groundwater, and surface waterways. In addition, the Regulation specifies the technical and administrative issues as well as the general rules to be followed regarding the construction of sanitary landfills. According to the Regulation, 60% of recyclable and recoverable waste is to be recovered by 2035.

Regulation on Waste Management ensures that all aspects of waste management, from the generation of waste through its disposal, are conducted efficiently and establishes guidelines for waste reduction, reuse, and recycling. Also, the Regulation has imposed new responsibilities on producers with regard to by-products and reusing materials. Taking into account the efficient use of products throughout their life cycle-including repair, reuse, shredding, and recycling-for the efficient use of resources without compromising the free movement of products on the market is the concept of Extended Producer Responsibility.

Regulation on Control of Packaging Waste emphasizes the reduction of plastic bag consumption, targeting recycling and recovery for packaging and adopting deposit system practices largely for beverage packaging. The most striking concepts underlined are zero waste and circular economy. Packaging and packaging wastes are required to be managed within a management system that includes deposit and zero waste systems, in accordance with circular economy and resource efficiency principles. Most notably, banning free plastic bags and in Turkish markets packaging used must be at least partially made from recycled materials. This regulation is significant because it tackles packaging waste and especially plastics packaging in line with the EU standards. All of these changes made in 2019 and 2021 were developed to be aligned with the EU Packaging and Packaging Waste Directive and are part of Türkiye's efforts to reduce plastic packaging. In addition, important efforts are necessary to continue Türkiye's alignment with the new amendments made by The Directive on Single-Use Plastics (Directive 2019/904).

Finally, as part of this new regulation, Türkiye has developed new yearly recycling and recovery targets across the country. As demonstrated by the tables below, Türkiye is significantly making efforts to reduce waste, packaging waste, and increase the recycling rate. For instance, between 2025 and 2030 (for each year) Türkiye wants to achieve a 65% recycling rate [65].

Table 4.2 Total recovery and recycling rate targets of Türkiye

Years	Total Recovery Rate (%)	Total Recycling Rate (%)
Between 2021-2025, for each year	60	55
Between 2025-2030, for each year	-	65
2031 and afterwards	-	70

Table 4.3 Material type-based annual recycling rate targets of Türkiye

Years	Material Type-Based Annual Recycling Rate (%) (preparing for reuse included)				
	Glass	Plastic	Metal	Paper/ Cardboard	Wood
Until 2026	70	55	60	75	25
Until 2031	75	55	70	85	30
2031 and afterwards	75	55	70	85	30

The Regulation aims to establish the application, declaration, collection, and monitoring processes for the recovery contribution fee to be collected from suppliers and retailers. Also, the Regulation is essential for the creation of an effective waste management system that incentivizes recycling efforts.

On the other hand, within the scope of the principle of extended producer responsibility, the duties and responsibilities of packaging manufacturers, those who put packaged products on the market and sales points have been determined, the minimum conditions that the packages must have and the marking-labelling obligations for these packages have been defined.

Procedures and Principles on Plastic Bags Fees regulate the requirements for plastic bags to be charged. In order to prevent all negative effects caused by plastic bags, a legal arrangement has been made for the payment of plastic carrier bags at the sale points such as markets and stores as of 1 January 2019. Via the "Charging of Plastic Bags" application which was started in 2019, an approximately 62.5% reduction rate in the use of plastic bags was achieved cumulatively, and until 2022 the formation of 760,000 tons of plastic waste was prevented.

Regulation on the Management of Waste Electrical and Electronic Equipment promotes the design and production of EEE in accordance with circular economy principles, notably in view of facilitating the re-use, dismantling, and recovery of WEEE, its components, and materials, achieving a high level of separate collection of WEEE and proper treatment of all collected WEEE.

Regulation on the Restriction of the Use of Certain Harmful Substances in Electrical and Electronic Equipment aims at limiting the use of harmful substances in electronic equipment to protect the environment

65 Regulation on Amending the Regulation on Control of Packaging Waste. Retrieved January 15, 2023, from https://www.resmigazete.gov.tr/eskiler/2020/03/20200313-4.htm

and human health. Market surveillance and inspection of electrical and electronic goods within the scope of the Regulation, in line with the provisions of the Framework Regulation on Market Surveillance and Inspection of Products, which came into force with the President's Decision dated 9/7/2021 and numbered 4269 carried out by the following institutions: Ministry of Health (for Medical Devices), Ministry of Commerce (for toys and sports equipment), Information Technologies and Communications Authority (For radio and telecommunication terminal equipment) and Ministry of Industry and Technology-ICTA (For other electrical and electronic goods).

Regulation on Recovery Contribution Fee (GEKAP) regulates the rules of "recovery contribution fee" paid by the producers and importers of the products listed in Annex-1 of the Environmental Law. All packaging including plastic bags, tires, accumulators, batteries, mineral oil, vegetable oil, medicine, electrical and electronic equipment, and beverage packaging are included in the scope.

Recovery Contribution Fee which is an economic instrument as an incidence of "polluter pays" and "extended producer responsibility" aims to finance the development of the waste management infrastructure and to meet the necessary expenses for collection, transportation, and recycling of packaging and other special wastes as well as encouraging the reduction of waste generation by reducing unnecessary packaging. The products within the deposit management system are exempted from Recovery Contribution Fee (GEKAP).

Regulation on the Reception of Waste from Ships and the Control of Waste aims to protect the maritime environment and prevent marine pollution by limiting the discharge of ship-generated waste and cargo residues. On the other hand, the Regulation lays out the essential road map for waste collection and management from all ships inside Türkiye's territorial waters. Plus, it assists in determining how to generate physical conditions and formulate management strategies. The Regulation highlights the steps that must be followed to limit or prevent the damage caused by ship waste to the seas. Recovery Contribution Fee (GEKAP) creates a financial source for the improvement of waste management infrastructure and dissemination of zero waste practices.

4.4. Plastic Value Chain

The entire manufacturing process of plastic, from the extraction of raw materials to the disposal or recycling of plastic products, is included in the plastic value chain. It is a complex and inter connected system with various stakeholders at different stages, including producers of plastic, distributors, retailers, and consumers, as well as suppliers of raw materials.

The plastic value chain usually commences with the extraction of fossil fuels, such as natural gas or crude oil, which serves as the feedstock for manufacturing plastic resins via a chemical process. Crude oil, which is transformed into a number of petrochemicals through refinement, serves as the main raw ingredient in the production of plastic monomers. Linking monomers together to create polymer chains is a step in the polymerization process. Petrochemicals are converted into plastic pellets as part of the manufacturing process. The plastic pellets created from these petrochemicals are subsequently utilized to create a variety of plastic items.

Following that, these resins are delivered to plastic producers, who use them to make a wide variety of plastic products, including consumer goods, packaging products, automobile components, and building materials. The stages of these processes include compounding, extrusion, and polymerization. Plastic pellets are melted during the extrusion process, and the finished product is created.

Product designers play a key part in the plastic value chain since they choose the requirements and conditions for plastic products, including the types of resins, additives, and processing techniques that will be used.

Transporting the products from the point of manufacture to the consumer is part of the distribution process for plastic products. Consumer plastic product distribution and sales are the responsibility of distributors and retailers. They are essential for promoting and selling plastic goods as well as educating consumers about their proper use and disposal.

Consumers represent the last phase of the plastic value chain, as they use and dispose of plastic products. Their actions and decisions significantly affect the plastic value chain, as they dictate the demand for plastic products and the quantity of plastic waste produced.

The waste management systems, recycling facilities, and regulatory frameworks are some examples of the infrastructure and auxiliary services that are included in the plastic value chain. Figure 4.2 summarizes the whole plastic value chain from production to use and then to after-use stages.

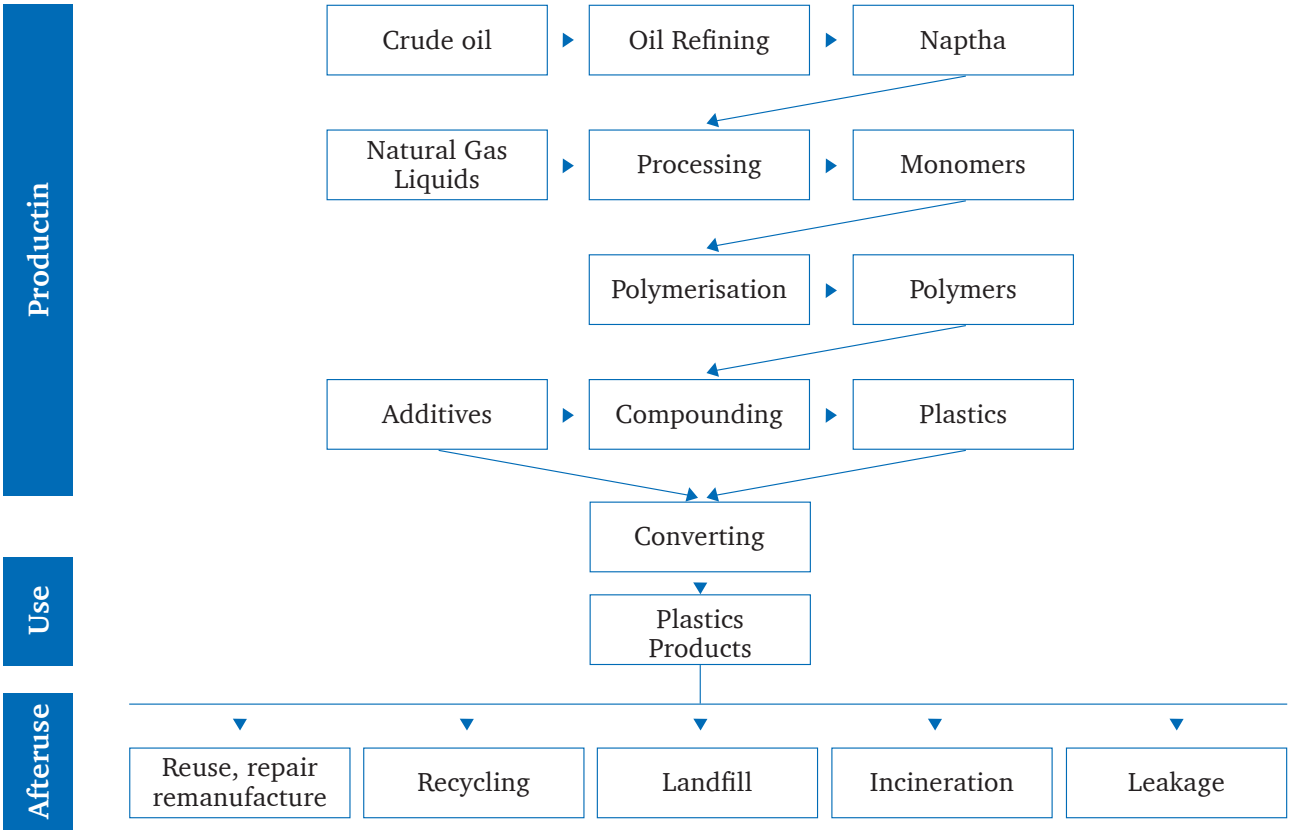

Figure 4.2 Plastic Value Chain[66]

4.4.1. Stakeholder Involvement Across the Plastic Value Chain

Stakeholder involvement in the context of plastics is the process of identifying and assessing the diverse collection of stakeholders who are affected by or can influence the industry's operations, regulations, and outcomes. This aids in identifying and prioritizing key stakeholders and their interests, comprehending power dynamics and potential conflicts, and developing successful communication and engagement strategies. Furthermore, identification and analysis of the many individuals and organizations with an interest in

66 European Environment Agency. (2020). Plastics, the circular economy and Europe's environment - A priority for action. EEA Report No 18/2020. Retrieved February 24, 2023, from https://www.eea.europa.eu/publications/plastics-the-circular-economy-and

or are impacted by the manufacture, use, and disposal of plastics, are required for stakeholder mapping across the plastic value chain. These stakeholders' relationships can be listed reveal to possible areas of cooperation, potential points of contention, and areas for development in sustainability and responsible plastic management.

The plastic value chain is the series of activities and stakeholders involved in the manufacture, consumption, and disposal of plastic products. Stakeholders in the plastics value chain can simultaneously take part in different stages from production to final disposal processes. The grouping here is structured under three main headings[67].

1. From raw material extraction to plastic production

- Raw material producers
- Polymers producers
- Plastic processors
- Product producers
- Brands and retailers

2. From consumption to final disposal

- Consumers
- Waste management companies
- Waste industry associations
- Informal waste sector
- Product industry associations
- Application industrial associations
- Wastewater treatment facilities

3. Policy, financing, advocacy, and R&D

- National government
- Local government
- Regional institutions and organizations
- Governmental and non-governmental international organizations
- Research and academia
- Finance institutions
- Industry associations
- Plastic industry associations

Opportunities in Plastic Value Chain

Despite rising worries about plastic waste and its environmental impact, the plastic value chain offers numerous prospects for innovation, growth, and sustainability.

67 OECD (2022), Global Plastics Outlook: Economic Drivers, Environmental Impacts and Policy Options, OECD Publishing, Paris. Retrieved February 24, 2023, from https://doi.org/10.1787/de747aef-en

Raw material production

Companies that produce raw materials, such as ethylene, propylene, and other polymers, can **develop innovative and sustainable materials** that can replace traditional plastics. They can **focus on bio-based materials and recycled plastics** to achieve this.

Manufacturing

The manufacturers of plastic products can adopt **sustainable practices and reduce their carbon footprint.** This can include using energy-efficient production methods, reducing waste, and recycling scrap material.

Packaging

The packaging industry is a significant consumer of plastic, and there are many opportunities to reduce waste by **developing new packaging designs** that use less material or are easier to recycle.

Recycling

The recycling industry plays a critical role in the plastic value chain. Companies in this sector can focus on **developing new technologies**, such as chemical or mechanical recycling of mixed plastics, **to improve the efficiency and quality of recycling.**

End-of-life Management

Companies can also concentrate on developing new technologies and infrastructure for managing plastic waste at the end of its life. For example**, waste-to-energy facilities or recycling facilities that can handle hard-to-recycle materials.**

Challenges in Plastic Value Chain

There are challenges as well as opportunities in the plastics value chain with its many actors. These challenges arise from raw material extraction to end-of-life processes of plastics.

Environmental Impact

The usage of plastics **significantly harms the environment,** including the contamination of rivers, oceans, and other natural resources. Along with other environmental issues, the disposal of plastic waste also increases greenhouse gas emissions.

Public Perception

There is growing public concern about the impact of plastics on the environment and human health. This has led to increased pressure on governments and companies to reduce their use of plastics and to adopt more sustainable practices.

Regulatory Environment

Governments around the world are introducing regulations aimed at reducing the use of plastics and improving the sustainability of the plastic value chain. These regulations can be complex and may require significant investment from governments and companies to comply.

Supply Chain Complexity

The plastic value chain is complex, with many different stages and stakeholders involved. This complexity can make it difficult to track and manage the environmental impact of plastics throughout their lifecycle.

Economic Pressures

The production and use of plastics are heavily influenced by economic factors, such as the price of raw materials and energy. Economic pressures can make it difficult for governments and companies to invest in more sustainable practices and technologies.

5. Plastic Waste Management in Türkiye

The waste management hierarchy prioritizes steps of waste management to prevent the formation of waste, if waste is already generated reuse, recycle, or recover (energy recovery included), and only if all the favorable options are exhausted dispose of (plastic) wastes in an environmentally responsible manner. Parallel to the policies that call for waste management hierarchy, the applications are advancing to get in line with it. Indeed, plastic waste management is a complex, multidimensional issue and should be supported by a careful waste management mechanism, and in Türkiye steps are taken towards this end and improvements are made.

According to TÜİK[68], in Türkiye there are 2752 waste disposal and recovery facilities treating 127,401,232 tonnes of total waste. The total number of waste disposal facilities is 184, of which 174 are landfills and 10 are incineration facilities in which a total of 77,762,423 tonnes of waste is processed in the landfills and 570,980 tonnes of waste sent to incineration facilities. There were a total of 2568 waste recovery facilities in Türkiye in 2020 processing a total of 49,067,829 tonnes of waste. Of these facilities, 9 of them were compost facilities, 50 of them were co-incineration facilities and 2509 of them were recycling facilities.

The total amount of plastic waste recycled in Türkiye is presented in the graph over the years.

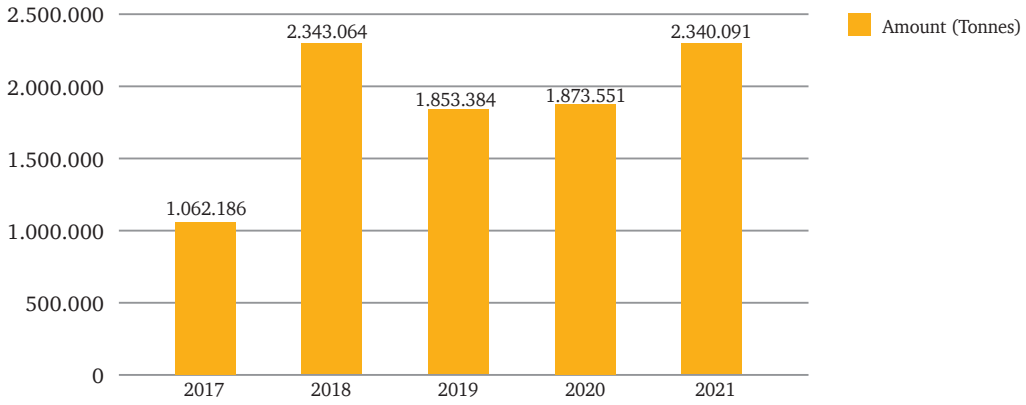

Figure 5.1 Amount of Plastic Waste Recycled

In Türkiye 1 million 895 thousand tonnes of plastic waste on average was processed annually between 2017 and 2021, of which 37% was packaging waste, 22% was manufacturing scraps, 20% was waste from household, leisure, and sports activities, 16% was from agriculture, 1% was from construction, 1% was from automotive sector and 3% was other waste. About 90% of these packaging wastes were PE/PA, PP, and PET/PC. In 2020, 835 thousand tonnes of recycled plastic packaging wastes were sent to recycling facilities with proportions of 48% PE/PA, 30% PET/PC, 19% PP, 2% PS, and 1% PVC to produce plastic raw materials in recovery plants.

68 TÜİK Kurumsal. (n.d.). Atık İstatistikleri 2020. Retrieved February 25, 2023, from https://data.tuik.gov.tr/Bulten/Index?p=Atik-Istatistikleri-2020-37198#:~:text=D%C3%BCzenli%20depolama%20tesislerinin%20toplam%20kapasitesi,milyon%20ton%20at%C4%B1k%20bertaraf%20edildi.

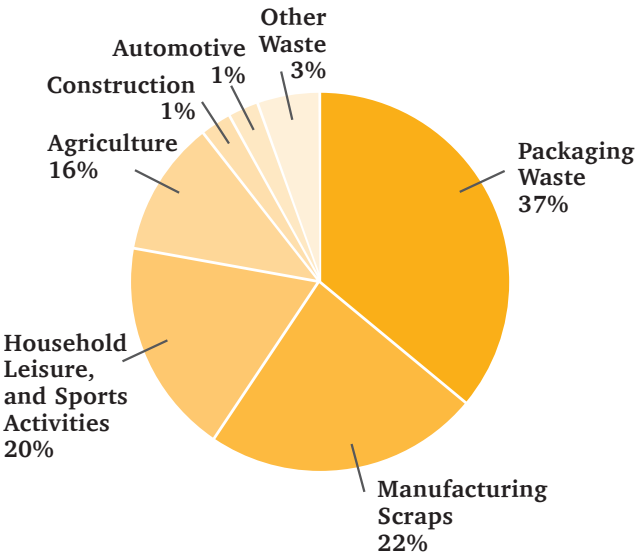

Figure 5.2 Annually Processed Plastic Waste in Türkiye Between 2017 and 2012

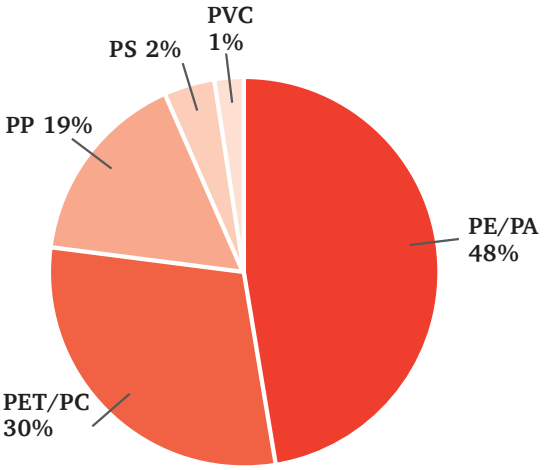

Figure 5.3 Recycled Plastic Packaging Waste in 2020

In the last 5 years covering 2018-2022, Türkiye's total plastic waste imports increased by an average of 12% per year on the amount and 26.4% on a value basis and reached 687.1 thousand tonnes and 296.9 million dollars in 2022. This trend is shown in Table 5.1.

Table 5.1 Plastic Waste Imports of Türkiye[69]

	2018	2019	2020	2021	2022	CAGR (%) 2022/2018
1000 Tonnes	436.9	757	682.2	722.2	687.1	12.0
Million $	116.4	139.9	195	317.8	296.9	26.4

In the last 5 years covering 2018-2022, Türkiye's total plastic waste exports increased by an average of 5.5% per year on the amount and 3.6% on a value basis and increased to 19.3 thousand tonnes and 19.9 million dollars in 2022. Table 5.2 summarizes this time-dependent data.

Table 5.2 Plastic Waste Exports of Türkiye[70]

	2018	2019	2020	2021	2022	CAGR % 2022/2018
1000 Tonnes	15.6	13.1	14.5	12.7	19.3	5.5
Million $	17.3	10.5	10.4	12.6	19.9	3.6

6. The Way Forward

Although there are existing policies and regulations for plastic waste management in Türkiye, since the ratio of the amount of waste generated to the amount of waste processed is still high, efforts are increasing in plastic waste management with an environmentally sound and circular economy approach. There are legislative, infrastructural, and financial gaps present for the implementation of the circular economy approach for plastic waste management. Building a circular approach for plastics will be possible by revising the legal framework in line with the EU policies along with the current legislation and policies on plastic waste.

Türkiye closely follows the EU's 2015 and 2020 circular economy action plans and has been making efforts on transition to circular economy via reducing the amount of waste and diverting waste away from landfills via increasing better source separation, collection and recovery practices. One of the main reasons why the circular economy has become an important issue for Türkiye in the near future is to prevent the depletion of natural resources, encourage recycling and facilitate access to raw materials.

"The Green Deal Action Plan of Türkiye" was published in the Official Gazette dated 16 July 2021, with a Presidential Circular No. 2021/15, in order to comply with the policies of combating global climate change and to support green transformation designed in alignment with the European Green Deal. The Action Plan includes a total of 32 objectives and 81 actions under 9 main headings. An important component of the mentioned plan is the preparation of the Circular Economy Action Plan for Türkiye and Turkish Ministry of Environment, Urbanization and Climate Change has been appointed as the responsible institution.

To support this action, the **"Technical Assistance for Assessment of Turkiye's Potential on Transition to Circular Economy"71 (DEEP Project)** was started in February 2022 by Turkish Ministry of Environment, Urbanization and Climate Change. With the project outputs, the transition to a circular economy, which also contributes to more efficient resource and waste management throughout Türkiye will be encouraged and a "Circular Economy Strategy and Action Plan" specific to our country will be prepared in 2023. Within the scope of the project, specific to plastics, by the first quarter of 2024;

69 Turk Stat (www.tuik.gov.tr) and ITC, Trade Statistics (www.intracen.org)
70 Turk Stat (www.tuik.gov.tr) and ITC, Trade Statistics (www.intracen.org
71 https://dongusel.csb.gov.tr/en

- The current situation in Türkiye (practices, legislation, etc.) will be reviewed and compared with the EU Plastics Strategy requirements. Since the EU Plastics Strategy requires some regulatory changes, a **Regulatory Impact Analysis (RIA)** study will be conducted. The RIA study will specifically include "Single Use Plastics".
- In line with the EU Plastics Strategy and Single-Use Plastics Directive, a country-specific **"Roadmap on Single-Use Plastics and Marine Litter"** will be developed, including the necessary actions for single-use plastics and marine litter. A public survey will be prepared on the restrictions of microplastics and single-use plastics.
- **"Life Cycle Assessment of Plastics"** related to the plastics industry will be carried out.

Those studies will support Türkiye to make tangible policies and take concrete measures on tackling single use plastics.

Improving the existing infrastructure, technology, and practices regarding plastic waste management, and increasing the efficiency of collection, separation, and recycling infrastructure for packaging and non-packaging plastic waste are still important areas of improvement. Separation of the collected plastic waste at the source is one of the key issues in waste management. In order to ensure efficient recycling of plastic waste by separately collecting at source, **dissemination of zero waste practices** is vital. Training, awareness raising, technical and financial support are provided by the Ministry of Environment, Urbanization and Climate Change to all relevant target groups in order to disseminate the zero waste throughout the country.

Developing and increasing the capacity of collection and recycling infrastructures to produce **high-quality secondary raw materials**, developing the infrastructure for the use of recycling technologies, and using more recycled and/or more alternative raw materials and less virgin inputs in manufactured products are important approaches that can be implemented.

A well-functioning market should be established in Türkiye for recycled plastics, which are seen as a substitute for virgin plastic. Setting **mandatory recycled content targets** and promoting **advanced recycling technologies** are important tools that can help in the formation of the secondary raw material market. The regulation made in the Environment Law in December 2020, regarding the compulsory use of waste or recycled materials obtained from waste is an important legal basis for starting further studies on mandatory recycled plastic content.

In order to support studies on the use of waste as a resource "**Technical Assistance for Development of End of Waste Concept in Türkiye Project"** officially started in April 2023. The project aims to develop technical and institutional capacity to determine and effectively implement end-of-waste criteria (EoW) for certain waste streams including others like plastics. With this project, it is aimed to increase the waste recycling capacity, the quality of recycled raw materials, and to develop and expand the market where these materials are used.

To support Türkiye's climate change adaptation and mitigation actions in Hatay province, the **"Climate Action for Hatay Project"** officially started in March 2022. The project focuses on improving the waste management sector's ability to reduce greenhouse gas emissions while implementing adaptation measures to safeguard the marine ecosystem from invasive species. Additionally, it aims to bring integrated solutions that can be piloted in Hatay and replicated in other coastal cities, while also increasing awareness on zero-waste practices.

During the transition to the circular economy, **incentives, grants, low-interest loans, and other financial instruments for the private and public sector** in the plastics waste management field is needed. Access to internationally supported financial resources and loans should be encouraged for the public and private sectors in particular SMEs.

Moreover, the protection of the marine ecosystem in the fight against plastic pollution is one of Türkiye's priorities. Particular importance is given to the policies and actions in order to reduce both land based and marine plastic pollution.

Türkiye exerts significant efforts towards protecting marine environment called "blue homeland". As having coastline to both Mediterranean and Black Sea and a party to both Barcelona and Bucharest Conventions, Türkiye has a pioneer role in the region. Türkiye is determined to continue the efforts it has shown so far in the field of protection of the marine environment and ensures to preserve its pivotal role in this field in the future.

Türkiye continues to work with the awareness that it is not possible to end plastic pollution and transition to circular economy without focusing on the entire life cycle of plastics and including all stakeholders in the plastic value chain.

As stated in the report "Turning off the Tap: How the world can end plastic pollution and create a circular economy"; tackling plastic pollution can only be achieved through 3 systemic market shifts from a linear to a circular economy: Reuse, Recycle, Redirect and Diversify.[72]

72 Turning off the Tap: How the world can end plastic pollution and create a circular economy", UNEP, May 2023, https://www.unep.org/resources/turning-off-tap-end-plastic-pollution-create-circular-economy


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