

RELEARN PLASTIC: INNOVATIVE METHODOLOGIES IN SCHOOLS FOR
STRENGTHENING THE AWARENESS AND ACTIVE CITIZENSHIP ABOUT
PLASTIC CONSUMPTION



ENVIRONMENTAL HAZARDS OF PLASTICS LEARNING MATERIAL AND GUIDE



***HANDBOOK FOR HIGH SCHOOL TEACHER –
Intellectual Output 1 – Learning Material: Plastics in
Europe***



This document represents the result of Intellectual Output number 1 in the ERASMUS+ Project n°: 2020-1-SI01-KA201-075895 „**Innovative learning methodologies in schools for strengthening the awareness and active citizenship about plastics consumption - ReLearn Plastics**“.

This work has been coordinated by the Faculty of organizational sciences, University of Maribor, and was done together in collaboration with all the other partners of ReLearn Plastics: Biotehniški center Naklo, Youth club of the municipality of Stara Pazova – OKOSP, E – gimnazija, Associacio Cultural CRESOL, IES Cid Campeador, CSI Centre for Social Innovation LTD and P.G.M.S. (Private Grammar & Modern School).

The topic of plastic overuse and environmental impact is one of the most pressing issues of today. As much as it is talked about, it is evident that high school students still lack awareness of the problem we are facing, so they need this Intellectual output as it has been concluded in the needs analysis with the schools in the partnership.

This intellectual output (IO1) refers to high school teachers and aims to increase their knowledge about plastics. The output consists of the systematization of the methodological tool, practical actions, and best practice experiences and it integrates technical knowledge in five main blocks or modules.

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„The generation that destroys the environment is not the generation that pays the price. That is the problem.“

Wangari Maathai



I INTRODUCTION

It is indisputable that the issue of plastics is one of the burning problems of today, in addition to global warming, climate change and polluted air. From the very beginning, plastic materials were born as a solution to replace scarce and unsustainable materials, since then plastic has shaped the world very successfully in the first place, while today that picture is changing. It is a clear fact that plastic is an excellent material, it is characterized by durability, flexibility and cheapness, which make it ubiquitous and irreplaceable in everyday life, and is therefore distributed around the world. Stable and sustainable, like no other that we use today, and precisely because of these properties, plastic is at the same time a big problem we are facing. No form of plastic we use today is biodegradable. There is no way to speed up the process of decomposition of plastic, because it decomposes in nature from 200 to 1000 years.

The problem with plastic is that we only need it for a short time and we soon throw it away, every day and in large quantities. Existing and irrefutable evidence tells us that the current use and disposal of plastics leads to significant pollution of both terrestrial and aquatic ecosystems. More than 70% of the total production is currently in the form of waste, most in landfills, but also a large amount that ends up in the oceans and other natural ecosystems. For that reason, scientists began to say that we live in the "Plastic Age" or on the "Plastic Planet".

According to statistics in 2019, plastic production was about 368 million metric tons worldwide, indicating that this production has been growing steadily from year to year. Unfortunately, the production of plastics has a very harmful effect in addition to the environment and the climate. It is estimated that plastic production and plastic waste on an annual basis they contribute to inseneration of 400 million tonnes of carbon dioxide equivalent (CO₂e). Almost one fifth of the global plastics production of 335 million tonnes was produced in Europe (*European Environment Agency*).

Although the demand and use of plastics is not declining, it is encouraging that worldwide emphasis is finally being placed on how dangerous plastics are and that many countries are banning the use of plastics. It is important to point out that large corporations are increasingly joining this trend.

There are various suggestions on how to solve this burning problem, and the most important one is to reduce plastic waste. Of course, this is achieved primarily through the replacement of materials with biodegradable, as well as recycling. However, in order for these measures to be adopted and applied as much as possible, it is necessary to educate and spread the awareness of a large number of people. And there is no better place for education than school. As the world rests on the young, it is also a great task for them to preserve it. It has been shown that environmental awareness in school gives the best results for achieving such goals.

This output is innovative, because it will systematically address the whole issue of plastic and then its impact on climate change. It will be designed in such a way that it can be easily implemented by teachers in secondary schools. The guidelines will link different sectors of society, including technical knowledge, common definitions, scope and innovative methodologies. Moreover, it will include examples of practical activities and project ideas in order to put this into the classroom.

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“You might not care, even if you know, but you can’t care if you don’t know”

Dr. Sylvia Earle



II GENERAL INFORMATION ABOUT PLASTIC RELATED TO THE PRODUCTION AND WIDESPREAD USE OF PLASTICS

2.1. History and Future of Plastics

Throughout history, people have looked to find the most elastic material possible, which is easy to shape, but which is also not expensive. This is due to the fact that people have long used materials, such as ivory, tortoiseshell, bone, tin, gold... The use of such materials led to the extinction of certain animal species, and the price was still too high to pay. Glass and ceramics have proven to be materials that are easy to shape, but after cooling they become quite stiff, the price also did not go in their favor. Searching for the most suitable, flexible and at the same time a substitute for natural materials, semi-synthetic materials such as nitrocellulose or celluloid (parkesin) were discovered in the middle of the 19th century.

The first plastic materials were completely natural, such is shellac, a gel that is still widely used today for varnishing wood, making inks, electrical insulation, coating the skin, but also as a glaze on candies, chewing gum, gives shine to apples, and the composition of new gels -nail polishes. It is made from the secretion of an Asian species of beetle - Kerria lacca.

The name "plastic" is of Greek origin "plasticos" which means "to have the ability to shape". From the chemical point of view, plastic consists of chains (polymers) formed by connecting individual carbon-rich molecules (monomers). Monomers can be diverse, but the way they are interconnected is also very important, which significantly increases the diversity of plastic materials.

Alexander Parkes, a British chemist and inventor, is considered the inventor of plastics. In 1856, at a large international exhibition in London, he presented his invention "parkesine", which he patented in 1856 . This flexible material consisted of various mixtures of nitrocellulose, alcohols, camphor, and oils that predated the development of the first plastic, celluloid.

The first synthetic polymer was invented in 1869 by John Wesley Hiatt, who was looking for a new material to replace ivory. By processing cellulose, made from cotton fibers, with camphor, under moderate pressure and temperature, Hiatt discovered plastic that can be shaped into various shapes and made to imitate natural substances such as tortoiseshell, horn, linen and ivory. This discovery was revolutionary. For the first time, human production was not limited by nature, because from now on people could create new materials. It was believed that this discovery helps not only people, but also the environment. He was considered the savior of turtles and elephants, it was believed that plastic could protect the natural world from various human needs.

In 1907, the first fully synthetic plastic polymer, called bakelite, was discovered, which is the main representative of phenolic polymers whose chains form phenol and formaldehyde. It is formed at high temperatures, and as it cools it hardens and becomes resistant to temperature and electricity. It was created for the needs of electrical insulation, which was in full swing at the time, due to the insufficient amount of shellac. Bakelite was not only a good insulator; it was also durable, heat resistant, and, unlike celluloid, ideally suited for mechanical mass production. Marketed as "the material of a thousand uses," Bakelite could be shaped or molded into almost anything, providing endless possibilities. Its application

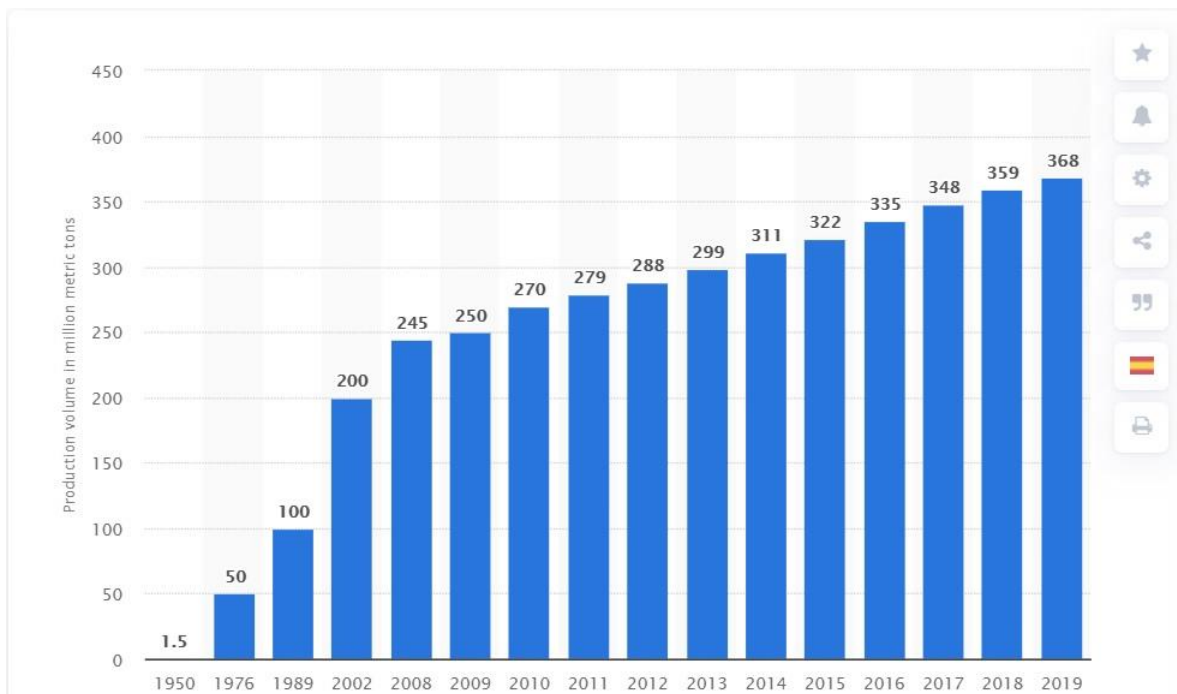
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was huge, it was used for parts of telephones, cars, furniture, instruments, jewelry, buttons, chess pieces, etc. With its wide application, it started a plastic revolution.

After World War I, improvements in chemical technology led to the explosion of new forms of plastic, while mass production began during the 1940s and 1950s. Although discovered earlier, polystyrene (PS) and polyvinyl chloride (PVC) are only now becoming popular, and new polymers are entering the scene - polyethylene (1933), polyethylene terephthalate (1941), polypropylene (1954).

In the eighties of the last century, the use of additives began, which provide plastic polymers with protection from ultraviolet radiation, flames, acids, enable temperature stabilization, lower the price due to weight gain, etc. These include plasticizers (e.g. phthalates), dyes, lubricants, antioxidants, and the list is quite long. Some of the additives are the main reason for concern due to the ability to separate from polymers and the impact they have on the living world.

Today, plastic production has grown so much that almost half has been produced in the last 15 years. A recent analysis of all plastic ever made estimates that the global production of plastic has increased from 2 million metric tons (Mt) in 1950 to 380 million Mt in 2015. By the end of 2015, 8,300 million Mt of virgin plastic had been produced (*Source: Center for International Environmental Law*). Due to the versatile application of materials, the production continues to grow from year to year, so in 2019, the production of plastics amounted to about 368 million metric tons worldwide (Picture 1), of which 61.8 million metric tons were produced in Europe.



Picture 1. Worldwid production of plastics in million metric tons from 1950 to 2019
(*Source: <https://www.statista.com/statistics/282732/global-production-of-plastics-since-1950/>*)

2.2. Production and Widespread use of Plastics

The production and use of plastic is too wide, so that in the current circumstances it really seems impossible to completely get out of our lives. It is found in all spheres of our lives, from dental floss, sponges, to optical aids, dentures, textiles, toys, plastic surgery, through bottles, bags, to solid parts of cars, planes, insulation, etc.

Plastics are derived from natural, organic materials such as cellulose, coal, natural gas, salt and, of course, crude oil. Two basic processes are used for plastics production - polymerization and polycondensation - and both require specific catalysts.

There are two basic types of plastic materials: **thermosets** and **thermoplastic** (Picture 2). The main difference between these two types is their behavior in response to heat application. The primary difference between the two is that the Thermoset material can be formed only once, because after cooling this material does not have the ability to be further formed, while thermoplastics can be heated, removed and cooled without causing any chemical changes. As a result of these physicochemical properties, thermoplastic materials have low melting points, while thermosetting products can withstand higher temperatures without losing structural integrity.



Picture 2. Thermoset and Thermoplastic plastic

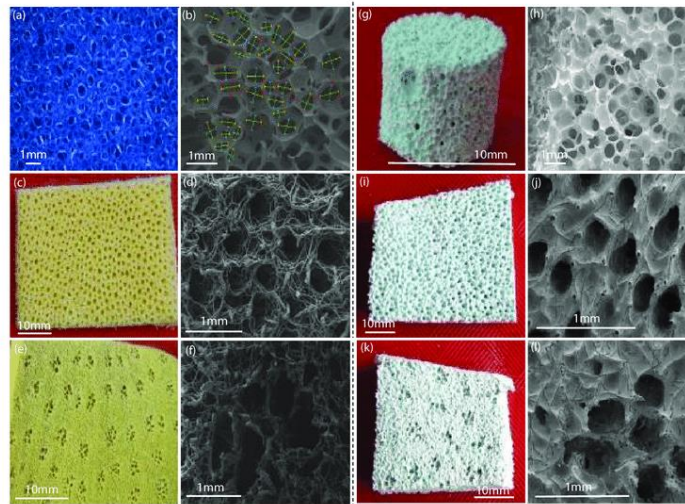
Thermoset plastic offers a better combination of thermal stability, chemical resistance and integrity of high-performance construction. The application of these materials in industry is wide, starting from the automotive industry, through the electrical, appliance, electrical, lighting, and energy markets, all thanks to the basic characteristics of products that are characterized by strength, durability, low cost and long life. However, they cannot be recycled chemically, but only mechanically by comminution and degradation to initial components.

Thermosetting polymers are built from various types of material that serve key roles and applications in the plastics fabrication industry. Specific types of thermoset materials that are in use within the plastics fabrication industry include the following:

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- Polyurethanes
- Polyureas
- Structural Foams
- Polyester
- Vinyl Ester
- Polyimides
- Epoxy (e.g., carbon fiber epoxy resin)
- Phenolics
- Bismaleimide (BMI)
- Fluoropolymers
- Polytetrafluoroethylene (PTFE)
- Polyvinylidene fluoride (PVDF)
- Melamine
- Silicone
- Urea Formaldehyde

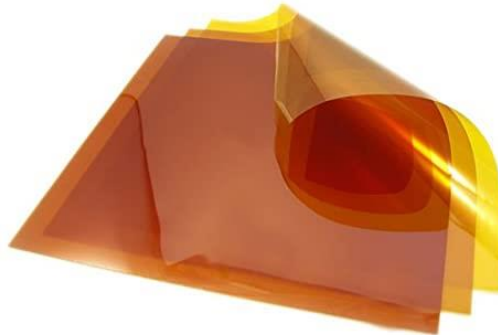
Polyurethane (Picture 3) is most often used in insulation in refrigerators, freezers and buildings, filling furniture, seats and airbags in cars, sponges, shoe soles, it is also used in the production of sports equipment, wheels on wheelchairs and roller skates, etc.



Picture 3. Polyurethane foam

Epoxy and resins (Polyepoxides) is an excellent adhesive that is resistant to heat and chemicals, which is why its main application is in joining vehicle and aircraft components. It is also found in protective envelopes for numerous items, paints, insulators, transformers, etc.

Polyimide (PI) (Picture 4) is used to insulate cables on spaceships, as a filter in incinerators, heating plants and cement plants, it is part of medical catheters, stents, etc., because it is a very resistant material, light and flexible, yellow-orange in color.



Picture 4. Polyimide

Silicone (polysiloxane) (Picture 5) stands out from other plastic polymers because it does not contain carbon, it is also resistant to water and oxidation. It can be in various forms from liquid to resinous. It is used as a lubricant for connecting glass parts and tiles, protection of paper and other materials from water, but also for cable insulation, as well as in plastic surgery.



Picture 5. Silicone

Melamine (Picture 6) is used in the production of surface layers of laminate and white plastic boards, plates, cups, etc.



Picture 6. Melamine

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One of the main advantages of the use of heat-resistant plastic is the retention of strength and shape even when heated, making it suitable for the production of durable components and large, solid shapes. In addition, these components have excellent strength properties (although they are brittle) and will not lose significant strength when exposed to higher operating temperatures. These materials have found wide application by manufacturers as a replacement for metal parts at a lower cost. Additional advantages that these materials have over their metal counterparts include: possibility of deviation in the mold, larger choice of color and surface, high strength-to-weight and performance ratio, exceptional dielectric strength, low thermal conductivity and microwave transparency, resistance to corrosion and water effects, lower tool / installation costs.

Disadvantages when using thermosets relate to the low initial viscosity of the material resulting in flash and the need for secondary operations. These materials cannot be recycled, they are very hard and rigid. It is much more difficult to finish the surface. Products cannot be remold and reshaped. They have quite poor thermal conductivity for housing replacement. The rigidity of the material can result in product failure when used in high in vibration applications.

As stated earlier **Thermoplastic materials** are all polymers that can be heated and shaped multiple times and are known for its versatility and recyclability. These include some of our most famous plastic materials, but also many others that we may have never thought about. All are 100% recyclable, but recycling many is not worth it and it is easier to just produce a new one.

The types of thermoplastics most commonly used in manufacturing include polyethylene (PE), polyvinyl chloride (PVC) and polystyrene (PS), which is often used for packaging. Other groups of thermoplastics are acrylics, fluoropolymers, polyesters, polyamides and nylons. common to all these types is that they can be melted several times and reshaped into different forms.

Some of the most common thermoplastic materials are:

- polyethylene terephthalate (PET)
- Polycarbonate
- Acetal Copolymer Polyoxymethylene
- Acetal Homopolymer Polyoxymethylene
- Acrylic
- Nylon
- Polyethylene (PE)
- Polypropylene
- Polystyrene (PS)
- Polyvinyl chloride (PVC)
- Teflon

Polyethylene terephthalate (PET) is mostly used for the production of polyester fibers in the textile industry, and then for the production of bottles (Picture 7). This material contains phthalates (plasticizers)

and due to the fact that they can be separated from the polymer, repeated use of PET packaging and bottles is not recommended. This type of plastic is mostly recycled.



Picture 7. Plastic bottles (PET)

Polyethylene (Picture 8) is a material characterized by high density, strength and rigidity. It can withstand heating to temperatures up to 110 °C and requires a large amount of crude oil during formation. Plugs are made from it, and it enters the composition of some types of protective suits against dangerous substances, buckets, bowls, gas pipes.



Picture 8. Polyethylene

Polyvinyl chloride (PVC) can have different rigidities. It produces shower curtains, plumbing and other pipes (Picture 9) , windows and doors, cables, but also food packaging. This material is toxic, because dioxins are released during production, and hydrogen chloride is released during recycling when heated. The recycling process is further complicated due to the various additives that are added to this material, due to its elasticity, and due to its complexity it is considered unprofitable.



Picture 9. Pipes made of PVC

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Polyethylene is mostly found in plastic bags (Picture 10) and foils, but also in some bottles and caps. It is technically recyclable, but in the case of plastic bags, recycling is not worth it due to their low weight.



Picture 10. Plastic bags

Polypropylene is a plastic that is most often found in food packaging (such as ice cream cans, sour cream) (Picture 11), as well as many cosmetic products (shampoos, baths ...). It can be said that due to its properties, it is a product that is produced in the largest quantities around the world. It can be recycled.



Picture 11. Plastic for food packaging

Polystyrene (PS) is a lightweight material that exists in solid form or foam form (styrofoam). Styrofoam (Picture 12) is primarily used for packaging and transport of various products and for insulation. This material is difficult to recycle, and due to the bursting of styrene, it is not recommended for storing food and drinks.



Picture 12. Styrofoam

Acrylates are polyacrylate resins that are found in acrylic paints (Picture 13), and are also used for the production of plexiglass, prostheses, as optical aids, because it is strong and resistant to scratches. Acrylic textiles also belong to this group.



Picture 13. Acrylic paints

Teflon or Polytetrafluoroethylene (PTFE) is causing increasing controversy and is thought to cause cancer. Studies have shown that at higher temperatures (above 300 ° C) Teflon pans emit toxic fumes containing perfluorooctanoic acid (PFOA), a potential carcinogen. There are claims that carcinogenic substances are released even at lower temperatures, while some studies have shown that most populations have an increased risk of developing some types of cancer if they use this material. Teflon is also used, in addition to nylon, in the production of dental floss (Picture 14).



Picture 14. Dental floss made of PTFE

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Polycarbonate (PC) is very easy to shape, which is why it is widely used. It is used for the production of plastic glasses, bottles CD / DVD (Picture 15), solid parts for cars and airplanes, medical devices, protective equipment. Of all the mentioned types of plastic, polycarbonate is the most resistant to mechanical impact, but not to scratches. It is controversial due to the presence of bisphenol A (BPA), a known endogenous disruptor. Therefore, the use of this plastic for storing food and drinks is not recommended, although there are BPA-free alternatives.



Picture 15. CD/DVD

The primary advantage of thermoplastics is reflected in their wide range of applications. They are characterized by high strength, lightweight materials and have relatively low processing costs. In addition, thermoplastic components are relatively easy to produce with great volume and precision. They are highly recyclable, have excellent impact resistance, can be easily removed and reshaped, and have excellent corrosion resistance. These materials are resistant to detergent and chemicals.

The main disadvantage of using thermoplastics instead of materials such as metal is the relatively low melting point. Certain types of low-quality thermoplastics can melt when exposed to the sun for a long time. Furthermore, thermoplastics may have poor resistance to organic solvents, hydrocarbons and highly polar solvents.

It should be noted that the largest market for plastics is packaging, an application whose growth has been accelerated by the global transition from reusable to disposable containers. At the same time, the generation of solid waste on a global level is strongly correlated with the increasing use of different types of packaging, which as a result accumulate before decompose, in landfills or in the natural environment.

2.3 Plastic Pollution and Facts

Today, more than 99% of the plastic produced is obtained from raw materials for fossil fuels, in the first place there are ethylene and propylene, which are obtained from natural gas or oil, as a by-product of crude oil processing. In recent times, propylene has also been obtained from coal. Thus, the life cycle of plastic begins in mines, oil wells, from where it will end up in the human environment after processing. At



the very source of fossil fuels, as well as during their transport, environmental pollution is already occurring.

By processing fossil fuels in refineries (which are one of the major pollutants) and crackers, these raw materials are transformed into polymers that form the basis of plastic. In order to obtain the best possible characteristics, these polymers are combined with a wide range of petrochemical additives, making them transparent, colored, soft, hard or flexible.

Due to their wide application and different characteristics, during the life cycle, some plastic materials such as tires, textile fibers wear out and decompose in a way that they degrade micro and nanoplastic particles and fibers into the environment. Many materials release toxic materials at different temperatures, so they are not considered suitable for packaging and food storage.

At the end of its life cycle, which can be different from short-term in terms of plastic food packaging and all disposable products, to much longer, as in the case of building materials, all plastic products become plastic waste. When plastic enters the environment, either in the form of micro or macroplastic, it slowly decomposes into smaller particles, which then mature, and thus pollute all areas of the environment - water, air and soil. After that, it accumulates in various food chains, at the same time releasing toxic chemicals (additives). And it is precisely these characteristics that enable its versatile application, durability and resistance to degradation, that make these materials difficult and almost impossible to assimilate in nature.

A very worrying fact related to plastic waste is that half of all plastics ever manufactured have been made in the last 15 years.

Scientific studies show that consuming water from plastic bottles significantly increases the amount of ingested particles that can be toxic. It is estimated that adults eat about 50,000 microplastic particles a year, while in children that amount is slightly lower and amounts to 40,000.

Plastic waste has a devastating effect on the animal world. Millions of animals are killed by plastics every year, from birds to fish to other marine organisms. More than 270 recorded species are endangered because they become entangled in plastic, while more than 240 species have been observed to swallow plastic. Most of the deaths to animals are caused by entanglement or starvation. Seals, whales, turtles, and other animals are strangled by abandoned fishing gear or discarded six-pack rings. Microplastics have been found in more than 100 aquatic species, including fish, shrimp, and mussels destined for our dinner plates. In many cases, these tiny bits pass through the digestive system and are expelled without consequence. But plastics have also been found to have blocked digestive tracts or pierced organs, causing death. Stomachs so packed with plastics reduce the urge to eat, causing starvation.

The plastic was also consumed by terrestrial animals, including elephants, hyenas, zebras, tigers and other large mammals, which in some cases caused death. Various tests have also confirmed liver and cell damage and disorders of the reproductive systems, which has caused some animals, such as oysters, to produce fewer eggs. New research shows that even fish larvae eat nanofibers in the first days of life.

When plastic is found in the oceans, it is difficult, but there are possibilities to repair the pollution. However, when plastic degrades into micro and macro particles, it is almost impossible to clean the oceans. The land cannot be restored to its original condition after any pollution. It is a worrying fact that

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every year humans and animals take in more and more plastic through food and water, the precise consequences of which will only be felt in a few years.

Every year, Europeans generate 25 million tonnes of plastic waste, but less than 30% is collected for recycling (https://ec.europa.eu/commission/presscorner/detail/en/IP_18_5). The recycling rate varies significantly from one Member State to another.

Half of the plastic waste collected for recycling is processed in foreign countries outside the European Union. The key reasons for this are the lack of capacity, technology or money for local processing. Significant quantities were exported to China, but after the ban on the import of plastic into that country, new solutions were intensively sought. Under the new plans, all plastic packaging on the EU market will be recyclable by 2030, the consumption of single-use plastics will be reduced and the intentional use of microplastics will be restricted.

Incineration is the most widely used method of plastic waste treatment in Europe, followed by underground disposal. The low plastic recycling rate in the EU means huge losses for the economy and the environment. It is estimated that 95% of the value of plastic material is lost due to short-term single use. Each year, plastic production and incineration emits approximately 400 million tonnes of CO₂ globally, which could be reduced by better recycling processes.

The main problem due to which plastic waste is not recycled in sufficient quantities is in the characteristics and price of plastic products. Plastic processing requires large quantities of plastic for recycling, which is produced under controlled conditions and at a competitive price. However, since plastics can be easily adapted to the needs of the manufacturer, the variety of materials complicates the recycling process and makes it more expensive and affects the quality of the final product. As a result, demand for recycled plastics is only six percent of total plastic demand in Europe.

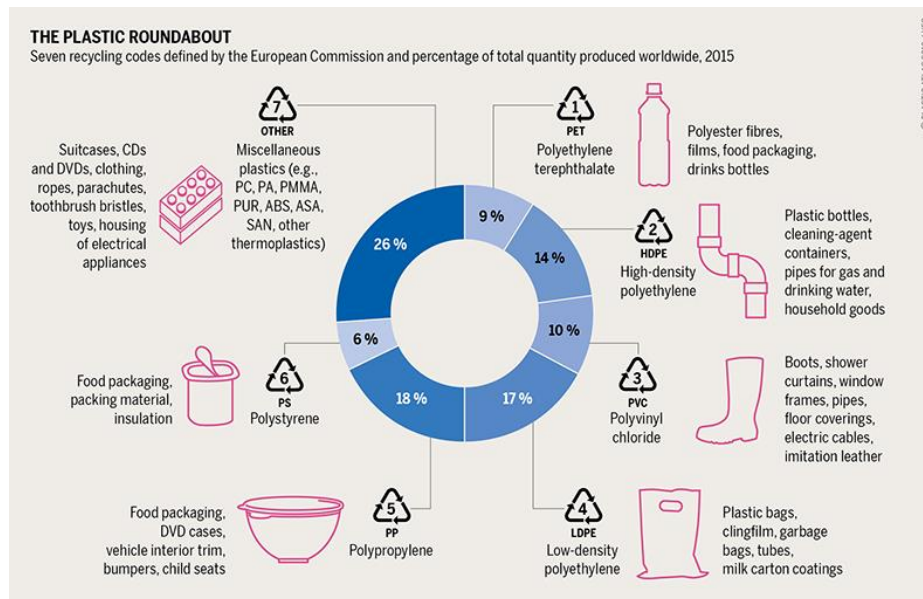
2.4. Plastics, Environment and Human Health

Nowadays, there is no material that is as present in everyday life as it is plastic. The use of this material in all branches of industry, from the production of packaging, through the construction sector, the automotive industry, agriculture to medicine, is a consequence of the feature of plastic to shape and adapt to the most diverse needs. Plastic is suitable for shaping, durable in different circumstances, light and cheap, in a word, it is the perfect material.

However, the mass use of plastic carries with it a certain price - the use of fossil fuels in the production process and inadequate management of large amounts of plastic waste are one of the biggest environmental challenges nowadays. Plastic became one of the most important materials at the beginning of the 21st century and it is shown by the fact that just in the last fifteen years half of the total plastic has been produced so far.

The reason why most produced plastics end up as waste is the very purpose of plastic products (Picture 16). Namely, more than half of plastic products are used once or in a very short period. As much as 40 % of the world's plastic is used for packaging. That means that almost half of the plastic packaging ends up

as waste very quickly after production and use, because it is not designed to have a usable value for a longer period of time. Managing of this amount of waste is a big challenge.



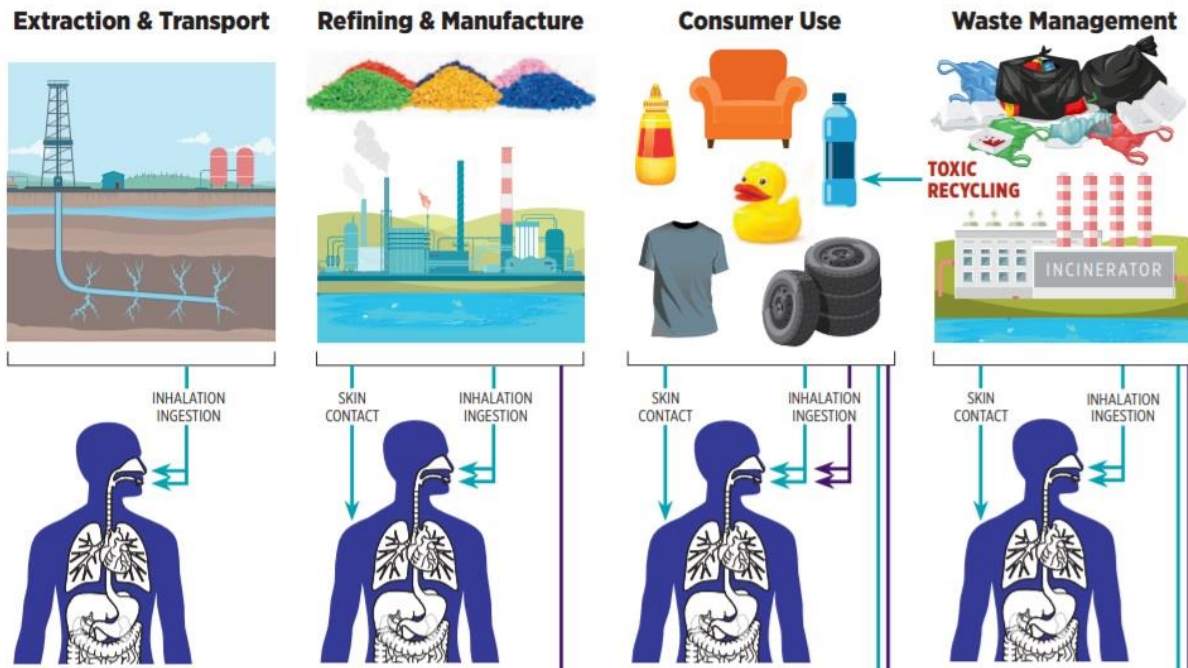
Picture 16. Global plastic production by purpose in 2015
(Source: PLASTIC ATLAS | Appenzeller/Hecher/Sack, CC BY 4.0)

As early as the mid-1970s, due to the increase in the production, use and consumption of plastics, there was confusion due to potential impacts on human health and the environment. In the last two decades, this concern has been growing and appears as one of the urgent issues. Although it is one of the most widespread materials on the planet, the impact of plastics on human health is still poorly understood.

Bearing in mind that approximately two-thirds of all plastics ever produced are released into the environment and remain there in some form - as residues in the oceans, as micro or nanoparticles in air and agricultural land, as microfibers in water supplies or as microparticles in human body and that in the form of various contaminants or through the food chain directly or indirectly affects human health, the problem of plastics must be observed as a whole, throughout the full lifecycle of the product. At every stage of its lifecycle, plastic poses distinct risks to human health, arising from both exposure to plastic particles themselves and associated chemicals. The majority of people worldwide are exposed at multiple stages of this lifecycle.

Throughout the life cycle of plastics, people are exposed to large amounts of toxic chemicals and microplastics by inhalation, direct skin contact or ingestion (Picture 17).

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Picture 17. Direct exposure people to plastic pollution
(source: ciel.org)

Taking into account the already mentioned fact that 99% of plastics are made from oil and gas, the process of extraction and transport of these energy sources can be taken as a starting point for the impact of plastics on human health.

Research has shown that during “pre-production,” including drilling, fracking, and flaring — a process used by the industry to burn off excess gases, which is the first stage of material formation, air pollution occurs. Every year, oil and gas production emits over nine million tons of methane and other pollutants, such as volatile organic compounds (VOCs). When VOCs are mixed with nitrogen oxides in the presence of sunlight, ozone or smog pollution is created, which has a detrimental effect on human health. Chronic exposure to ground-level ozone can adversely affect lung function, leading to asthma and chronic lung disease. The most at-risk group includes children, people with pre-existing respiratory problems, pregnant women as well as the elderly. It can also have a negative impact on the health of people who spend a lot of time outdoors.

Of the 353 chemicals associated with oil and gas, 75% affect the skin, eyes and other sense organs, the respiratory system, the liver and the gastrointestinal system. Up to 50% of the chemical can affect the nervous, immune and cardiovascular systems, as well as the kidneys. Harmful chemicals used during fracking can reach the source of drinking water, which can also endanger human health.



During the transport of oil and gas through the pipeline, harmful gases such as methane, ethane, benzene, toluene, xylene, carbon monoxide, ozone, and other pollutants may be emitted. and the continuous flow through the pipelines creates additional emissions into the air, as well as noise pollution.

During the production of plastics, due to use of many different chemicals, hazardous substances are released, which additionally pollute the air, and at the same time they are carcinogenic. Some of the pollutants are: 1,3 butadiene, benzene, ethane, styrene, propylene, propylene oxide and toluene. The severity of these pollutants depends on the time of exposure. Short-term exposure can cause irritation of the eyes and throat, headaches, fatigue, decreased blood pressure and pulse, central nervous system damage, dizziness, drowsiness, and unconsciousness. Long-term exposure can cause cancer and increase the likelihood of leukemia. Workers working in plastics factories are exposed to fumes from various types of toxic chemicals.

Whether plastic is used as a disposable cup or as a vacuum cleaner or a TV in the house, all plastics used by consumers can also have a negative impact on human health. As a result of the global shift from reusable to single-use packaging (including containers), the most significant market for plastic today is packaging and comprises 42% of all plastic ever produced. Packaging is also the product with the shortest lifespan. The impact of plastic on human health can be multifaceted. First of all, chemical additives, chemicals that are added to every plastic material, can have a negative impact. Secondly, micro and nanoparticles of plastic can also affect human health. For now, more emphasis has been placed on additives, while the impact of nano and micro plastics is more explored in the marine world. However, there is emerging data demonstrating the presence of micro- and nanoparticles of plastic (including toxic chemical additives) in the food we eat, air we breathe, and water we drink, raising concerns among scientists about their potential impacts on human health.

Plastic can leach unreacted chemical monomers, some of which are hazardous. The plastic that is most hazardous based on carcinogenic monomer release includes: polyurethanes (flexible foam in furniture, bedding, and carpet backing), polyvinyl chloride (pipes, packaging, wire, and cable coatings, the monomer being vinyl chloride), epoxy resins (coatings, adhesives, and composites, such as carbon fiber and fiberglass), and polystyrene (food packaging, CD cases, hard plastic in consumer products, the monomer being styrene).

Recent reports show that microplastics reach the human body through water, food and air. The study showed that plastic reaches human intestines, which gives a well-founded suspicion that all food chains are contaminated. Much less is known about the possible toxic effects of micro and nanoparticles in the human body. Assumptions are that they could lead to inflammation such as cancer, heart disease, inflammatory bowel disease, rheumatoid arthritis, and more), genotoxicity (damage to the genetic information within a cell causing mutations, which may lead to cancer), oxidative stress (leading to many chronic diseases such as atherosclerosis, cancer, diabetes, rheumatoid arthritis, post-ischemic perfusion injury, myocardial infarction, cardiovascular diseases, chronic inflammation, stroke, etc.

There are still many unknowns regarding the exact effect of microplastics, people are exposed not only to it but also to various toxic chemicals. However, research has shown that the use of plastic consumer objects and plastic packaging has a serious impact on human health.



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“The greatest threat to our planet is the belief that someone else will save it”.

Robert Swan

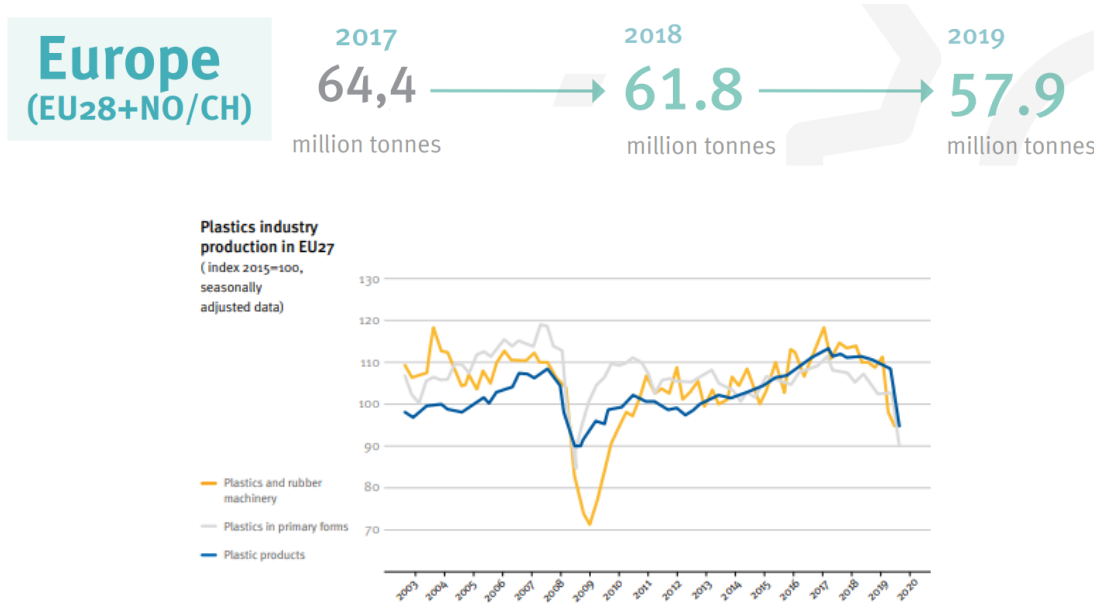
III PLASTIC WASTE, COVERING THE IMPACT IT HAS ON THE ENTIRE PLANET

The following chapter will present country specific examples on plastic waste and pollution.

3.1 Plastic waste and pollution in Spain

3. 1. 1 Plastics production

According to PlasticsEurope, who represents active polymer manufacturers in the plastics sector in Europe, production reached 57.9 million tons of plastic in 2019 after suffering a decrease since 2018 (Picture 18), said the decline has intensified as a result of the COVID-pandemic. 19 generating a negative impact on the industry in general, it is estimated that the level of production before COVID-19 will not be reached again before 2022 (Plasticseurope , 2020) having the following figures.



Picture 18. Plastics industry production in EU27

(Source: Eurostat)

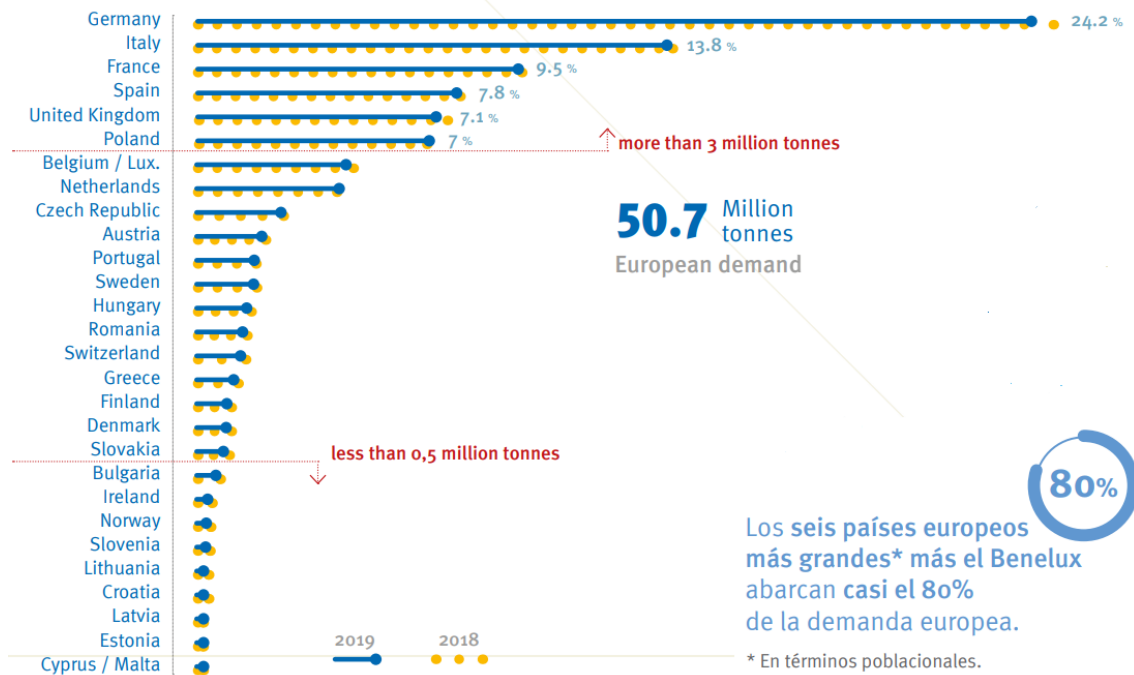
Asia is the region with the largest plastic production in the world, accounting for more than half of world production (51% of the total). China is the main plastics producer with 31% of the total in 2019, followed by North America (NAFTA) with 19%. Europe has moved to third place in plastic production with 16% of the total in 2019.

In Europe during 2019, more than two-thirds of the demand for plastics was concentrated in just six countries (Picture 19): Germany (24.2%), Italy (13.8%), France (9.5%), Spain (7.8 %), United Kingdom (7.1%), and Poland (7%) (Plasticseurope, 2020).

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PLASTICS DEMAND BY COUNTRY 2018 AND 2019

Distribution of European (EU28+NO/CH) plastics converters demand by countries in 2018 and 2019.



Picture 19. Plastics demand by country 2018 and 2019

(Source: PlasticsEurope Market Research Group (PEMRG) and Conversio Market & Strategy GmbH)

Most of the plastics consumed are used in the manufacture of packaging, that is, in products that are directly designed to be discarded after a single use before being recycled or discarded, this last action being the most recurrent and according to the UN this has meant that plastic packaging now represents half of the waste around the world and only 9% of the plastic produced is recycled, 12% is incinerated and 79% accumulates in landfills or in the natural environment. (UN, 2018).

Specifically in Europe, the demand for plastics for packaging was 39.6% in 2019 (Plasticseurope, 2020). Later, these containers will be the plastic objects that we find most frequently in the environment damaging marine ecosystems, according to the international organization Oceana, 80% of the plastics that are dumped into the sea only in Spain come from land while a smaller percentage comes from direct sources such as ships (Oceana, 2020).

In the European Union, around 85% of marine litter is plastic waste of which 50% are single-use plastics, which is a growing global problem not only for marine ecosystems, biodiversity, health, human activity and cross-border character. Therefore, reducing it constitutes a key action to achieve the United Nations Sustainable Development Goal # 14, which consists of conserving and sustainably using the oceans, seas,



and marine resources to achieve sustainable development (Official Gazette of the European Union, 2019), an objective for which there is much more work to be done when Spain according to the WWF organization Spain is the fourth country that consumes the most plastic in Europe and the second that generates the most garbage in the Mediterranean Sea with 126 tons/day in 2018 (WWF, 2018) thus generating damage and stress to the global marine ecosystem and even affecting the food chain due to the presence of microplastics and the ingestion of these from many marine species for human consumption, generating accumulation of toxins in species that are used as human food (Matthew SS 2017) also affecting tourism due to the presence of plastics on the beaches.

3.1.2 Waist in Spain

In Spain, according to 2018 Plastics Europe, 2.6 Mt were collected post-consumer waste plastic. Of which 41.9% were recycled, 19.3% were used in energy recovery and 38.8% were deposited in landfills. It was in that year when, for the first time in Spain, the amount of plastic waste sent for recycling exceeded that which was deposited in landfills. With almost 42% of plastic waste sent to recycling, Spain presents a rate almost 10 points higher than the European average (32.5%). Since 2006, the amount of post-consumer plastic waste collected for recycling has more than doubled (x2,3). However, in 2018 almost a million tons were still sent to landfills.

However, if you look at other sources, the values are different.

Ecoembes states that in 2017 a total of 747,922 tons were generated, of which 521,572 tons were recycled (69.7%). According to the Institute National E estadística (INE) in 2017, Spain produced 132.1 million tons of waste of which 758.5 tons is plastic. Also, the Ministry of Ecological Transition in Spain offers different data.

The information on plastics is very different depending on the different sources. On the one hand, it is difficult to obtain clear information due to the multitude of generation points (homes, industries, public bodies ...), on the other hand, the diversity of types of plastics. On the other hand, the discrepancies are generated by economic interests versus ecological interests and obviously, this appears a great controversy.

3.1.3 The controversy

Ecoembes provides data on the percentage of containers recovered in the yellow container that has been later recycled. As of 2018, 75.8 % (ca.) Of recovered plastic containers were recycled. The percentages corresponding to the recycling of plastics in the last three years are broken down as follows:

Plastics recycling: 66.5% (2016) - 69.7% (2017) - 75.8% (2018).

The Zero Waste Alliance, which groups Greenpeace, Ecologists in Action, Surfrider Spain, Rezero, Retorna, and Friends of the Earth has a very different opinion and contrary to the numbers shown in the Ecoembes reports, in its objectives, vision, mission, integrity and even social work that you show so much in your advertising campaigns and, for environmental organizations, Ecoembes sells an environmental image that is far from reality.

Greenpeace estimates the recycling of plastic packaging at 25.4% for 2017 (in contrast to 69.7% for Ecoembes). Textually, it indicates that "[...] the level of Recovery/recycling of plastic containers in Spain

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would be around 25.4%." By recovery/recycling we mean the recycled plastics of all those that have been collected.

According to Ecoembes data, for 2017 a total of 521,572 tons of 747,922 tons were recycled. This gives a plastic recycling rate of 69.7%. This percentage, lower than the 77.1% mentioned above, is still very far from the 25.4% estimated for Greenpeace.

According to data from the European plastics industry (Plastics Europe report for 2017, little suspicious of ecologist) in Spain in 2016 2.3 million tons of post-consumer plastic waste were collected, of which 37% were recycled. This information was provided by the Spanish business organization of plastic industries Cicloplast. If we pay attention to the Ecoembes data regarding the tons of plastic recycled in 2016, it turns out that 66.5% of recovered plastics were recycled. Between the two percentages, there is a notable difference and, in any case, 37% of Plastics Europe is closer to 25.4% of Greenpeace, despite the difference of one year.

According to the MTE, the percentage of recycling of total recovered plastic containers would be 45.46% for this year. This percentage would be between that supplied by Ecoembes and by Plastics Europe for the same period. It must be said that these percentages of recycled packaging include not only domestic packaging but also commercial and industrial ones.

In summary, we have three very different data regarding recycling in 2016 (66.5%, 37%, and 45.46%) and two data (69.7%, and 25.4%), also very discrepant, concerning 2017. If the figures for 2017 already seem very contradictory, those of 2016 confirm the tremendous dance of figures regarding the recycling of plastics in Spain.

Another data that contributes to the controversy is the data of the MITECO (Ministry for the Ecological Transition), 44% of Spanish plastics end up in landfills when most could be recycled. For example, the case of Utiel Recicla SL in Valencia is paradigmatic. A facility not authorized to store plastic but in which, since 2016, plastic from eight companies have accumulated, six of them approved and awarded by Ecoembes.

Send the report also indicates the plastic waste to countries with less capacity for waste management is even more questionable. A recurring exercise is the export of plastic waste and waste, the ambiguous export regulations and the lack of controls allow some exporters to send plastics abroad with impunity. In Malaysia, for example, Greenpeace has found, two years in a row, Spanish plastic packaging in illegal landfills, such as Jenjarom. The Malaysian Ministry of Energy, Science, Technology, Climate Change, and Environment has returned to Spain, in the last two years, more than twenty containers of plastic waste that tried to enter the country illegally.

These events occur frequently in other European countries:

An investigation by a team of Greenpeace Italy journalists found that of the 2,880 tons of plastic waste that Italy exported to Malaysia between January and September last year, almost half were received by companies operating illegally.

UK exports to Malaysia increased significantly in the first four months of 2018, compared to the same period last year, from 15,612 tons to 51,549 tons.

3.2 Plastic waste and pollution in Cyprus

Cyprus in 2021 has generated a total of 100 713 tons of plastic waste recorded annually. As a result, plastic leakage on the island is surprisingly high reaching 760 tons to the marine environment. The main factors contributing to this leakage are high waste generation and coupled inefficient waste management systems. Cyprus exports around 11% of its plastic waste, 50% is directed to Greece, and 44% to Asian countries. Given the size of the island, there is a lack of plastic recycling facilities and the plastic waste recycling percentage remains relatively low, despite the implementation of a waste recycling collection program operated by Green Dot Cyprus.

Following the adoption of the Circular Economy Action Plan in 2015 the European Commission adopted a new package of deliverables in January 2018¹. This included additional initiatives such as (i) an EU strategy for plastics; (ii) a Communication on how to address the interplay between chemical, product, and waste legislation; (iii) a report on critical raw materials; and (iv) a framework to monitor progress towards a circular economy². The circular (secondary) use of the material in Cyprus was 2.3 % in 2016, well below the EU-28 average of 11.7 %. On the other hand, Cyprus performs above the EU-28 average on the number of people employed in the circular economy (1.99 % of total employment in 2016 vs the EU-28 average of 1.73 %)³.

In the 2017 Special Eurobarometer 468 on attitudes of EU citizens towards the environment, 92 % of Cypriot people said they were concerned about the effects of plastic products on the environment (EU-28 average 87 %) and about the impact of chemicals (98 % vs EU-28 average of 90 %)⁴. Cyprus is the leading EU country in terms of popular support for greater EU involvement (EU-28 average 85 %). Cypriot society appears to strongly support circular economy initiatives and environmental protection measures. Cyprus performed below the EU average on resource productivity⁴ (how efficiently the economy uses material resources to produce wealth), with 1.14 EUR/kg in 2017 (EU average 2.04 EUR/kg)⁵. Resource productivity increased between 2011 and 2015 and decreased significantly between 2015 and 2017.

Municipal waste generation in Cyprus is still significantly higher than the 2017 EU average (637 vs around 487 kg/y/inhabitant). Following a decrease over several years, the rate has increased since 2014. There has been a decrease in landfilling and a slight increase in recycling and composting in Cyprus, due to the termination of open landfills and the implementation of waste treatment facilities on the island.

Cyprus landfills most of its municipal waste (76 %, vs an EU average of 24 %). It recycles 16 % of waste which includes a 2 % composting rate. This is significantly below the EU average (46 %). Despite a steady decrease in 2009-2014, the landfilling rate increased again in 2016. **Cyprus should make a considerable investment in recycling and separate collection in the coming years to reach the 2020 recycling target**

¹ https://ec.europa.eu/environment/circular-economy/index_en.htm

² <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1516265440535&uri=COM:2018:29:FIN>

³ https://ec.europa.eu/environment/eir/pdf/report_cy_en.pdf

⁴ https://data.europa.eu/euodp/data/dataset/S2156_88_1_468_ENG

⁵ <https://ec.europa.eu/eurostat/web/environment/material-flows-and-resource-productivity/database>

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of 50 %. The Commission published an 'early warning report'⁶ for Cyprus, setting out priority actions for Cyprus to comply with the 2020 and the post-2020 recycling targets⁷. The 2015 municipal solid waste management plan prioritizes separate collection and introduces economic deterrents such as a landfill tax, the extension of the extended producer responsibility (EPR), and pay-as-you-throw schemes. However, the implementation has been quite slow.

Cyprus still faces difficulties in implementing the relevant EU waste policy and in meeting its 2020 targets. This is mainly due to: (i) the lack of infrastructure and systems for collecting recyclables and for diverting biodegradable waste from landfills; and (ii) a lack of coordination between different administrative levels and lack of capacity at the local level. Some measures to address these weaknesses have been introduced, including the ongoing capacity building and technical assistance program for public administration, local authorities, stakeholders, and the public. In addition, the planned introduction of legislative measures assigning responsibility to local authorities for the establishment of separate collection schemes is also expected to improve the situation.

3.3 Plastic waste and pollution in Serbia

The use of plastic has become an integral part of almost all branches of the economy and everyday human life. Positive properties of plastics such as easy shaping, perseverance in different circumstances, cheap production, and the possibility of adapting to the most diverse needs have led to the use of this material in all branches of industry. Global plastic production is on the increase and is projected to double again in the next twenty years [1]. However, the production of plastics based on additives and fossil fuels has led to impaired human health and biodiversity. The data relating to pollution is devastating. It has been determined that about 150 million tons of plastic wastes have accumulated in the oceans and that by 2050, there will be more plastic in the oceans than fishes.

The use of disposable plastic is also a big problem because it is discarded immediately after use. It is estimated that the value of discarded disposable plastic is between 80 and 120 billion dollars a year. The global threat to human health and the environment also comes from microplastics, which are present in various products ranging from cosmetics, synthetic clothing, to plastic bags and water bottles. Microplastics can be primary when is added to various products, and secondary when is formed by different methods of comminution. It has been scientifically proven that microplastics enter the food chain and that due to their persistence they accumulate in living organisms. What can be concluded is that microplastics are everywhere, in the air, soil, rivers, and the deepest parts of the ocean. In order to reduce the consequences and improve the quality of life, the European Chemicals Agency has come up with a proposal of measures, which include a ban on adding microplastics to products for general and commercial use. Thanks to that, the release of 10-60 thousand tons of plastic into the environment would be stopped. That would be one of the first steps in reducing this problem and the negative impact on the

⁶ European Commission, Report on the implementation of waste legislation, including the early warning report for Member States at risk of missing the 2020 preparation for re-use/recycling target on municipal waste, SWD(2018)415 accompanying COM(2018)656.

⁷ 6 Directive (EU) 2018/851, Directive (EU) 2018/852, Directive (EU) 2018/850 and Directive (EU) 2018/849 amend the previous waste legislation and set more ambitious recycling targets for the period up to 2035. These targets will be taken into consideration to assess progress in future Environmental Implementation Reports.



environment. In addition, since 2015, the EU has adopted a number of documents with the aim of pointing out to the member states possible ways to solve this problem. In January 2018, the European Commission adopted a document with recommendations for reducing plastic waste, and in May of the same year, a package of directives for the circular economy with special emphasis on the collection and recycling of municipal and packaging waste, as well as special waste streams and permitted disposal rates municipal waste to landfills.

When it comes to the Republic of Serbia, it is known that about 100 thousand tons of plastic packaging waste are generated annually, of which only 27% is recycled. Of particular concern is the fact that most of the waste (62%) is disposed of in landfills, or discharged into the environment, while the rate of incineration with energy recovery is only 11%. What should be emphasized is that at this moment in the Republic of Serbia there are no specific requirements regarding restrictions, when it comes to plastic production. The largest producers of polyethylene (high and low density) in the Republic of Serbia are HIP Petrohemija in Pančevo, with a capacity of 150,000 t / year, and factory in Odžaci with a capacity of 32,000 t / year. Inadequately processed plastic bags are also a special problem for the environment. Research has shown that the average citizen of the Republic of Serbia consumes seven plastic bags a day, while their number is around two billion annually. According to the Environmental Protection Agency, 12 landfills are located directly on watercourses, 65 are in the immediate vicinity, 28 are in the floodplain, while the number of illegal landfills is between 20,000 and 30,000 (Picture 20). Bearing in mind that the rivers in the Republic of Serbia belong to the basins of the three seas (Adriatic, Aegean, and Black), it can be concluded that the problem is very serious.



Picture 20. A wild landfill near Prijepolje
(Source: <https://www.bbc.com/serbian/lat/srbija-49172486>)

When it comes to illegal landfills, in addition to the great dangers of fire, there is a possibility of spreading the infection, and by filtration through garbage, contaminated water reaches the soil, plants, and animals, and eventually food for human consumption. According to the data of the World Organization for Nature, man ingests five grams of plastic a week, while the largest source of microplastics is water. Since 2010, the Environmental Protection Agency has been collecting data on the quantities of plastic bags on the market of the Republic of Serbia [2]. Table 1 provides an overview of the quantity of plastic bags in the Republic of Serbia for the period from 2016 to 2018.

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Year	Plastic bags with additives	Plastic bags without additives	Total
2016	6937.05	205.03	7142.08
2017	6747.12	596.97	7344.09
2018	3912.96	390.55	4303.51

Table 1. Plastic bags in the Republic of Serbia from 2016 to 2018

(Source: Environmental Protection Agency)

Based on the data in Table 1, it can be concluded that there is a significant reduction in the number of plastic bags with additives (3912.96). However, what is still worrying is the fact that 91% of the citizens of the Republic of Serbia use disposable bags for garbage disposal, while only 9% buy garbage bags. Table 2 provides a comparison between the EU and the Republic of Serbia when it comes to packaging waste and its recycling. All data refer to 2016.

European Union, 2016.	The Republic of Serbia, 2016
Market share of packaging: 39.7	Market share of packaging: 45%
Demand for recycled plastic: 6%	Unknown
Plastic packaging waste recycling rate: 42.4%	Plastic packaging waste recycling rate: 20.3%
Recycled (EU or non-EU): 6.9 million tonnes	Recycled: 18 thousand tonnes
Collected for recycling per capita: 13.5 kg	Collected for recycling per capita: 2.6 kg

Table 2. Comparison between the EU and the Republic of Serbia for 2016

(Source: Serbian Chamber of Commerce)

According to the data of PlasticsEurope for 2017, the amount of generated plastic waste in the Republic of Serbia amounted to 93.6 thousand tones. However, pollution problems are still unresolved, although the management of packing and packaging materials is regulated by the Law on Packaging and Packaging Waste ("Official Gazette of RS", No. 36/2009 and 95/2018 - other law). There are still non-compliances, so most of the waste is disposed of in landfills, and not in recycling centers. Also, many local governments do not cooperate with informal collectors of secondary raw materials, which would significantly contribute to the improvement of waste management. Warnings and reports related to the state of the environment were also issued by the State Audit Institution. Based on their Report in the period from 2017 to 2018, the Environmental Protection Agency did not control the submission and accuracy of data, as well as the application of the Law on Packing and Packaging Waste. Having in mind all the above, as well as the fact that plastic bags that are used for an average of 25 minutes remain in the environment for 100 to 500 years, and that their decomposition emits toxic substances that pollute the environment, requires an urgent response at all levels.

In July 2019, the Chamber of Commerce of Serbia, in cooperation with numerous industries (Association for the Chemical, Rubber and Non-Metals Industry), adopted a Plastics Management Strategy Draft by 2030 in the circular economy package [4]. According to that draft, specific goals, quantitative indicators and measures that need to be taken in the Republic of Serbia are given.



When it comes to specific goals, special emphasis is placed on reducing the consumption of lightweight plastic bags (thickness between 15 and 50 microns), as well as the rational and economical use of very lightweight bags, whose thickness is less than 15 microns. Based on the positive experiences of some countries in the EU, one of the possibilities for achieving this goal is the conclusion of a Voluntary Agreement between the Government of the Republic of Serbia and the interested party in accordance with the Law on Packing and Packaging Waste. Thanks to this agreement, the disruption of the single market of the Republic of Serbia would be avoided.

3.3.1 Recommended measures related to disposable plastic product

Recommended measures are:

1. Harmonization of legal regulations with Directive 2019/904;
2. Alignment with future EU measures;
3. Measures to reduce the consumption of single-use plastic products (stoppers, lids, beverage cups, food boxes, etc.); within this measure, it is recommended to apply a system for monitoring the consumption of these products starting from 2022 to 2026;
4. Measures to prohibit the placing on the market of single-use plastic products (ear sticks, cutlery, straws ...), as well as packaging made of expanded polystyrene;
5. From 2025, PET bottles must contain at least 25% recycled plastic;
6. Extended producer responsibility measures must be established for all single-use plastic products;
7. Measures for separate collection for recycling (applies to beverage bottles up to 3l, including their stoppers and lids); By 2025, it is necessary to recycle 77% of disposable plastic products placed on the market, while in 2029, the recycling rate is expected to be 90%.
8. Awareness-raising measures include both informing and encouraging responsible behavior among consumers in order to reduce the disposal of waste from disposable products.
9. In the Republic of Serbia, the plastic market with biodegradable properties is not developed. This figure is not surprising, given that globally the bioplastics market does not exceed 1%, and only 43% of it is compostable plastic [3]. Activities related to composting of organic waste are at the very beginning and it is assumed that they will be realized by building regional waste management centers. The draft strategy defines specific goals, as well as measures that will enable the placement of products made of compostable bioplastics on the market of the Republic of Serbia.

3.4 Plastic waste pollution in Slovenia

In the past decades, changes in lifestyle, economic and commercial growth, technological development, and other factors led to increases in waste generation in many countries [5]. Waste is regarded as an inevitable, valueless by-product of human activities [6]. Waste has many negative environmental consequences, and thus the prevention of waste generation got into the forefront of environmental strategies around the world [7].

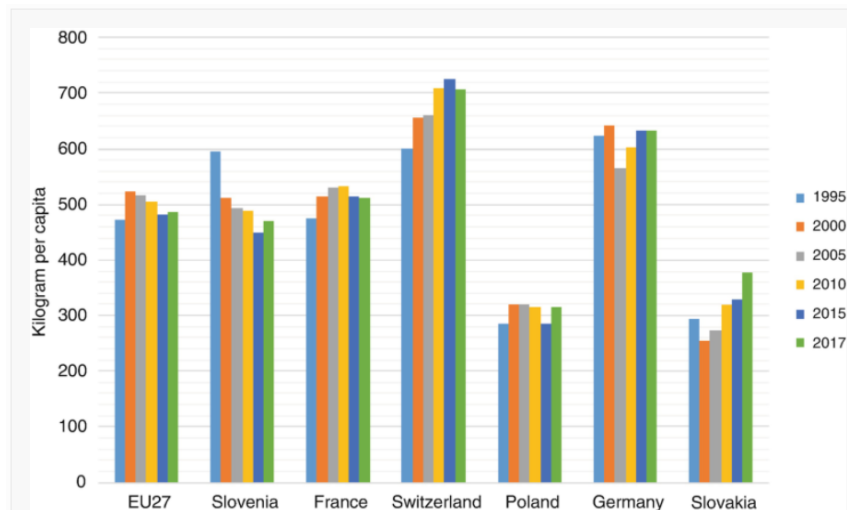
Plastics are an important part of many waste types: they can be found in industrial, municipal, and household wastes as well as in packaging waste. Therefore, it is difficult to evaluate the total amount of generated plastic waste by a country or to compare such data among countries due to differences in data collection and management (landfilling, incineration without energy recovery, incineration with energy recovery, and recovery other than energy recovery), statistical analysis, missing data, and also the definition of various types of waste. For example, statistical data in the EU define the amount of generated

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plastic waste by the population as the amount of plastic waste collected by recycling centers of each municipality. It means that it is the plastic waste that inhabitants brought to the recycling center and not all the plastics collected by municipalities. In Slovenia, it is 2 kg per capita, while in the EU (28) (data for 28 member states) it was 5 kg per capita in 2014 [8]. But the majority of plastic waste is found in municipal and packaging waste.

Most waste generated by the population is collected as municipal waste. The main compositional categories of municipal solid waste are paper and cardboard, organic waste, plastics, metals, glass, textiles, and other minor fractions of waste [9]. In Slovenia, the most abundant fraction of mixed municipal waste is plastics (24%), followed by organic waste (18%) and paper (14%) [10]. However, the municipal waste composition varies a lot among countries. It also depends on local conditions, the waste collection, and the management system. It is strongly affected by socioeconomic factors, level of industrialization, geographic location, climate, level of consumption, collection system, population density, the extent of recycling, legislative controls, and public attitudes as well as by seasons, for example, in the amount of organic yard waste [1, 7].

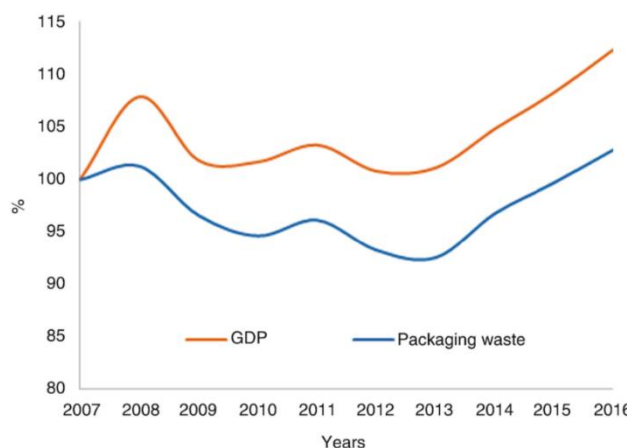
The amount of generated municipal waste is also very variable. Although the move toward the reduction of waste in Europe was introduced by the Waste Framework Directive already in 1975 emphasizing the importance of waste prevention and minimization [8], there is still no common trend of municipal waste reduction. For example, over the last 22 years, in Switzerland and Slovakia, the amount of municipal waste per capita increased by 18% and 28%, respectively (Picture 21). In the EU (27) the overall generation of municipal waste is relatively stable, similar to many member states (e.g., Poland and Germany). In Slovenia, the amount of municipal waste per capita was reduced by 21% [4] (Picture 20).



Picture 21. The development of municipal waste generation (kg per capita) in different countries of the European Union from 1995 until 2017 [4]

Picture 21 also shows a significant difference in the amount of waste generated by each country, and it seems that some countries within the EU generate a significantly lower amount of municipal waste than others (e.g., Germany and Poland). However, countries define municipal waste differently; some countries also include bulky or garden waste. Then, it appears that these countries generate more municipal waste per capita than a country that excludes these waste fractions. Some countries also include only waste from households, whereas other countries also include waste from commercial activities [8].

Plastic packaging comprises about two-thirds of all the plastics put on the market [9], and most of the packaging is disposable. Thus, it can be assumed that plastic packaging waste is a relevant indicator of plastic waste generation by the population. In 2016, 170 kg of packaging waste was generated per capita in the EU, varying from 55 kg per capita in Croatia and 221 kg per capita in Germany and Slovenia with about 108 kg per capita [4]. The generation of packaging waste can also be linked to an economic situation of a country. The more the population grows, the more goods are consumed, and packaging becomes an important part of the waste. For example, when the gross domestic product (GDP) – a quantitative indication of the mean living standard of a nation – is compared to packaging waste generation in Slovenia from 2007 to 2016 (Picture 22), there is a significant correlation. In this case, Slovenia was dragged into a deep recession by the European financial crisis from 2008, and it was quickly reflected in the package waste generation. After 2014, the financial situation stabilized, and GDP and the amount of packaging waste again steeply increased (Picture 22).



Picture 22. Comparison of packaging waste generation in Slovenia and gross domestic product (GDP) from 2007 to 2016 (calculated from 100% in 2007 selected as a starting year) [9]

In Slovenia, the amount of plastic packaging waste generated per capita is stable with 22.66 kg per capita in 2007 and 22.45 kg per capita in 2016. Packaging plastics represent about 21% of the total packaging waste [4].

The amount of waste generated in Slovenia has been increasing over the years, with plastic waste accounting for a relatively small share (in 2016: 1.1 %), but it is a major environmental problem. In 2016, only a good third of plastic waste was recycled.

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3.4.2 Facts

- **5.5 million tons of waste**

So much waste was generated in Slovenia in 2016, of which almost a million tons was a municipal waste. One-tenth of all waste generated in Slovenia in 2016 was generated in households, i.e. where each individual can help reduce waste and preserve nature by acting responsibly.

- **Waste plastic**

One of the major ecological problems recently is the pollution of the environment with plastic waste: waste plastic packaging and other waste plastic generated in households and production and service activities.

In 2016, 59,000 tons of plastic waste were generated, which was 19% less than in 2015, but 12% more than ten years ago. In the total amount of waste generated in Slovenia in 2016, plastic waste accounted for a relatively small share, only 1.1%.

Most plastic wastes were generated in service activities, 49%; almost 46% of them were produced in manufacturing and just over 5% in households.

Plastic waste is also imported and exported. In 2016, Slovenia imported 105,000 tons and exported 51,000 tons (half less than it imported).

- **Plastic waste management**

In 2016, 35% of plastic waste in Slovenia was recycled, 6% of this waste was incinerated, a little more than 2% was disposed of in landfills, and the rest of this waste was temporarily stored or treated according to pre-treatment procedures and is waiting for further processing.

The data thus show that the situation related to the generation and management of plastic waste has been improving over the years. This shows that people are becoming more and more environmentally aware and that the measures taken in this area have been the right one (<https://www.stat.si/StatWeb/News/Index/7426>).



“The purpose - where I start – Is the idea of use. It is not recycling, it’s reuse”.

Issey Miyake



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IV HOW PLASTIC WASTE COULD BE REDUCED, NAMELY RECYCLING AND REUSE?

The following chapter will present country specific examples on plastic waste and pollution.

4.1 Case of Spain

Companies and institutions such as ECOEMBES, CICLOPLAST, CEACV and the Valencian Government (Generalitat Valenciana) offer teachers a great number of educational resources to teach environmental values by introducing the environment into the classrooms, and taking the classrooms out to the environment.

WORKSHOPS

- CEACV (Valencian Community Environmental Education Center) - “Zero waste playgrounds”

The main aim of Zero Waste Playgrounds is to bring snacks to school without any type of waste, that means, bringing reusable bottles for drinks instead of plastic bottles, Tupperware for sandwiches, biscuits, fruit... instead of plastic bags, foil paper and, in general, no other type of disposable wrappers.

They classify the different types of snacks as follows:

- ZERO WASTE: snacks that don't produce any waste (in a Tupperware and flask),
- RECYCLABLE WASTE: snacks that produce recyclable waste (juice cartons, yogurts, etc.),
- TOTAL WASTE: snacks that produce any kind of waste (sandwiches wrapped in foil paper, cakes and biscuits in disposable plastic wrappers).

As they arrive in CEACV, an educator welcomes the group of students and takes them to the area where they take their snacks. There the instructor watches 'in situ' to what extent and how each group complies with the zero waste compromise. Each day the data will be registered and then quantified at the end of each week. To compare the results and evolution of the programme, a graph is elaborated at the end of each month.

- GENERALITAT VALENCIANA, “Recycling with your five senses”

Recycling with your 5 senses is an educational programme designed to raise environmental awareness. The programme tries to create a joint responsibility in all the citizens of the Valencian Community through a number of free in-person workshops. These workshops deal with different aspects related to the recycling of glass, paper, and cardboard packaging, also blister packs, and electric and electronic equipment.

- ECOEMBES “Educating in ECO”

This programme consists of a number of educational activities addressed to the students of each school. These activities are integrated inside the school curriculum and they are performed by using the peer instruction methodology. Through these activities, they intend to make students aware of the impact that their daily gestures may have on the preservation of the environment at the same time that they learn about the benefits of recycling. The programme also involves providing the schools with yellow bins (for plastic, cartons, and cans) and blue bins (for paper and cardboard) as well as explanatory posters in order



to create a recycling station. They also offer training for teaching and non-teaching staff giving them all kinds of support to ease the recycling process in the school.

EXHIBITIONS

- CICLOPLAST displays the Exhibition “Plastics with the Environment”, to make the world of plastics known and to contribute to improve the predisposition of society towards the preservation of the environment. Cicloplast has designed this Exhibition with two clear objectives:
 - TO INFORM about the “unknown” of the plastic materials,
 - TO TEACH through the most adequate environmental practices to encourage the Prevention and the Recycling of plastics in addition to presenting the objects made of recycled plastic, jerseys, fences, bollards, benches, flower pots, floor tiles, etc.

The Exhibition is appropriate for all kinds of public, from neighborhood associations to senior age groups or mass media and particularly, young people, who attend the exhibition accompanied by their teachers in scheduled school visits. Apart from the simple and clear language used in the exhibition, there are some other reasons that explain its huge success such as the possibility of seeing and touching 'in situ' the different objects that come together with the panels in a park that shows recycled plastic made objects: benches, flower pots, jerseys, bollards, etc.

VIDEOS

- Video “I recycle too, and you?”

It consists of a video starred by the magician Jorge Blass. The video is direct, functional and easily understandable by everyone and it shows the different types of plastic packaging that must be placed in the yellow bin. It also describes the full process of recycling plastics until it becomes a new resource to produce new products. The main aim of the video is to inform and educate citizens, both children and adults, about their key role in the initial part of the recycling chain of plastic packaging’s at the same time that it solves the frequent doubts that we all have when we wonder: “what happens to my plastic bottle or my yoghurt tub after I throw it into the yellow bin?” <https://vimeo.com/25093786>

- Association EKOACTIVE: Short film “Trashformation”

Among the pollution and waste that invade the city where the main characters live, a group of inhabitants of the area decide to try to separate the trash that surrounds them. By doing so, they discover that the city transforms gradually as they separate the different elements that are in the rubbish of their city. <https://www.youtube.com/watch?v=v5Q5Z4gBQTo>

- Project LIBERA (ECOEMBES, SEOBIRDLIFE) PRESENTATION BASURALEZA (acronym of basura, trash in Spanish, and naturaleza, nature in Spanish) <https://proyectolibera.org/aulas-libera/aprende>

COURSES

- For teachers: BY CICLOPLAST “Plastics: Development, Applications, Recycling and Environment”, accredited by The Spanish Ministry of Education.

It provides training and didactic tools about the characteristics and benefits of plastic materials, its recycling process and its effects on the environment for teachers in Secondary Education, also teachers in Post-obligatory Secondary level or Vocational Training Education teachers. The course includes a

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theoretical part, interesting laboratory practices such as the synthesis of Nylon or the spherification cooking technique by Ferrán Adriá, the acclaimed Spanish Chef, among others as well as visits to plastic recycling plants. Furthermore, they supply various materials to the student-teachers so that they can use them with their own students in their schools when giving their classes.

ACTIVITIES FOR THE CLASSROOM

- GREENPEACE “plastic calculator” It allows us to realize how much plastic we actually consume. <https://calculadoraplasticos.greenpeace.es/>
- National Geographic Spain: Test “How much you know about recycling” It allows you to test your knowledge in the area of recycling <https://calculadoraplasticos.greenpeace.es/>
- TERRACYCLE- BIC “Programme for recycling writing tools” This programme offers the possibility of throwing the writing tools that we don't use anymore in the public schools in the collecting points that Terracycle has. When someone brings some trash to a public collecting point, the person in charge of the collecting point gets points in his/her account TerraCycle® and will be able to redeem them (each point is a cent of a euro) for the association or school they choose.
- Project LIBERA (ECOEMBES, SEOBIRDLIFE) Game “Planet Liberate” Online Game which deals with situations related to the problem of waste at a local and global levels, players must solve the situations in order to have a city free of waste. <https://proyectolibera.org/aulas-libera/aprende/>
- PROJECT LIBERA: Contest “Solve” Solve is a contest where participants have to find a solution to the problem of waste in nature. They must work in groups and suggest an idea that could provide a solution: the main aim is to identify the trash found in the selected spot. Once this is done, they have to pose solutions to free nature from its presence and translate it into the project.
- LLOBREGATS “The sustainable family” Animated mini-series produced by the charity Llobregats that shows its citizens about the circular economy and helps to solve doubts about recycling. <https://llobregats.wordpress.com/punto-limpio/>
- Volunteering for cleaning the beaches “BIOagradables” Activist Volunteering Group which is committed to the cleaning of beaches. They try to motivate and make the largest possible number of people aware so that everybody can help in their mission of changing the planet. They base their actions on encouraging global change through small local efforts. To do so, they carry out monthly cleaning days on the beaches along the Mediterranean Coast of the Valencian Community. They also offer workshops for children, give talks in schools and collaborate to raise this awareness at a European level by participating in projects and events oriented to the preservation of our ecosystems and the sustainable use of our natural resources.
- Programme “LLARS VERDES” (Green Houses) “Llars Verdes” is included in the programme “Hogares Verdes”, an educational project of the Ministry of Environment and Rural and Marine Environment, developed by CENEAM which has been conducted for four years. The programme works through the participation of families. The families are given a series of objectives or environmental challenges which have to be accomplished at home in a cooperative way (water and energy saving, reduction of waste, etc.) Those challenges are set after an initial

environmental audit performed in every single home through the real water consumption, gas consumption, etc.).

At the end of the process the families are advised and offered technical support so that they can meet the specific goals that they had been given. Finally, a new audit is carried out in order to evaluate the process and test if there has been an impact in the amount of consumption.

4.2 Case of Republic of Serbia

Accumulated used plastic packaging is becoming an increasing and more visible problem globally as well as locally. Although the consequences of this pollution can be moderated, in Republic of Serbia there is a lack of measures which would encourage wider participation in recycling and help those who deal with collection and recycling.

However, it is very possible to imagine Serbia without so much pollution from (waste) plastic. It is enough to have a look at our streets and rivers and we will get a clear image that a lot can be done related to this issue.

Plastic takes a very long time to disintegrate on its own; meanwhile it pollutes land, riverbeds and sea surfaces.

The measures that Serbia has taken in the past in the field of plastics (and ecology in general) were mainly introduced in order to harmonize with European standards, in order to join to the European Union (the EU). Structure of production of plastic products is showed in Table 2.

15%	33%	6.7%	45.3%
Construction	Plates, pipes and profiles	Other plastic products	Packaging

Table 2. Structure of production of plastic products
(Source: Serbian Chamber of Commerce)

Plastic consumption in Serbia in 2016	Average plastic consumption in Serbia in 2016	Average plastic consumption in the EU in 2016
385 000 t	54, 5 kg per capita	100 kg per capita

Table 3. Plastic consumption in 2016
(Source: Serbian Chamber of Commerce)

Bearing in mind the abovementioned data, it can be concluded that in terms of consumption (Table 3) Serbia still has not reached the average consumption in the EU, but in the country, there is a trend of growth and relatively high consumption in relation to GDP. Quantities of plastic packaging produced in Serbia are showed in Table 4.

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	2010	2011	2012	2013	2014	2015	2016
Production of plastic packaging	40456	55880	130918	80269	80390	100714	107986

Table 4. Quantities of plastic packaging produced in Serbia

(Source: Serbian Chamber of Commerce)

Moreover, Serbia needs to prepare its economy and consumers for the challenges ahead. The ban on certain types of plastic products is one of the changes which means that consumers either stop using these products or find a replacement (e.g., cardboard or metal products).

	2016	2017	2018
Plastic bags with additive	6937,05	6747,12	3912,96
Plastic bags without additive	205,03	596,97	390,55
TOTAL	7142,08	7344,09	4303,51

Table 5. Quantities of plastic bags placed on the market of the Republic of Serbia

(Source: Serbian Chamber of Commerce)

The problem of the use of plastic packaging (Table 5) and its consequences for the environment began to be dealt with more seriously in Serbia recently. In previous years, it was taken an initiative in Serbia to ban and restrict the use of plastic bags. So recently, some retail chains introduced charging of plastic bags and now a plastic bag costs 2 or 3 dinars per piece.

The research shows that the average citizen of Serbia consumes seven plastic bags per day. Annually, about 2 billion plastic bags are consumed and discarded in Serbia.

Apart from aesthetic pollution, plastic is dangerous to health. About three-quarters of the produced plastic are soon being discarded. About 80 percent of discarded plastic ends up in the environment and in landfills. The direct consequences for ordinary people, as it is estimated, will be felt in future because if the way how plastic is used does not change, by 2050 in the oceans there will be more plastic than fish. Used plastic is worthless also because it is cheaper for the manufacturer to produce a new one than to recycle the used one. About 50 percent of PET packaging, the plastic from which recyclable bottles are made, is collected in recycling centers around the world, but only 7% is recycled while the rest remains there forever.

Apart from the excessive use of plastic packaging in Serbia, an even bigger problem is inadequate and uncontrolled waste disposal, which creates serious environmental consequences, especially for watercourses. Few rivers in Serbia are not seriously polluted with plastic waste. According to the data of



the Environmental Protection Agency, out of the city landfills, twelve landfills in Serbia are located directly on the watercourse, sixty-five of them are in the immediate vicinity of watercourses, while twenty-eight landfills are in the flood area. Illegal landfills, which are estimated to be between 20000 and 30000 in Serbia, contribute to this problem additionally. According to the regulatory framework of the Ministry of Environmental Protection, if illegal landfills are located in a public area, local governments are obliged to remove them, and if they are located on private plots, inspections order removal measures to the owners. However, in practice, nothing is happening in terms of remediation of illegal landfills, whether on public or private land, and thus huge piles of plastic which grow on illegal landfills in Serbia.

In the issue of plastic packaging, in addition to consumer awareness, it is important to emphasize that institutional frameworks (institutions), i.e., policy regulation and incentives in the waste management sector have a major role in the development of recycling. The situation in Serbia regarding to the recycling of PET packaging is far below satisfactory. In Serbia, only about 5% of plastic packaging is recycled annually, according to the latest data from the Ministry of Agriculture and Environmental Protection. The goal of Serbia is to reach the level of 50 percent by 2030.

On the other hand, solving the problem of plastics, apart from recycling and consumer awareness, raises the question of the role of large companies which use plastic packaging en masse to pack their products.

In Serbia, there is an environmental tax for environmental pollutants, but it is not applied in the context of plastic packaging.

A factor that is crucial in the context of changing 'recycling awareness' is the economic benefit of recycling. The current purchase price of PET packaging in Serbia is very low. Thus, for a ton of plastic packaging, you can get from 110 to 240 euros.

Raising the purchase price of plastic packaging in Serbia would bring positive changes in recycling. In addition to reducing plastic waste in the environment, such a move would bring the possibility of additional income to the poorest and marginalized strata of society, such as the Roma population. The Roma population, whose existence in most cases depends on the collection of raw materials in city checkpoints, plays an important role of informal recyclers in the society. They provide an excellent example of a circular and sustainable economy in practice, which has a positive impact on the environment and the economy in the context of resource reuse.

Another solution to the recycling problem in Serbia would be the direct employment of informal collectors of raw materials. Such a move would allow social rights for marginalized groups, but also integration into a society in which individuals are currently invisible. It is estimated that around 50000 people in Serbia are engaged in informal collection of raw materials, while a quarter are under the age of eighteen. Out of that number, 90 percent are the Roma.

What can we, individuals, do?

- We can reduce the use of disposable plastic - bags, straws, plastic bottles, plastic cutlery, etc.
- Moreover, we can, for example, use solid 'ordinary' soaps instead of liquid soaps because their packaging decomposes quickly and easily. Recyclable waste should be disposed of in recyclable waste containers.
- The plastic we want to discard we could give to the collectors of secondary raw materials.

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- We can even sell recyclable plastic to the recycling companies (which there are in Serbia and which can come to your address if you have a lot of plastic) or take it to a recycling center.
- We can buy from companies dedicated to sustainable production, those which use recyclable materials in their production or that use little or no plastic for packaging.
- We can definitely use the reusable bags.
- We should continue the education of students related to plastic in schools.

With all these things that an individual can do, it is equally important to demand that the state pay equal attention to this problem.

In the Republic of Serbia, the most important measure is the establishment of an adequate waste management system, i.e., measures which ensure primary classification (selection), setting up collection points and construction of recycling yards and regional centers.

At present, there are no specific requirements in the Republic of Serbia regarding to restrictions in the field of design, engineering and production of plastics. Of course, certain types of plastic products are manufactured in accordance with quality standards that ensure market placement, depending on the intended use of these products. The Republic of Serbia is preparing to open negotiations on Chapter 27 Environment and Climate Change. In that context, according to the National Program for the Adoption of the EU Acquis (NPPA), it is planned to fully transpose European regulations into our legislation by 2021. The directive on reducing the impact of certain plastic products on the environment 2019/904 was adopted this year and it is a novelty for both member states and for our country.

4.3 Case of Republic of Slovenia

4.3.1 Waste management from households in Slovenia - How plastic is reduced/recycling and reuse at home in Slovenia?

In Republic of Slovenia, the management of packaging waste is under umbrella regulation, the Environmental Protection Act and is regulated in detail by the Regulation on the management of packaging and packaging waste and the Decree on environmental tax on the generation of packaging waste. Those regulations lay down detailed rules for the management of packaging waste and related obligations.

Households that are end users of a product or packaging are the producers of municipal waste. Due to the necessity of reducing waste in landfills, separate collection points of fractions were introduced as 'ecological islands', enacted at the state level in 2001 by the Decree on the Management of Separately Collected Fractions. It prescribed that collection points should be arranged in residential areas. In the area of the city centre or a larger residential area, one ecological island must be provided for every 500 inhabitants.

The collection point for separate fractions of municipal waste or ecological island is a space arranged and equipped with containers for separate collection and temporary storage of individual types of waste.

Ecological islands are one of the cornerstones of a separate waste collection system, where household waste that is suitable for treatment and reuse is collected separately.

Waste, namely paper, glass, bottles, cans and textiles, are disposed of separately in containers. Separate waste collection is a today's necessity, as it returns waste to industry and recycles it.

The system of separate collection of household waste is arranged in a following way:

- Mixed municipal waste (black container)
- Packaging waste (yellow container)
- Packaging waste from plastic and metals and tetra packs are collected separately. These include: milk packaging, juices (tetra packs), plastic bags, bottles, yoghurt pots, cottage cheese pots, cans (of beverages, food...), aluminium foil (aluminium foil), food wrap, metal lids / stoppers, plastic lids stoppers. Picture source: (<https://www.dol.si/sl/>)
- Bottles and cans of beverages and foodstuffs, bottles of cleaners and detergents, plastic bags, plastic packaging of shampoos, toothpastes and liquid soaps, plastic pots, packaging of CDs and DVDs, plastic foil in which products are wrapped, Styrofoam packaging , packaging of composite materials (packaging for juice, yoghurt or milk, consisting of paper, plastic and aluminium foil)
- Biodegradable waste (brown container)
- This container includes kitchen and garden waste. It is most desirable for households to compost biodegradable waste at home, in which case they do not have to pay for the removal of this part of the waste.
 - Glass (green containers)
 - Textile container
 - Waste paper containers



Collected and separated waste is taken by the municipal company to a centre for separate waste collection. There, the waste is inspected and sorted again. In between, there are also those that do not belong to the ecological island. Recyclable waste is taken for further processing to recycling centres. Waste that cannot be recycled is taken to a landfill.

The costs of separate door-to-door collection and in collection points (ecological islands) are paid by households.

As certain types of waste are subject to extended producer responsibility, households can submit them free of charge:

- waste grave candles in special containers at the cemetery
- medicines in pharmacies or mobile collection points
- end-of-life vehicles at the end-of-life collection point or dismantling plant
- worn tires at a service centre or at a public utility collection centre
- waste electrical or electronic equipment at the supplier, dealer or collection centre of the public utility service
- packaging waste in the collection centre of the public utility service

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- waste batteries at the distributor, in mobile collection points or in the collection centre of the public utility service

Hazardous waste can be disposed of in the collection centre of the public utility service or in mobile collection points. They can also dispose of waste medicines in mobile collection points, which are not accepted in collection centres. In the collection centre, households can also dispose of bulky waste, in some places up to a certain amount free of charge.

Within some public utility services, there are Reuse Centres, where they take over preserved products, bulky waste or electrical and electronic equipment free of charge. At the centres, these products are refurbished, repaired, upgraded and sold at low prices to extend their lifespan.



Picture 23. Reuse centre

4.3.2 EXAMPLES: How the government is supporting projects regarding waste management education

- **Project: Plastic Pirates – Go Europe!**

'Plastic Pirates – Go Europe!' is an international citizen science campaign launched by the ministries of education, science and research of Germany, Portugal and Slovenia, which is taking place during their Trio Presidency of the Council of the European Union.



Picture 24. Plastic Pirates Project Logo

(Source: <https://www.facebook.com/plasticpiratesgoeurope/photos/a.106739777758956/131829098583357/>)

Purpose:

Europe is taking a joint approach to this task – a task with greater importance. Macro- and microplastic pollution in lakes, rivers and the ocean are a significant hazard to the stability of marine ecosystems and a danger to wildlife as well as plant diversity. It may start with small rivers further inland that connect to other rivers, but they eventually reach the sea. However, the scientific community – around the world and in Europe – still does not have enough data to determine the actual amount of pollution.

Goal:

The goal is to raise awareness of the importance of protecting our rivers as natural resources and to highlight the value added of international research collaboration. On the other hand, the campaign aims to emphasise the importance of international research collaboration. Scientific work is thus involved in researching the plastic waste problem as well as for avoiding plastic waste.

In 2020 and 2021, ‘capturing’ this waste on the riverbanks and near bodies of water becomes the Europe-wide task of the Plastic Pirates. By collecting plastic waste and uploading data on the amount of waste found. Project is citizen science project, contributing to research into the spread of both micro- and macro-plastic in and around European rivers.

Target group:

Project is open to schools and extracurricular youth groups with young people aged 10 to 16 from EU member states Germany, Portugal and Slovenia.

Participating as a group (e.g., school class or extracurricular youth group) is a requirement because different subgroups have to be formed. This is the only way to ensure that the results of the project are comparable throughout Europe and that the data can be included in the scientific evaluation.

The campaign calls upon children and adolescents to investigate the subject of plastic waste in the environment, particularly in and near various bodies of waters.

Activities:

Participants identify the types of plastic waste found along the banks of rivers and, thereby, to support the scientific community by sending in their results. Data is collected from the banks of a river, stream or other flowing water in Germany, Portugal or Slovenia through the gathering and categorisation of various types of plastic waste found there. First, zones are demarcated in different sections of the riverbank. All unnatural occurrences of waste are then collected and documented from within these marked zones. The exact procedure and execution of the task, including categorisation of the waste collected, are described in detail in the project booklet.

- The sample results collected are submitted – sorted according to their waste type – online and evaluated by scientists and researchers. In this way, with the help of school classes and

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extracurricular youth groups, the research community gains insights into plastic waste pollution in various regions throughout Europe.

- A research field for which a reliable database is still largely lacking. The Department of Research on Learning and Instruction at Ruhr-Universität Bochum is doing supporting research to bring the scientific and societal benefit of the campaign into focus. Their research centres on the impact of the “Plastic Pirates – Go Europe!” campaign and will explore whom it is benefiting, how much and under which conditions.

The primary reference points for Plastic Pirates – Go Europe! are in STEM subjects such as biology, geography, physics and chemistry. But relevant questions can of course also be addressed in the social sciences. The campaign is designed to be used in interdisciplinary settings (for instance as part of a project or theme week).

Why participation is important:

We are all tasked with protecting the ocean and all bodies of water – regardless of whether we live on the coast or further inland. Even plastic that is thrown away on inland riverbanks can eventually make its way into the sea. And the harm that this causes to animals and our food sources is a cross-border problem. The Plastic Pirates – This is where the sea starts! campaign took place for the first time in Germany 2016 as part of the Science Year 2016*17 – Seas and Oceans. Now young people from three countries in Europe are taking part and form the Plastic Pirates – because avoiding plastic waste and researching the causes and relationships are tasks that we in Europe can best tackle together. We all – as citizens of Europe – are called upon to use our curiosity and our dedication to support scientists and researchers.

Materials:

The accompanying teaching materials and worksheets and the project booklet provide guidelines on the campaign and are available free of charge. Link to materials: <https://www.plastic-pirates.eu/en/material/download>

The next sampling period starts on 1 May and runs through 30 June 2021 Source: <https://www.plastic-pirates.eu/en/about>

- **Project Green Academy**

Purpose:

The Green Academy project is intended to raise awareness of people about reducing the impact of pollution of the coastal zone and the sea in the area of Koper and Ankaran municipalities (Slovenia). It's final time to start cleaning and taking care of the sea. Unusual outdoor classroom is the sailboat which enables participants to get concrete experience on pollution and its consequences.

Goal:

Goal of the project is to raise awareness of the problem of marine pollution, especially with bulky and plastic waste. Through this project, the Green Academy wants to present the issue of marine pollution in an interesting way. The main goal of the project is to strengthen the sense of the environment among the



young generations, to treat our sea with respect and responsibly. In 20 years, we will have nowhere to swim if the pollution trend will be as is today.

Target group

The project is intended primarily for primary school pupils and high school students, who are the main 'visitors' to the unique outdoor classroom. In the future, the project wants to attract also the general public and other coastal municipalities.

Activities:



Picture 25. Project Green Academy

During the sailing with the legendary 20-meter sailboat, which competed in the most famous regatta around the world (Volvo Ocean Race regatta), participants train basic boat handling skills and meanwhile get to know the problems of marine pollution with plastic and microplastics. In the second part of the so-called outdoor classroom, participants participate in cleaning part of the coastal strip along the Koper Bay. The most critical situation in the Slovenian sea coast is in Strunjan area.

The general sponsor of the project is the Port of Koper (majority state-owned) was convinced by the interesting content of the project, and above all by the fact that it is a kind of outdoor classroom, where children will not only learn sailing skills but also actively participate in protecting our environment.

Sources:

<https://www.regionalobala.si/novica/zelena-akademija-nadaljuje-svoje-poslanstvo-v-treh-dneh-gosti-150-koprskih-osnovnosolcev-foto>

<https://www.obalaplus.si/green-academy-ucilnica-na-prostem-bo-ozavescala-o-pomenu-nasega-morja/>

- **Green penguin**

Short movie presentation: <https://www.youtube.com/watch?v=JgpYDBU8dj8>

Purpose:

Project Green Penguin is making children life-long stewards of our planet. Benefits are for now and for generations to come.

Project idea is based on the use of smart, digital technologies (measurement, cloud computing, edge computing, big data analysis, visualization tools, list of possible best practices, ideas for reduction etc.) engagement of kids through gamification and user applications), to achieve significant CO2 reductions based on created energy efficiencies and resource consumption reductions:

- All schools and kindergartens of Ljubljana municipality can save 1086 t of CO2 in 1 year = 3259 penguins.

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- If kids bring this practice back home, to their households (proved by many studies & similar projects) only for 5% - this means households save 7522t CO2 in 1 year = 22.565 penguins; 1,5 Ljubljana-Stožice stadium

Goal:

Tackle global environmental challenges and engage residents to co-create a carbon-neutral city with:

- Environmental literacy.

To teach kids environmental literacy; Kids need to know what is 1 kg, 1t of CO2 footprint. So, we calculated it in trees and in m³ of icebergs = penguins.

- Digital literacy

To teach kids digital literacy; they learn about the tools, effects of real-time data and potentials of synergies of technologies.

- Sense of belonging

Kids see effects of their actions, they compete school to school, learn, play and get awarded. The aim is to create a competition between schools where each school would be assessed based on its resources efficiency use & CO2 emission and based on the percentage of reduction of these emissions.

- Significant CO2 reductions

Significant CO2 reductions will be seen based on created energy efficiencies and resource consumption reductions.

- Costs reduction

Costs will be reduced (documented with evidences).

- Environmental reporting

Based on the technology we can create full environmental compliance and report for Municipality, offer them a great, accurate, real-time resource management tool

Target groups

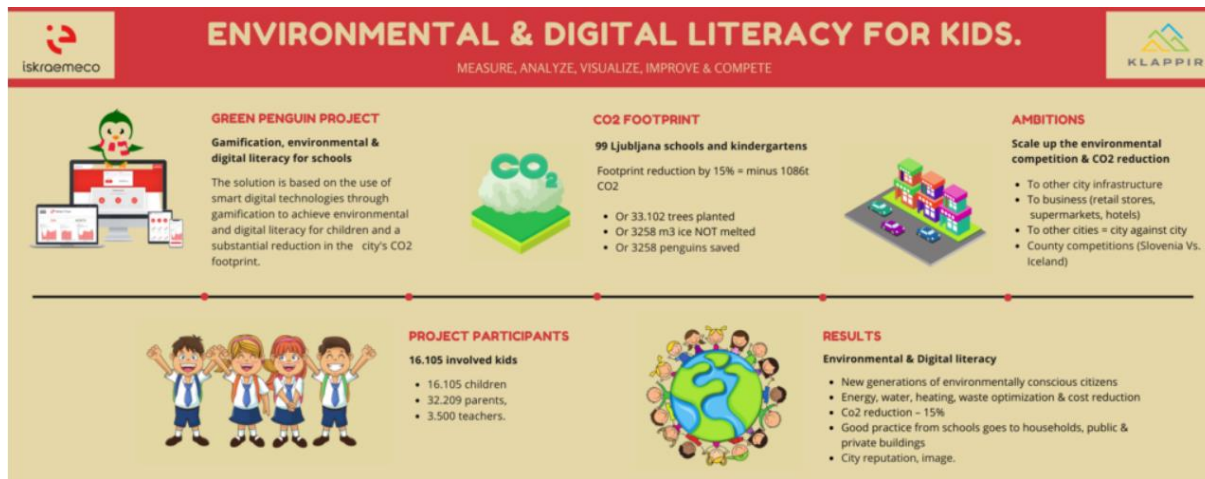
- Kindergarten children
- Pupils of primary schools
- The best part of the idea is that it is could be applicable to other public buildings and similar city infrastructure: from schools to universities, hospitals, retail stores, hotels, logistic centres. Or even more, the competition could be done from city to city or even between different countries. Imagine if retail stores had screens showing their resource consumption to the customers – where would you go for shopping?

Activities:

Idea is based on the use of smart, digital technologies (measurement, cloud computing, big data analysis, visualization tools, list of possible best practices) and engagement of school kids through gamification. Using smart digital technologies and gamification to achieve environmental and sustainability literacy for primary school and kindergarten and a substantial reduction of the city's CO2 footprint. With resource consumption data, schools will compete against each other on reducing CO2 footprint. CO2 will be recalculated into ice not melted and penguins saved.

Partners:

- Iskraemeco, Slovenian global company which moto is: Bringing intelligence to Energy
- Klappir, Icelandic company with moto: We empower businesses,
- municipalities, investors and governments to work systematically toward improved sustainability



Picture 26: Environmental and Digital literacy for kids

What can be next steps?

This is how we can engage residents, business into concept of smart city to create the environmental benefits and 'decarbonization' needed:

- From schools to smart city,
- From schools to other public buildings
- From school to households, city districts

Some facts, to underline the idea:

Fact 1: In CO2 calculations we calculated, heat, electricity, waste. For benchmark we took average size of Ljubljana's school, we know there are 52 schools + 47 kindergartens. We could add logistic of kids, food (as menus, waste).

Fact 2: Based on studies and pilot projects we know that with changing the behaviour we can decrease our resource consumption significantly, studies and many pilot cases are saying up to 30%, for the calculation we took 15% reduction. And on the reductions on households, we took really conservative 5% reduction approach.

Fact 3: we only took into consideration CO2 decrease that is done based on changes of our behaviours, not reduction based on building renovations, etc. This would add a whole lot more of CO2 reduction.

Fact 4: technological solutions exist, the problem is, that companies and households are not motivated enough, as mainly they seek financial motivation & incentive; for average household this would be 5€/month – and obviously this is not enough (data: Slovenian project Nedo, other international projects). This is because the price of energy in SI is relatively low – in countries where prices are higher, community's motivation is also higher (Germany, UK, Nordic countries, Middle East countries, North Africa)

Fact 5: We know that with changes of the existing legislation on energy, with coming energy taxation and with the overall strategy of EU to meet climate goals, this will change and the financial risk is also, what we wish to mitigate with the project.

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Sources: <https://www.iskraemeco.com/en/green-penguin/>

- **Association Ecologists without Borders**



The Association Ecologists without Borders is a Slovenian non-governmental organization in the field of environment. It works in the public interest and strives to improve the situation concerning the environment with an emphasis on efficient use of resources and active citizenship. The association plays an active role in formulating a national strategy for the prevention of illegal waste disposal and focuses on raising public awareness related to waste reduction and management, waste separation, active citizenship and sustainable lifestyle.

The main source of funding is national and international programmes/founds, and to a lesser extent donations and sponsorships.

The association is also co-funded by the Ministry of the Environment and Spatial Planning and the Ministry of Labour, Family, Social Affairs and Equal Opportunities

Ecologists without Borders was created by organizing 'Let's Clean Slovenia in One Day' campaigns, which are considered to be the largest volunteer events in the history of Slovenia. They connected 280,000 individuals, companies, various associations, the Slovenian army, the police, communal services, municipalities. As part of the campaign, a register of illegal dumpsites in Slovenia was created.

Association responds and influences environmental legislation and development guidelines at national and European level. It encourages the transition to a circular economy and the introduction of Zero Waste practices at all levels of society. It actively cooperates with decision-makers in order to solve the challenges of the past and the future and proactively influence decision-makers by opening up new topics such as illegal dumps, plastic, discarded food and washable nappies.

At the end of January 2014, Ecologists without Borders became a member of the Zero Waste Europe network and thus the national organization for Slovenia through the Zero waste Slovenia program. Zero waste Slovenia runs a national network of municipalities, hotels and events and confirms and monitors progress within their Zero Waste commitment or plan. It promotes Zero Waste nationally and establishes a platform for collaboration and networking with businesses and policy.

Sources: <https://ebm.si/glavna/web/>

- **Visible projects of the Association Ecologists without borders**
- **Everyday Plastic**

Purpose:

Slovenia lacks good and up-to-date data in the field of plastic packaging waste management, and usually the problem is focused when it is too late and the yards are already full of piles of plastic.



Disposable plastic has become one of the most problematic waste. Together with waste of fishing, it contributes 70% of the waste that lands in our seas. 80% of the plastic in the seas comes from the land. In the census for the global campaign World Clean-up Day 2018, plastic waste was present in as many as 4 out of 5 landfills. In Slovenia the quantities of packaging waste are growing, the share of quality plastics is falling, there are regular problems with collection, the recycling rate is low, reuse is even rarer, and materials are rarely recycled several times. Reducing the amount of plastic packaging directly contributes to lower energy and natural resource consumption, and consequently reduces the impact on climate change. It is time to deal with disposable plastics also in Slovenia.

Goal:

- By researching and gaining data/information filling the gap in the field of plastic packaging and waste management
- Informing public and essential institutions on situation
- Breaking several myths, eliminate misunderstandings between different types of plastics
- Help prevent the accumulation of new waste
- Strive to a higher level of quality separation and awareness of more sustainable alternatives.

Activities:

- Preparation of E-manual 'Basket of goods' (result in Slovene language - "*Košarica dobrin*") – making an inventory of the type of consumer packaging. In detail description of the types of consumer packaging (food, beverages, cleaners and household appliances) and presentation of possible alternatives that can be used by manufacturers, traders and buyers.
- Cooperation with retailers - preparation of a self-assessment questionnaire on the quantity and materials, which is the basis for concrete proposals for improvements and prevention of unnecessary packaging waste
- Breaking the 10 most common myths about plastic (result in Slovene language -10 *mitov*). Getting information about what happens to a plastic waste when it leaves the backyards of homes and businesses. Obtaining estimates of the types of collected plastic packaging by materials and levels of actually recycled plastic packaging waste.
- Raising awareness of the 'Big plastic 5' (result in Slovene language - *Velikih 5*). Special attention was paid to the 'Big plastic 5': bags, bottles, food packaging, straws and a coffee pot on the way, which are the most visible symbols of our 'obsession' with plastic. For this purpose, the awareness news was prepared that are available free of charge for use in schools, utilities, the media and public institutions.
- Implementation of the research 'Research on types of plastic packaging and recycling rates' (result in Slovene language - https://ebm.si/r/PNV_raziskava.pdf). Research was designed in two parts - as a detailed survey and as a set of interviews within municipal companies, companies for the management of plastic packaging waste processors and all others involved in any way in the management of waste (plastic) packaging. We wanted to get information on the actual waste management packaging in Slovenia and insight in all different stakeholders to discover where are the consensus points and where conflicts and where conflicts escalate.
- **#Plasticsinthepotlight**

Purpose:

Current European legislation on food contact materials is outdated and insufficient to no longer protect the health of Europeans, as acknowledged by the European Commission, which proposed a revision. Until

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this legislation is tightened, consumers can protect themselves from hazardous chemicals by choosing natural cosmetics and cleaners, eating fresh and as little packaged food as possible, and avoiding PVC products (labelled 3, ♻️) and polycarbonate (PC).

Goal:

- Analysing the urine samples for the purpose of detection of presence of phthalates and phenols, hormone disruptors that enter our bodies through plastic packaging.
- Results of the project are a motivation to continue talks with manufacturers and traders, who are being called upon by non-governmental organizations within the Break Free From Plastic movement to take action and reduce the use of disposable plastic products. Recent global inventory of brands putting the world's biggest corporate polluters back on the line.

Results:

From Spain, Belgium, Bulgaria, Latvia, and Portugal, 52 samples of urine samples were analysed. Of the 28 chemicals analysed, we found an average of 20.5 in each sample, which is a clear alarm for the need to tighten legislation, move to more sustainable packaging and self-protective behaviour of individuals. New research reveals that there is a worrying amount of toxic chemicals in our bodies. The Zero Waste Europe network reveals that harmful chemicals, which are an integral part of food packaging, also pass into human bodies.

Samples tested at the Norwegian Institute of Public Health and analysed at the University of Barcelona were tested for the presence of chemicals commonly used in disposable plastic packaging. These include phthalates and phenols, which are linked to cancer and cardiovascular disease and affect the reproductive and immune systems. The researchers point out that we should be concerned about the results mainly because of the general exposure of the entire population, as there are no safe limit values.

Source: <https://ebm.si/glavna/web/prispevki/tudi-slovinci-smo-okuzeni-s-plastiko>

- **Eco-concept**

Purpose:

More and more visitors of the events have become aware of the environment and are disturbed by the large amounts of waste generated during the event itself and are often visible even after it.

Goal and activities:

- Reusable glass rental service for events.
- Waste prevention.
- Proof that the environment can be taken care of even during entertainment and that this is not difficult at all.

Results:

If someone want to organize the event in such a way that there will be less waste left after it, one of the most noticeable measures is the offer of drinks in reusable plastic glasses. There is a possibility to rent or buy glasses.

Glasses can be bought s in three sizes - 2 dcl, 3 dcl and 5 dcl. The glasses are washable and suitable for long-term use, for hot and cold drinks. The price for an individual glass is the same, regardless of the size of € 0.50. In case a whole box is bought, the price is € 20 for a box and a 10% discount on glasses.

Source: <https://ebm.si/eko-koncept>

- **Bag on Bag**

Purpose:

An adult resident of Slovenia is expected to consume between 130 and 150 plastic bags per year on average. These usually end up in mixed waste after use, which is usually no longer than 30 minutes. Currently, only about 4% of them are recycled. Plastic bags decompose for up to 1000 years. They pose a threat to nature and to the health of humans and animals (especially marine ones) mainly because they remain in the environment in the form of microparticles in water and air. They are made from non-renewable raw materials such as oil and natural gas.

Goal:

- Draw attention to the problem of overuse and improper handling of plastic bags through art
- Conducting research on the use of plastic bags
- 1,400 divided reusable bags
- The problem of plastic bags becomes visible and known to the general public

Activities:

Conducting a small survey in four major stores in Ljubljana (the survey included food, textile and drugstores), where the attitude of buyers and sellers towards the use of disposable plastic bags were observed.

Results:

Observation has brought interesting results, namely that customers in stores or at checkouts, where they know they will not get free bags, are much more aware of this and bring their shopping utensils with them to a greater extent than at checkouts, where they know they will get a free plastic bag, customers bring most of their own carrying accessories in grocery stores (76%) and the least in textiles (8%). Vendors in textile stores handed out a free plastic bag to all customers, in drugstores in more than half of the cases, and in grocery stores in less than a fifth of purchases; customers rarely refuse a free plastic bag, they usually take more than one in grocery stores, and “quick cash registers” are also a particular problem; more of their own wearable are brought to stores by women and the elderly.

In 2021 you can't get free plastic bags anywhere.

As part of one of Association's project – ‘Tekstilnica’ (‘Textaile’), it was shown to people how they can reuse clothes in a different way. Tailors have been making shopping bags from used or scrap textiles, or cotton t-shirts and trying to teach as many people as possible how they can do it themselves. Sewing

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workshops were organized for children during the summer school holidays, and various articles and a short, animated film called 'From a T-shirt to a bag' were prepared.

Source: <https://ebm.si/prispevki/vrecka-na-vrecko>

- **Healthy little butts**

Purpose:

In Slovenia, more than 20,000 tons of disposable nappies are generated annually, and their disposal costs us 4 million euros. Disposable diapers account for 2-3% of all household waste or up to 14% of mixed waste.

Goal:

- Cooperating with Vrhnika Kindergarten as part of a pilot project to introduce washable nappies in kindergarten
- Breaking stereotypes about washable diapers
- Introduction of the use of washable diapers in kindergartens
- Promotion of incentives for the use of washable diapers

Results

Vrhnika Kindergarten uses only washable nappies in all units with the help of the project and saves approx. € 10,000 per year. 5.8 tons of waste was generated annually in the kindergarten, mostly for diapers. Washable diapers significantly reduce the amount of waste and thus the cost of removal.

Parents who already used washable nappies were in direct contact with those parents who didn't know what to do, answered their concerns and questions, presented the advantages and the way of changing, washing, etc.

Source: <https://ebm.si/zdrave-ritke>

- **Portal 'Less is More'**

Purpose

Slovenians throw away more than 10 kg of useful things a year, and the trend of fast fashion forces us to always buy new low-quality clothes.

The portal for the first zero waste step. There is more and more talk about reuse, processing, borrowing, exchanges, buying products without packaging, and many people would do it themselves, but do not know where to start. Zero Waste lifestyle takes a lot of time because you have to look for suitable stores, you can't buy everything in one place and the like. Real and fast information certainly helps to solve these problems.

That is why Ecologists without Borders has prepared an online platform with the eloquent name 'Less is More', where you can find the answers to all these questions in one place and with one click. In it you will find the Masters Map, the ZW Stores Map and also the Calendar of Events.



Goals

- Create a map of repair shops, second-hand shops, rental shops and re-use centres
- Create a map of zero waste stores where at least some products can be purchased without packaging
- Promote exchanges, lectures and waste prevention workshops with a calendar of events

'Less is more' is a concept that advocates more quality, more savings, and less waste. By repairing, exchanging or renting items, we avoid buying a new product and giving this item a new life. However, when we cannot prevent the purchase of new things, we choose products with as little packaging as possible. Reuse, which saves natural resources and money, takes precedence over any recycling in the waste hierarchy.

Source: <https://manjjevec.si/>

- **Launch of new international Zero Waste projects**

Two international projects related to the Zero Waste concept have started in the autumn 2020.

-Several members of the Zero Waste Europe network (also Slovenia) are participating in the 'Transitioning to Zero Waste one community at a time' project, with the aim of upgrading the work and expanding the network of municipalities with Zero waste strategies. As part of this project, testing of the certificate for Zero waste sites will also take place. Ecologists Without Borders has a more mentoring role in it, and at the same time it is an opportunity to develop or translate additional materials and tools.

-The Erasmus+ project 'Building a European ZW Academy' project is being run in collaboration with Estonian universities, Let's do it Foundation and Zero Waste Europe. The main goals are the preparation and implementation of training for Zero Waste ambassadors and trainers.

Source: <https://ebm.si/zw/o/ekologi-brez-meja-2/>

4.4 Case of Cyprus

The problem of plastic waste may have been around for a long time, but it was not until 2008 when a non-profit organization (Green Dot) was set up, that Cyprus took an active role in working against plastic pollution among others.

Since then, more companies, Institutions and Municipalities have taken the initiative to reduce waste in general, with great focus on plastic waste with the intention to minimize the problem as much as possible. This year the project taken on by some town councils as a pilot program has been decided to be taken applied from the government to all town councils for the reduction and waste of plastics nationwide.

4.4.1. Company & Organization Operations (Case of Green Dot)

Green Dot Cyprus is the first Collective Compliance System for Packaging and Packaging Waste in Cyprus since 2008. It collects and manages three packaging streams, PMD, Paper and Glass and has since its operation back in 2008 to be established as the main organization for waste management and recycling in Cyprus. It has achieved 2 international awards:

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- 2nd place at European level in the category ‘Supporting the Development of Green Market & Resource Efficiency’ at European Enterprise Promotion Awards of EU, 2013.
- Distinction among the 10 best European companies in the category ‘Environmental & Corporate Sustainability’ at European Business Awards 2014/2015

Green Dot’s work

In urban areas, PMD are collected door-to-door, from the pavement once a week. The packaging has to be placed in the special PMD bags, which are available in the supermarkets. This means that there is no need for a recycling bin to be placed outside each house which makes it easier for every person to contribute in recycling.

In rural areas, after sorting citizens should transport it to the bring point and place it in the correct bin from where PMD is collected in a weekly basis.

Results in Plastic Recycling

With PMD recycling, Green Dot has managed, since the beginning of its operation in 2008, to increase collection of recyclable plastic from **2141 tons** per year to **11871 tons** in 2020 (nationwide).

4.4.2. Municipality Operations (Case of Municipality of Aglantzia)

One of the capital’s town municipalities, municipality of Aglantzia, has taken this year as a pilot demonstration the program “**Pay as you Throw**” (PAYT). The program is a rational method of waste management that aims to link waste generation to billing with the aim of having citizens significantly reduce the cost of waste they have been paying, with the practical application of the following philosophy:

1. **Limit:** By limiting our purchases to what we really need, we limit the amount of waste produced and save money.
2. **Reuse:** Much of the waste generated can be reused following repair or conversion.
3. **Recycle:** The Holistic Waste Management Program significantly increases the types of waste recycled.
4. **Save:** Charging for waste is now dependent on the volume of waste that is not separated. Thus, environmentally conscious citizens who produce less waste and properly segregate, save significant sums of money.

While in this program recycling in general is being promoted PMD recycling is one of its major streams is Plastic Recycling.



Picture 27. Programm Recycling

How does “PAYT” work?

Every house’s garbage bin has an installed microchip which connects the bin to a particular house address where a physical person lives. Consequently, through an installed application/software each garbage bin’s weight can be measured and tracked back to the specific house address along with the date and time of measuring. In addition, citizens are required to only use specific waste bags which are biodegradable and can be bought from the supermarket.

Results of PAYT

While it is soon to get an overall annual picture as the program has only been implemented in Summer 2020, according to available data, during the two months of the program’s implementation, there was 99.3% participation by the residents and reduction of garbage by 39%.

Video URL: https://youtu.be/HQQjI6Z_yVY (Enable English subtitles)

4.4.3. Governmental Operations starting 2021

Given the successful example of Aglantzia Municipality described in section 4.4.2. Municipality Operations (Case of Municipality of Aglantzia), the program “Pay as you Throw” (PAYT) is expected to be implemented all over the country. The target is to reduce the burial of biodegradable material, increase the number of materials to be recycled and to prevent the establishment of waste.

4.4.4 Social Operations

Various other organizations companies or individuals organize events or undertake projects with main aim the reduction of waste, and promotion of recycling. A number of projects can be found below.

4.4.4.1 AKTI

<http://www.akti.org.cy/>

- **Project “Fighting plastic pollution in Cyprus: The Responsible Beach Bars Initiative”**
The project has been recognized as an innovative social initiative and therefore awarded by Beyond Plastic Med organization (<http://www.beyondplasticmed.org/>).

This initiative aims to engage beach bars, snack shacks and beach restaurants (henceforth called beach bars), strewn around Cypriot beaches, to take ownership of ‘their’ stretch of beach, to

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protect it and minimize the amount of marine litter, and especially plastic, left on it by their customers and in general beach goers.

The initiative, and particularly the outcomes of the Responsible Coastal Businesses award, was the focus of CYBC's 'Spiti sti Fisi' (Home in Nature) show which aired in October 2018.

- **Project #Potavristou**

The program was the first original campaign that started from the local citizens and was organized with the Center for Studies and Research of AKTI.

More than 500 people collect garbage they found in the beach like, bottles, bags, soft drinks, etc. A total of 5.5 tons of garbage was collected.



Picture 28. Poster for Potavrisou project



Picture 29. Map of Cyprus with the all the beaches cleaned by Potavristou project

- **Zero Waste Future program in Cyprus and Malta: Zero Waste Beach in Cyprus and Zero Waste Cities and Zero Waste Campus programs in Malta.**

This joined program between Cyprus and Malta targets marine litter. Marine litter is an environmental, economic as well as human health problem with no simple solution.

It poses a global, complex and multi-dimensional challenge with significant implications for the marine and coastal environment and human activities all over the world.

Recovery and **recycling** of the most common marine litter items, are important steps in halting the inflow of items into the marine environment and are also critical first steps in promoting the Circular Economy. Recovery and recycling are particularly critical in island countries, such as Cyprus and Malta.

To address the problems outlined above, the initiative proposed here aims to engage citizens, students, local authorities and businesses to take ownership of the environment they spend most time in so as to increase recycling and decrease land and marine litter, using the “producer responsibility” mentality, but through soft, awareness-raising and participatory measures.

In greater detail “Zero Waste Beach” project which was supported by Coca Cola Foundation and the success of the project was achieved by various planned activities, some of which are explained below:

- **On-the-go recycling through bins on coastal walkways and public coastal spaces:** 50 specially designed on-the-go-recycling bins, for PMD collection, have been donated to **2 Local Authorities** (Geroskipou Municipality & Kissonerga Community Council) and installed over 5 km of coastal pedestrian roads.

The aim is to encourage local authorities and communities to improve collection infrastructure and implement reduction actions for plastics used. Source identification activity was performed for this action. More specifically, AKTI’s staff separated the collected waste per source, to create an innovative database with data that can be used for directing budget to the management of the most frequent litter.

35.2 tons of recyclable waste were collected from these bins, within a period of **eight** months.

- **Beach cleanups in conjunction with the International Coastal Cleanup:** implemented annual beach cleanups on selected beaches with the collaboration of the Responsible Coastal Businesses, schools, volunteers (including Coca-Cola System employees) and local authorities. Beach cleanups were implemented between June 2018 – August 2018 (in the summer tourist season), which included **15 beach cleanups** with the participation of **614 volunteers**, including **110 students** and representatives of **15 local authorities**.

Over **16000** litter items were collected, weighing **1.12 tons**.

- Built on the “**Responsible Coastal Businesses Network**” in Cyprus which **aimed** to inform Coastal Businesses about marine litter and encourage them to participate in and implement activities that will achieve the best possible management of plastic waste, either produced within their coastal business or left behind by beach goers. The network of businesses has been expanded to **137**

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members around the island, through Implementation of **an extensive awareness-raising campaign**, targeting all coastal businesses on the island.

To provide inspiration, a Decalogue and a Guide were developed and distributed to the Coastal Businesses. Decalogue contained 10 basic possible good practices and the Guide contained examples of these good practices in order to inspire the applicants and encourage them to act against plastic pollution and generally for a greener performance of their businesses.

- Tracked and recorded recycling waste from the “Responsible Coastal Businesses” (Shown on the map in the figure below): The members of the Responsible Coastal Businesses network ought, as a mandatory term of their network membership, to record the amount of waste (PMD, glass, general) that they dispose. **1730** tons of recycling waste collected by the responsible coastal businesses throughout the 6 months duration of the project.



Picture 30. Responsible Coastal Business Map

4.4.4.2 Precious Plastic

Precious Plastic is a global community of hundreds of people working towards a solution to plastic pollution. Knowledge, tools and techniques are shared online, for free.

The organization has created a machine that enables anyone to recycle plastic. They are made from basic materials, affordable and easy to build.



Picture 31. Machine built from Precious Plastics for recycling plastic

How the machine operates

Plastic flakes are heated and injected into a mold. It's a relatively quick process which is well suited for creating small objects repeatedly. Molds have been created by using CNC mills or lathes, or by simply welding them.

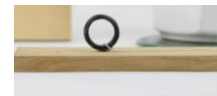
How this material is used



Picture 32. Molten plastic

The molten plastic material is then turned into a wide range of products.

JEWELRY: Plastic jewelry is constructed using the melted plastic and



ART: This material can be turned to pieces of art for exhibition or performance.

Construction: We start producing the organization produces its own construction material beams & bricks using techniques or machines.



MOULDS: The molds used to create upcycled products are created by the melted plastic. The molds are super precise and detailed to make highly professional products.



To conclude, even if Cyprus has only taken a more active role in recycling, only in the last couple of years (last decade) given the increase in,

- recycling volumes,
- projects arising from different private companies, organizations, and municipalities aiming waste management and recycling,
- the latest governmental decision for a nationwide implementation of the PAYT program

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It is obvious that Cypriot citizens from all backgrounds, are more willing to participate in this global effort for waste management and recycling given the correct education and opportunities. Now that the public is more informed and moved by the general issues arising from waste and equipped with plenty of options for recycling as well as upcycling, we believe that Cyprus is moving down the right path.



„We are moving very fast towards "Planet Plastics" and if we do not want to live in such a world, we would have to rethink how we use certain substances, in this case plastic.“

Prof Roland Geyer



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V LINK BETWEEN THE USE OF PLASTICS AND CLIMATE CHANGE

Plastic is obtained from fossil fuels, thus affecting the creation of greenhouse gases, so it can be said that it also affects climate change. Once again, the whole life of plastic products must be reconsidered. From the initial phase and extraction, transport and processing, there is pollution at every step, to the release of CO₂, as well as gases that create a greenhouse effect. The report shows that according to the current business scenario, total CO₂ emissions in the entire life cycle of plastics will increase by 50% by 2030, while it will triple due to inadequate waste disposal and widespread incineration practices. In 2015, emissions from manufacturing ethylene, the building block for polyethylene plastics, were 184.3 to 213 million metric tons of carbon dioxide equivalent, which is about as much as 45 million passenger vehicles emit during one year, according to the CIEL report. Globally, carbon dioxide emissions from ethylene production are projected to expand by 34% between 2015 and 2030.

Greenhouse gas emissions result initially when forested land and fields are cleared to make way for wellpads and pipes to drill for oil and natural gas. The fracking process emits methane, a greenhouse gas that, over 20 years, traps more than 84 times more heat in the atmosphere than does carbon dioxide. Methane results from flaring and leakage, which can occur anywhere from the well to the end user.

According to the World Economic Forum about 4 to 8 % of global annual oil consumption is related with plastics. If the trend of use and reliance on plastic continues, it is considered that will account for 20% of oil consumption by 2050.

In general, approximately 40% of all plastics in the world are used as packaging. The largest share of packaging is intended for single use, so that it is quickly removed. This type of packaging can be recycled in three different ways: by dumping, incineration or recycling. Of the three options mentioned, waste incineration has the greatest impact on climate change. According to World Energy Council projections, if plastic production and incineration increase as expected, greenhouse gas emissions will increase to 49 million metric tons by 2030 and 91 million tonne tons by 2050. Incineration of waste can release thousands of pollutants, many of which can be very toxic. This way of dealing with plastic waste not only affects climate change, but also has a negative impact on human health.

When we talk about landfills, they have much less impact on climate change, but they can also cause a lot of problems. In places where there are sanitary landfills, soil pollution can occur, which can also lead to groundwater. Groundwater can be in contact with a water source, which can have a negative impact on human health, as well as an impact on rivers, seas, oceans and the living world in them. Also, if the landfills are not sanitary, or are unregulated, wild, it means that there is no drainage layer. In such cases, various gases can leak, most often methane, which is easily flammable and thus large amounts of toxic pollutants can be released. The substances that are mostly emitted during combustion are nitrogen and sulfur oxides, dioxides, furans and heavy metals, and in addition, a strong, very unpleasant odor is emitted, which significantly affects life in the vicinity of the landfill. Also during atmospheric precipitation, harmful substances dissolve and wash away, which then infiltrate and directly pollute the soil and groundwater, while the wind will make sure that the pollutants spread over longer distances. Large, thick, gray clouds



spread over the settlement, pollute the atmosphere, travel for miles to later extraded with rain to fields, gardens, lakes.

Recycling, in addition to certain advantages, brings with it a completely different set of problems. Compared to the low cost of obtaining basic materials, recycled plastic is a high price with low commercial value. This recycling only makes it profitable, so it requires significant government subsidies. Research from the Ellen MacArthur Foundation suggests that only 2% of plastics are recycled into products with the same function. Another 8% are “downcycled” to something of lower quality. The rest is landfilled, leaked into the environment, or incinerated. Recycling facilities also often receive poor quality materials. Very often, plastic materials come into contact with biological waste, which automatically reduces the quality of the plastic material.

As scientists say, such a system is unsustainable, but despite that, a way out of the crisis is possible, provided that all parties work on a common goal. Too much pressure is put on consumers and waste management, and that these efforts are insufficient in the absence of measures at every stage of the value chain, from the production and use of plastics to its disposal. Although in most cases the packaging that sells the product needs to stop the production and use of single-use, disposable plastic. Promoting zero-waste communities, requiring extended producer responsibility, adopting and enforcing ambitious targets to reduce greenhouse gas emissions from all sectors, including plastic production are just some of the possible solutions that would lead to a reduction in global warming.



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„Act as if what you do makes a difference. It does“.

William James



VI ACTIVE STRATEGIES FOR SECONDARY SCHOOLS

In the following chapter the cases from partners secondary schools are presented.

6.1 Strategy for Plastics (BC Naklo, Slovenia)

- **Environmental certificate**

The Biotechnical Center Naklo publishes a Sustainability Report, prepared according to the GRI (Global Reporting Initiative) guidelines, which provides information on the economic, environmental, social and management effects and results of the Biotechnical Center Naklo. In 2018 we started with the establishment of the ISO 14001 system, in 2019 we obtained a certificate.

We appointed an environmental team, appointed administrators for environmental management in individual areas. Set targets and prepare waste management guidelines. We focus on monitoring energy consumption, water consumption, separation of mixed municipal waste. In 2021, we set the following goals:

- **Maintenance of the Eco school Certificate**
- **Setting criteria and indicators for the inclusion of environmental content in the curriculum**
- Establishment of a unified base for monitoring environmental and energy flows
- Reduction of water consumption by 10% compared to 2019
- Reduction of thermal energy consumption by 10% compared to 2019
- Reduction of electricity consumption by 10% compared to 2019
- Preparation of a medium-term program to improve energy efficiency

From the Sustainability Report for 2020, we understand that BC Naklo pursues the achievement of strategic goals by taking into account the global sustainable development of the United Nations (17 goals) and taking action, e.g., in the field of measures to combat climate change and its consequences:

Energy accounting.

Carbon footprint and monitoring of greenhouse gas emissions.

- **Monitoring of material and energy flows of BC Nakla.**
- Participation in projects and implementation of activities for climate change mitigation and / or adaptation.
- **Monitoring the life cycles of products and services at BC Naklo.**

Ensuring sustainable methods of production and consumption in BC is ensured by:

- Organic production of milk and dairy products.
- Organic vegetable production.
- Sales of organically certified products in the store.
- **Waste separation.**
- Reduction of food waste.
- Composting of organic waste.
- Product life cycle.⁸

⁸ Vir: Trajnostno poročilo 2020, BC Naklo

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- **Eco school**

In 2006, the Biotechnical Center Naklo, also under the name of the Secondary Biotechnical School Kranj, signed the EKOLISTINA (ECO charter) and joined the network of Eco school in Slovenia. By signing ECO charter, we committed ourselves to the following long-term goals:

- Encouraging all students and teachers to think that we too can contribute to reducing environmental problems.
- Concern for the environment, nature.
- Encouraging a positive attitude towards nature, of which we are also a part.
- Encouraging cross-curricular integration in the field of environmental protection, waste, separate waste collection.
- Care for connecting the school, its students and teachers and other school staff with local organizations that care for the environment.

The green flag of BC Naklo was confirmed for the 14th year in a row with the annual upgrade of our activities in the project "Eco-school as a way of life". This year was a little different, but we managed to carry out quite a few activities during the year. In September we held an eco-sports day, during the year we learned a lot about forests, climate change, analyzed and monitored the quality of drinking water in the institution, raised awareness about school gardens, planted herbs, and spices, visited the hydroelectric, showed our knowledge in the eco-quiz, **from tetra packs we made products on the theme of forest animals, plants and ecological vehicles of our future**, we collected waste toners, cartridges, and corks every day. We regularly read books on ecological topics and educated ourselves on eco-living.

Activities related to the commitment to maintain the green flag and long-term goals for the school year 2020/21 are as follows:

- Students, under the guidance of their mentor Marjeta Vovk, attend the Eco quiz for secondary schools every year; In knowledge of the topics of this year's **national competition Eco quiz "Circular Economy"** and "Forest in Slovenia and the World", 5 students of BC Naklo competed with their peers on February 1, four of which won a bronze award.
- WASTE MANAGEMENT / SEPARATE COLLECTION OF WASTE MATERIALS
- plastic stoppers: we are continuing with the campaign of collecting waste plastic stoppers for humanitarian purposes for the "Vesele nogice" association. The objectives of the activity are to collect plastic caps separately - help OPP - less discarded plastic.
- campaign to collect waste newsprint. The goals of the activity are to raise awareness - the importance of recycling (lower energy, oil, water consumption in recycling ...) - to collect as much waste paper as possible.
- used batteries, toners and cartridges. The goals of the activity are collected toners, cartridges and batteries in one place - common removals, collection center - ecological awareness - less waste at school.
- Other activities are: FOOD AND HEALTH / AWARENESS, SUSTAINABLE MOBILITY / AWARENESS, WATER / WATER DETECTIVES, SCHOOL SURROUNDINGS / SCHOOL GARDEN, BIODIVERSITY / DETECTIVES FOR BIODIVERSITY, I CHOOSE HOME, Eco-reading for eco-life, Young environmental reporters, School »VRTilnica«.

In 2019, the National Coordination of the international project "Eco-school as a way of life" announced a competition for creative creation with waste cardboard packaging for milk and juices on the topic of forest animals and plants in the forest and eco vehicles and vessels of the present and future.⁹

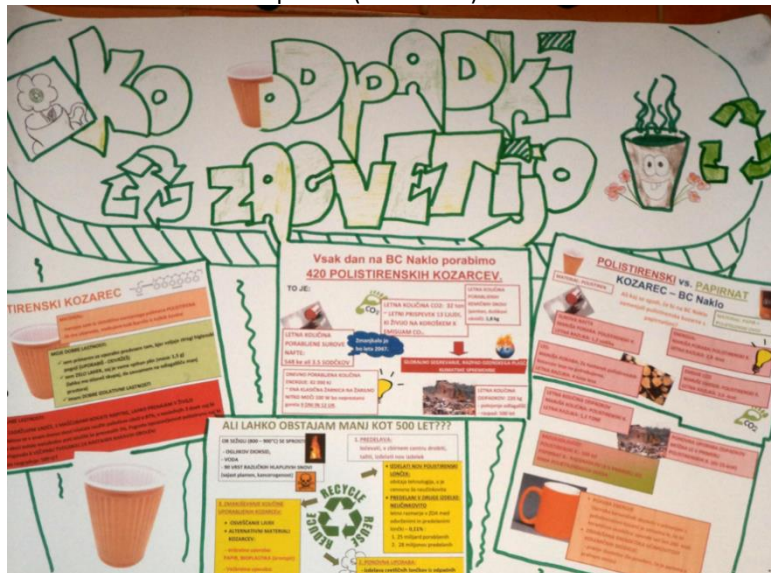


Picture 33. Ekošola, BC Naklo

(Photo source: <http://www.bc-naklo.si/srednja-sola-in-gimnazija/srednja-poklicna-in-strokovna-sola/dejavnosti/ekosola/aktualno/>)

6.1.1 Involvement in projects and cooperation with the environment

The project Teaching Sustainability across Slovenia and Italy (TESSI) in a practical way promotes the concept of sustainable development in secondary schools in the Italian and Slovenian regions. Cross-border competition TESSI - intended for all public and private high schools and their students from the above areas. At the TESSI, cross border AWARD competition, WHEN THE WASTE BLOOMS, we marked the containers with numbers on BC Naklo and diligently counted the discarded plastic polystyrene jars in them for 14 days and displayed the selected results on the poster (Picture 34):



Picture 34: Selected results presented on a poster

⁹ Vir: dostopno na: <http://www.bc-naklo.si/srednja-sola-in-gimnazija/srednja-poklicna-in-strokovna-sola/dejavnosti/ekosola/aktualno/>

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They learned about the materials with which we can replace polystyrene plastic jars. They made bioplastics out of potatoes that could be molded into a jar shape.

- **Inclusion of environmental education in educational programs - Module sustainable development and interdisciplinary integration**

At BC Naklo, secondary vocational education programs (florist, gardener, rural manager, confectioner, baker...) include module - an environmental protection with the basics of sustainable development, while secondary vocational education programs (horticultural technician, agricultural technician, food technician, nature conservation technician) include module - the sustainable development. In both modules, in a theoretical and practical way, they also deal with contents related to the connection between living and user habits and environmental impacts, types of waste and methods of their management, and get acquainted with the recycling and utilization of recycled materials.

In the renewed, modularly designed educational programs in the field of biotechnology, there is a great emphasis on connecting theory with practical exercises and interdisciplinary or. during the modular integration of general and professional content. Examples of such integration at BC Naklo in relation to environmental education are mainly between the sustainable development modules and the English language.

- **Researches and projects**

As part of the educational programs of the vocational high school and secondary vocational school students prepare project assignments with various professional contents.

One such example is the student's project: **Reducing packaging consumption** by finding that more and more people are aware of the importance of recycling and reusing plastic products, but we still throw away far too much plastic. The problem with plastic is that it cannot be fully recycled, and in nature it decomposes over 1000 years. Plastic accumulates in waste, as we throw it away much more than we recycle it.

Student's Project **Excessive use of plastic for water**, where research has shown that people are aware of excessive use of plastic and agree that the use of plastic itself would be reduced. The problem is that reusable bottles are quite expensive (usually around 40 €). The solution to this would be to try to make these bottles accessible to everyone and also promote them appropriately.

Research project **Plogging and care for the environment**, where students find that Plogging is a combination of light running with intermediate collection of waste in nature. It is a form of recreation in which we take care of our own health and the health of nature. It first appeared as an organized activity in Sweden in 2016.

6.2 IES Spain

- **ECOEMBES "Educating in ECO"**

It is important that the students can recycle in their own classroom so that it can become a daily familiar gesture. Hence, recycling bins need to be visible and reachable. Likewise, it is a good idea that these bins are available in the photocopying room and in the school administration office. Ecoembes has supplied our school with yellow bins (plastic packaging, carton and cans), and blue bins (paper and cardboard) (Picture 34). They have been placed all around the school together with the explanatory posters in order to create the school recycling stations.



Picture 34: Recycling bins at IES, Spain

These bins are especially along the corridors, inside the classrooms we have “recycling boxes” (Picture 35) to separate the different types of waste and in the playground the traditional bins have been painted in different colours so that the students can separate the plastic, paper and organic waste.



Picture 35: “Recycling boxes” at IES, Spain

- **ECOEMBES: Documentary “The second opportunity”**

<https://youtu.be/mCo0Yn5p7HE>

The different classes will watch the documentary during the Tutorial period. Its content will be discussed and a list with the correct recycling practices will be made so that they can reflect about the benefits of recycling afterwards. They will also talk about the scope of recycling in our society, pointing out different aspects such as the different types of bins that exist in order to make a correct waste management and what waste should people place in each of them. ➤ In our 1st year of Bachiller (Post Obligatory Secondary Education) students have designed some **posters to encourage and motivate their peers to recycle** (Picture 36).

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Picture 36: A poster made by students to encourage and motivate their peers to recycle

- **CULTURAL WEEK, this year topic : 'Recycling'**
- Games: eco-memory, domino, bingo. All related to the topic of Recycling
- Recycling workshops



Picture 37: Recycling workshops



- **Visiting a Recycling Plant** or recycling station will help both teachers and students to be more informed, concerned and environmentally aware. They will get to know this reality personally since they will be given a guided tour and will be spoken about the challenge of waste in the facilities all adapted to the age of the students. We are convinced this visit will have a high impact on the students who will greatly benefit from it.

- **Proposal of using only sustainable and reusable packaging for the school snacks**

The students are growing and need to eat healthy in the break time as well as when they go home. How about carrying their snacks to school in a Tupperware? Or drinking water from a flask instead of disposable plastic bottles? These would help us not generate waste with the most popular packaging at the moment, plastic or foil paper which last more than 100 years to decompose although they are only useful during the brief period of time which lasts to carry a snack to school.

- **School survey about recycling habits in the school**

Students will prepare a survey to check on the recycling habits in their own homes.

- **Working with newspaper articles to encourage recycling**

Reading and discussion of newspaper articles on the subject of recycling, plastic waste pollution ... in order to reflect in the classroom (Tutorial, Biology, Technology ...).

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6.3 PGMS - Grammar School Nicosia, Cyprus

In our school, through various extra-curricular activities (clubs) as well as during normal school hours, recycling, care for the environment and caution in climate change has been promoted in a great extent. In the following pages, we describe existing clubs and their activities that contribute to student awareness. These are the clubs through which we are planning to enhance with activities to promote plastic recycling and upcycling.

6.3.1 Annual Tree planting event

Every year 200 trees and a variety of herbs are planted to make our schools greener. Students and Teachers from both schools as well as parents participate in this worthwhile event. The aim the tree planting was to battle climate change. This is one of the numerous activities (Picture 38) that both schools organise as participants in various environmental programmes like ECO- SCHOOLS and Climate action, along with thousands of other students from 70 countries around the world.



Picture 38: Annual Tree planting event

6.3.2 Environmental Science Club

The club (Picture 39) aims are to promote environmental awareness among students' main objective is to carry out activities for the ECO school international programme and maintain the GREEN FLAG. In May 2017, The Grammar School was awarded the 'Green Flag' by CYMEPA, an acknowledged symbol of environmental excellence. Since then, the school has maintained the Green Flag and continued to encourage environmental awareness and action through various activities such as tree planting, **recycling of old clothes and PMD on school premises, recycling of batteries at the reception area** among other initiatives.



Picture 39: Environmental Science Club

The Eco-Schools programme also aims to raise students' awareness of sustainable development issues through classroom study, as well as school and community action. It encourages students to take an active role in how their school can operate for the benefit of the environment, highlighting the importance of social values and community action. For this reason, students actively participate in related environmental activities such as the 'Climate Action International Programme' every year.

6.3.3 Animal Planet

Animal Planet (Picture 40) is open for students who care about animals and their quality of life on our Island, as well as for students who are interested in a future career in the veterinary sciences.



Picture 40: Animal Plant

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6.3.4 Social Work

Students contribute to the community's also build organizational social and communicative skills which are invaluable after school. The Social work club (Picture 41) organises the "**Clean the Beach**" event where students get to clean the beach while recycling plastic at the same time!



Picture 41: The Social work club

6.3.5 Young Volunteers

The "Young Volunteers" (Picture 42) is a registered charitable institution and its members are children between the ages of 4-18. The main objective of this organization is to encourage volunteerism with the involvement of the whole family and through this offer community service. The Young Volunteers promotes upcycling of material such as the decoration of glass bottles and reselling them, while offering the proceeds to the children's hospital. Young Volunteers also decorated the Children Hospital with Paintings.



Picture 42: Charitable institution "Young Volunteers"

6.3.6 Plastic Cap competition

Every beginning of the year we ask students to start collecting caps from empty bottles and we create a competition who will collect most caps. Those caps (Picture 43) are then given for recycle in exchange of medicinal instruments/equipment.



Picture 43: Plastic caps

6.3.7 Recycle bins around School

Within school premises we added several locations recycle bins for Cloth – Paper – Glass – batteries. Recycle Bins (Picture 44) can be found both indoor and outdoor in designated areas around the school. By instilling a sense of environmental awareness in pupils, the education industry can inspire children to get involved in other environmentally friendly practices. This can be an attractive factor for the parents of prospective students. In order to encourage children to use these bins efficiently, you could ask pupils to design their own recycling labels to help them easily identify where to put their waste. Children also create their own posters as an additional reminder.

Administration offices and printing room are all equipped with recycle paper bins.



Picture 44: Recycle Bins around School

6.3.8 Environment Week

The purpose of this week (Picture 45) is to raise environmental awareness among the students. The activities of the week included a lecture from the “Cans for Kids” organization representative as well as presentations on “The Endangered Animals of Cyprus” by class 1 students. Moreover, there were various workshops conducted by researchers from the Friends of the Earth Organisation. These included workshops on Sharks, on Biodiversity in the Sea and on Endangered Marine Life.

Furthermore, environment themed projects were placed on display in the school lobby by students.



Picture 45: Environment Week

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6.3.9 Eco-Schools

Grammar School is a certified Eco-School (Picture 46).

Eco-Schools is a fundamental initiative which encourages young people to engage in their environment by allowing them the opportunity to actively protect it. It starts in the classroom where it expands to the school and eventually fosters change in the community at large. Through this programme, young people experience a sense of achievement at being able to have a say in the environmental management policies of their schools, steering them towards certification and the prestige which comes with being awarded a Green Flag. The Eco-Schools programme is an ideal way for schools to embark on a meaningful path towards improving the environment in both the school and the local community while at the same time having a life-long positive impact on the lives of young people, their families, school staff and local authorities.

- **Include Everyone**

Combining learning with hands-on experiences, the whole programme is run according to an all-inclusive, participatory approach involving students, teachers and the local community at large.

- **Motivate**

Eco-Schools challenges students to engage in tackling environmental problems at a level where they can see tangible results, spurring them to realise that they really can make a difference.

- **Improve Attitudes**

Eco-Schools instils in students a sense of responsibility and cultivates a sustainable mindset which they can apply on a daily basis. It equips those involved with the drive to really make a difference and to spread such proactive behaviour amongst family and friends, ultimately passing it on to future generations.

- **Involve Communities**

Eco-Schools places great emphasis on involving the local community from the very beginning. It is anticipated that by doing so, the lesson the students pick up are transferred back into the community where they will take hold and lead to more sustainable, environmentally responsible behaviour patterns.

This year's activities included:

- Organization of the Environment Week
- Projects on endangered animals and plants of Cyprus
- A presentation on the Cyprus Turtle (Department of fishery and Marine Biology)
- A presentation on Cyprus Biodiversity (Institute of Agricultural research)
- ***Recycling of plastic bottles across the school***
- ***Creation of posters on recycling***
- Student presentations on organic farming
- A bazaar with organic food.

- Collaboration with the Robotics Academy to create models of wind energy generators.
- A trip to a Troodos nature trail
- A visit to Kritou Tera on Biodiversity
- Tree planting



Picture 46: Grammar School as a certified Eco-School

6.4 European scope

Directive 94/62 / EC of the European Parliament and of the Council on packaging and packaging waste

This directive aims to limit the production of packaging waste, promote recycling, reuse, and other forms of recovery of this waste, minimizing its impact on the environment with these measures. It also establishes that the Member States must incorporate return, collection and recovery systems in order to achieve the objectives set by the European Union.

Although it was amended by other subsequent directives, introducing nuances and exceptions, the fundamental requirements and the general objectives pursued by this Directive remain in force.

These objectives go in two directions: 1) minimize the environmental impacts associated with packaging and 2) eliminate barriers to trade. To this end, quantified objectives are set to be met by the Member States in relation to the recovery and recycling of packaging waste.

Directive 2004/12 / EC of the European Parliament and of the Council on packaging and packaging waste

In 2004, Directive 2004/12 / CE was approved, which modifies Directive 94/62 / CE and whose main novelty has to do with setting reduction targets (Incinerate) and recycling of plastic containers. more ambitious focused on profitability and energy recovery, they also make their definitions clearer and more specific as well as add more preventive measures against the formation of packaging waste to reduce as far as possible the environmental impact of packaging without questioning its essential functions, such as prevention plans, promotion of reuse, producer responsibility, elimination of heavy metals in packaging, etc.

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Directive 2008/98 / EC on waste

In 2008, Directive 2008/98 / EC on waste was approved, which establishes some important issues that are summarized below: A hierarchy of priorities is established with regard to waste: prevention, reuse, recycling, recovery for other purposes (such as energy recovery) and disposal.

- The concept of "extended producer responsibility" is introduced. It entails the obligation of producers to correctly manage the waste after it has been used and, therefore, to assume the costs derived from the management of this waste.
- It is the Member States who must establish management plans and waste prevention programs in their national territory.
- The recycling and recovery targets to be achieved before 2020 in relation to household waste are updated (50%).

Directive 2015/720 of the European Parliament and of the Council amending Directive 94/62 / EC with regard to reducing the consumption of lightweight plastic bags.

Since directive 94/62 / CE was adopted to prevent or reduce the impact on the environment of packaging and its waste. Although plastic bags are packaging within the meaning of said Directive, it does not contain specific provisions on the consumption of these bags and these in turn produce high levels of dispersed garbage causing pollution in the environment, garbage in water bodies affection in economic activities. Therefore, they must be taken into account in the analysis and strategies for plastics management and in turn commit the countries of the European Union to comply with the established guidelines, guaranteeing reduction measures.

Directive 2018/851 on waste amending Directive 2008/98 / EC

This current modification considers that waste management must be improved and transformed to a more sustainable management in order to protect, preserve and improve the quality of the environment and human health, the established objectives are increased in order to advance in a more ambitious way towards a circular economy modifications that are directly related by the "European Commission Adopts Circular Economy Action Plan" proposed since 2015 and according to this plan includes measures that will help to stimulate Europe's transition towards a circular economy , boost global competitiveness , foster sustainable economic growth and generate new jobs .

The EU Action Plan for the Circular Economy establishes a concrete and ambitious program of action, with measures covering the whole cycle: from production and consumption to waste management and the market for secondary raw materials and a revised legislative proposal on waste. (European Commission, 2020) this plan seeks to ensure that the economy is fit for a green future and strengthen competitiveness while protecting the environment. It introduces legislative and non-legislative measures and target areas where action at the EU level brings added value.



The first-ever European Strategy for Plastics in a Circular Economy adopted on January 2018 will transform the way plastic products are designed, used, produced and recycled in the EU. Better design of plastic products, higher plastic waste recycling rates, more and better quality recycles will help boosting the market for recycled plastics. It will deliver greater added value for a more competitive, resilient plastics industry. all this just to “prepare a strategy addressing the challenges posed by plastics throughout the value chain and taking into account their entire life-cycle”. In 2017, the Commission confirmed it would focus on plastics production and use and work towards the goal of ensuring that all plastic packaging is recyclable by 2030. European Commission (2018).

Given this strategy, the 2018 amendments to Directives 2018/850 arise, modifying Directive 1999/31 / EC on the dumping of waste. Directive 2018/851 amending Directive 2008/98 / EC on waste. Directive 2018/852 amending Directive 94/62 / EC on packaging and packaging waste.

Directive 2019/904 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on reducing the impact of certain plastic products on the environment

Through all the strategies so far named by means of directives of the European Parliament and plans of the European Commission, directives are increasingly being reached that aim to prevent and reduce the impact of plastic products on the environment, in particular the aquatic environment, and human health, as well as promoting the transition to a circular economy with innovative and sustainable business models, products and materials, thus also contributing to the efficient functioning of the internal market.

With the 2019/904 directive it is sought not only to modify but also to correct the directives 94/62 / CE and 2008/98 / CE since if they come into conflict it will be the first one that will prevail, being 2019, setting reduction objectives of consumption of plastic products thinking about the future 2026-2030 and also restricting the introduction of single-use plastic products to European markets and the responsibility of the producer will have extended liability regimes and will have to cover costs of awareness, collection of discarded products, transport and treatment, cleaning of scattered garbage, among others.



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CONCLUSION

The topic of plastic overuse and environmental impact is one of the most pressing issues of today. In order to reduce the use of plastics and stop climate change, it is necessary for all subjects of the social community to get involved. What has proven to be the best solution is education, primarily for children and youth. As much as it is talked about, it is evident that high school students still lack awareness of the problem we are facing, so they need this Intellectual output as it has been concluded in the needs analysis with the schools in the partnership. This intellectual output (IO1) refers to high school teachers.

What is most important is that together with the teachers we create an active community that will fight against plastic waste and climate change. Teachers are the ones who should teach and encourage students to think critically, broaden their horizons and bring them closer to this topic in a creative way.

The output consists of the systematization of the methodological tool, practical actions and best practice experiences developed by the non-High Schools regarding use of plastics and the effects it has on climate change.

This manual integrates technical knowledge in five main blocks or modules.

- The first part refers to the general information about plastic related to the production and widespread use of plastics.
- The second part covers plastic waste, covering the impact it has on the entire planet.
- The third part describes how plastic waste could be reduced, mostly referring to recycling and reuse.
- In the fourth part, a link is made between the use of plastics and climate change.
- The fifth part, as a concluding part, contains active strategies for secondary schools.

This intellectual output is designed for teachers in order to increase their knowledge about environmental hazards of plastic. Each teacher can choose an active strategy in accordance with their lectures, school opportunities and needs.

This output is innovative, because it systematically addresses the whole issue of plastic and then its impact on climate change. It is designed in such a way that it can be easily implemented by teachers in secondary schools. The guidelines link different sectors of society, including technical knowledge, common definitions, scope and innovative methodologies. Moreover, it includes examples of practical activities and project ideas in order to put this into the classroom.



Source: <https://www.dw.com/en/learningpack-plastic/a-42272672>



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