November 2023. Technological Report

Plastix

Study of the plastic sector in the 6 project regions

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Generalitat de Catalunya
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PLASTIX. A Technological Snapshot

ACCIÓ
Government of Catalonia

Prepared by
ACCIÓ's Strategy and Competitive Intelligence Unit

Barcelona, November 2023

1. Preface

- Interreg Europe / Plastix
- Project goals
- Methodology

Interreg Europe / Plastix

An interregional cooperation project for improving **circular economy** policies

GREEN

€ 1.30 M EU FUNDING

Mar 2023
May 2027

Project Partners

The Baltic Institute of Finland (FI)
Council of Tampere Region (FI)
Catalan Agency for Business Competitiveness (ACCIO) (ES)
Province of Fryslân (NL)
Faculty of Environmental Protection (SI)
Värmland - Paper Province (SE)
Intelligent Factory Lombardy Cluster (AFIL) (IT)
Development Agency of Savinja-Šalek Region (SI)

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This report is a baseline analysis document of the plastics and recycling sector in the regions that are part of the Interreg PLASTIX project.

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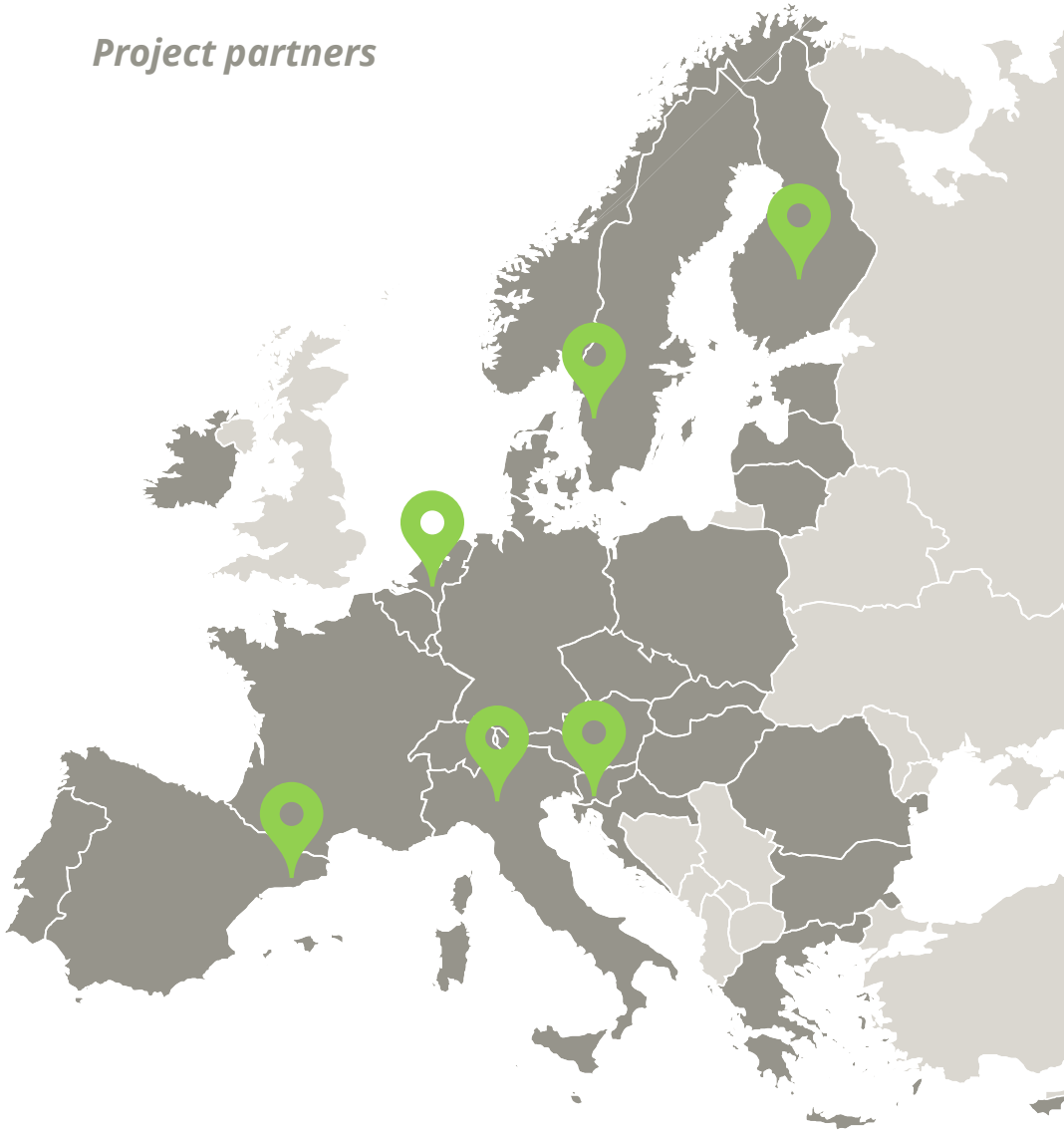

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Project goals

PLASTIX support the transition towards a resource-efficient economy, circular economy growth and eco-innovations in participating regions by addressing the reusability, recyclability and replaceability of plastics.

The project tackles the growing problem of plastic waste, its recyclability and its replaceability as a part of the transition towards a more circular economy.

All European regions are facing similar plastics challenges: consumption of huge amount of plastics, their recyclability, reusability and replaceability with bio-based raw materials, as well as microplastics are issues that need to be solved. Furthermore, waste plastic also causes climate change.

European regions play an important role in responding to the plastics challenges by tailoring their policies and innovation and sustainability investments towards a more sustainable and circular plastic economy and related regional innovation and natural ecosystems.

By identifying good practices and novel solutions through interregional exchange and co-creation, the project aims at helping regional policy makers to improve and create policy mechanisms which facilitate industrial transition towards a resource-efficient economy. As the main result of the project, the addressed regional policy instruments are improved to better - and faster - facilitate the shift towards a society where plastic use is sustainable.

Methodology

To carry out the study, different databases and reports from European and international associations and organizations such as Plastic Europe, Bio Plastic Europe, directives of the European Union, UN, and UNESCO, among others, as well as scientific articles related to plastic recycling technologies have been consulted.

A survey has been carried out in the participating regions (Catalonia, Fryslân, Lombardy, Savinja-Šalek Region, Tampere Region, Värmland), gathering information on the state of the art in their respective territories.

Data has been collected to size the sector, as well as the policies and strategies that support the transition towards a circular economy, the opportunities and challenges, and success stories or good practices.

With these data, the aim is to facilitate the exchange of ideas, benchmarking, and co-creation to formulate solutions and improvements on the path to circularity.

2. Definitions

- Definition of polymers
- Definition of plastics
- Bio-based plastic

Definition of polymers

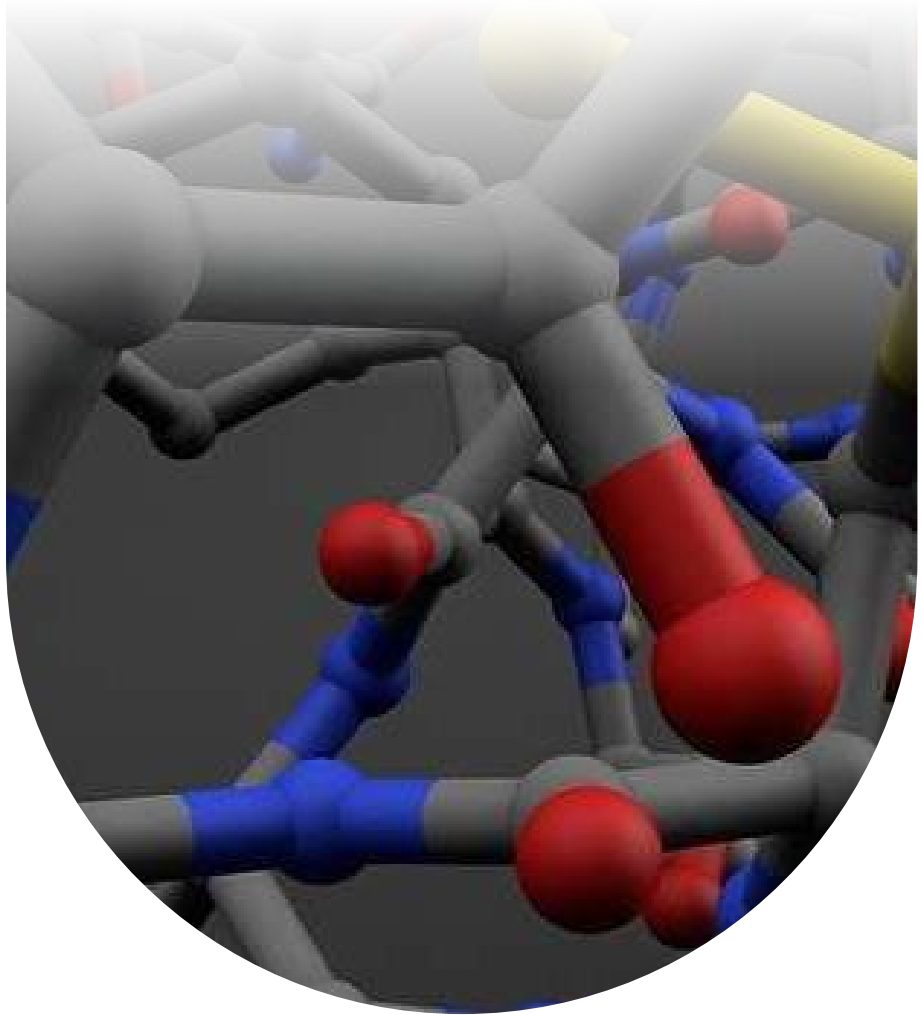
Polymer, any of a class of natural or synthetic substances composed of very large molecules, called macromolecules, that are multiples of simpler chemical units called monomers.

- The word polymer designates an unspecified number of monomer units. The process by which simple molecules get converted into polymers is known as polymerisation.

- There are two types of polymers: synthetic and natural. Synthetic polymers are derived from petroleum oil and made by scientists and engineers. Examples of synthetic polymers include nylon, polyethylene, polyester, Teflon, and epoxy. Natural polymers occur in nature and can be extracted. They are often water-based. Examples of naturally occurring polymers are silk, wool, DNA, cellulose and proteins.

- Today, synthetic polymers are being used to emit light, act as semiconductors in low-cost printable devices, as light weight materials for bullet proof vests (where the fibers are stronger than steel), in medicine to deliver drugs, as artificial skin and for many other applications that were not imagined just a few years ago. Rapid advances in polymers are enabling the nanotechnology revolution.

- Synthetic polymers now constitute one of the most successful and useful classes of materials and possess a broad range of physical properties.



Source: IEA, 2021

Definition of plastics

Plastics are semi-synthetic organic materials that come from oil or petroleum.

They are routinely labeled as polymers.

Plastics are produced by condensation and addition polymerization reactions.

They are classified either as thermosetting polymers or thermoplastic polymers.

- Thermosetting polymers solidify into a permanent design and shape.
- Thermoplastic polymers can be heated and remolded for an unlimited amount of time

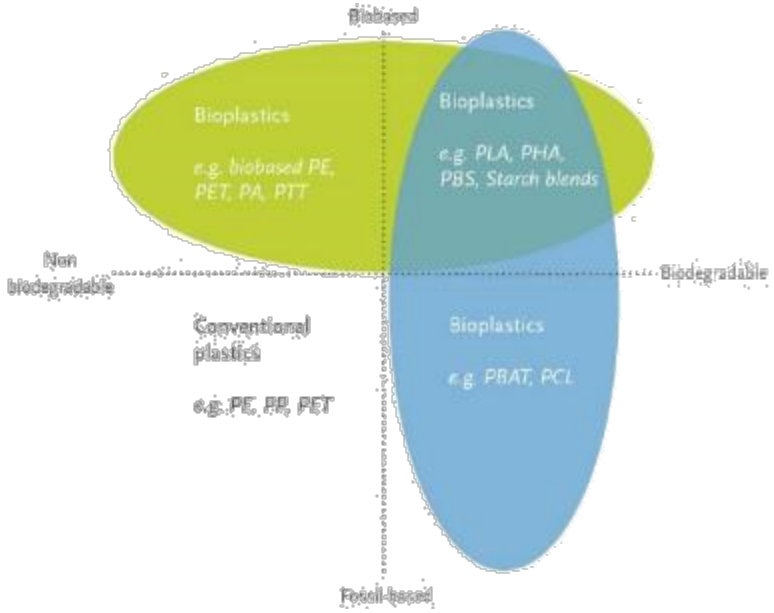
Plastics are used in a wide variety of products and have displaced other materials -such as wood, metal, and glass- that were previously used for the applications that plastics now dominate.

The production of plastic requires four basic steps: the acquirement of raw material, synthesizing a basic polymer, compounding the polymer into a usable fraction, and lastly, molding or shaping the plastic.

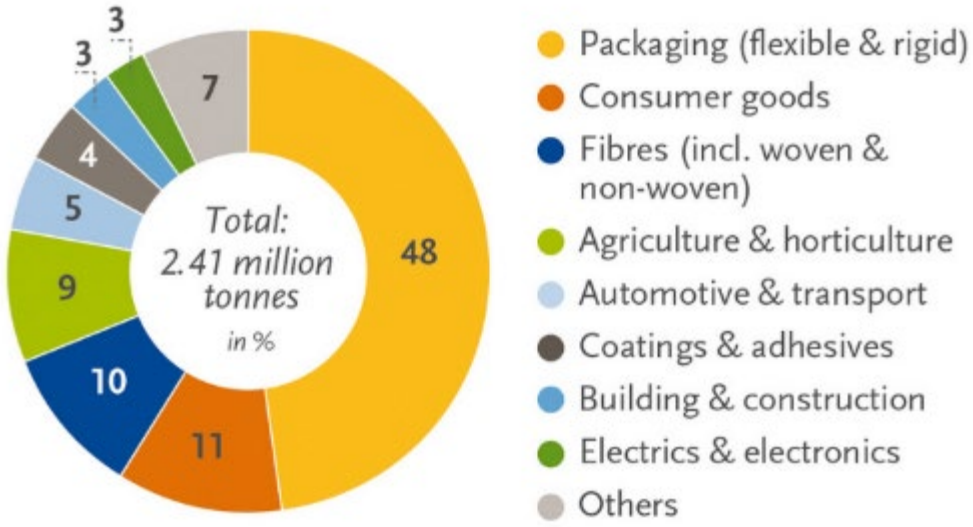
Sources: Source: Britannica, Carnegie Mellon University, IUPAC

Bio-based plastic

Bioplastics are not a single material. With this name, a series of materials are known that may or may not be biodegradable and are based on products of biological origin such as plants, cellulose, etc...



Global production capacities of bioplastics in 2021 (by market segment)



However, the production of bioplastics represents about **1%** of the total annual production of plastic, although it is forecast to increase in the coming years. Its applications can be found in different market segments, mainly packaging, agriculture, electronics and automobiles, as well as some household products.

Source: Bioplastic Europe 2022

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3. Plastics & Polymers applications

- Demand for plastics by type of resin
- Plastic and polymer applications
- Importance of plastics for the industry

Demand for plastics by type of resin

Bio-based plastic: based on products of biological origin such as plants, cellulose, etc...

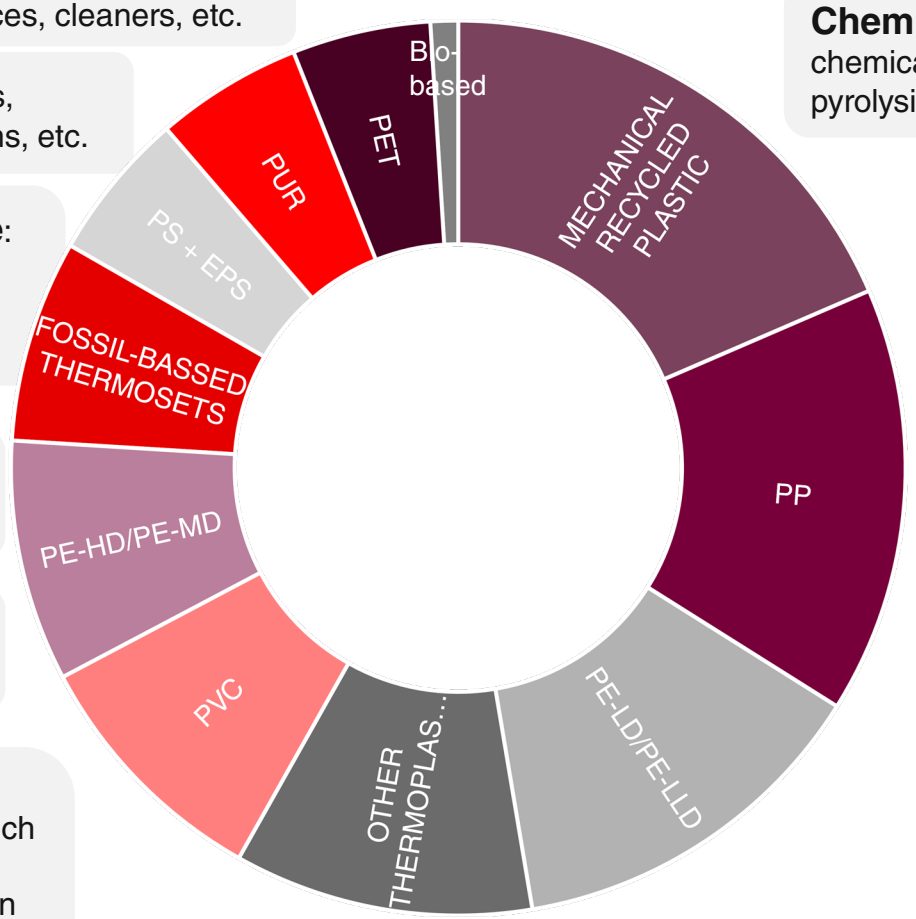
Polyethylene Terephthalate: bottles for water, soft drinks, juices, cleaners, etc.

Chemical Recycled plastics are produced from chemical process (depolymerisation including solvolysis, pyrolysis, or gasification).

Polyurethanes: building insulations, pillows and mattresses, insulating foams, etc.

Polystyrene + Expanded polystyrene: food packaging (dairy, fishery), building insulation, electrical & electronic equipment, inner liner for fridges, eyeglasses frames, etc.

Mechanical Recycled plastics are produced from waste via physical (mechanical, dissolution)



Polypropylene: food packaging, sweet and Snack wrappers, hinged caps, microwave containers, pipes, Automotive parts, bank notes, etc.

High-density polyethylene / Medium-density polyethylene: toys, milk bottles, cosmetic bottles, houseware, etc.

Polyvinyl chloride: window frames, profiles, floor and wall covering, pipes, cable insulation, garden hoses, inflatable pools, etc

Polyethylene Low density / Linear low-density polyethylene: reusable bags, health and disinfection, trays and containers, agricultural film, food packaging film, etc.

Other thermoplastics: hubs caps (ABS), optical fibers (PBT), roofining sheets (PC), touch screens (PMMA), cable coating in telecommunication (PTFE); and many others in aerospace, medical implants, surgical devices, membranes, valves, & seals, protective coatings, etc., synthetic rubber

Source: EIC, Plastic Europe 2023

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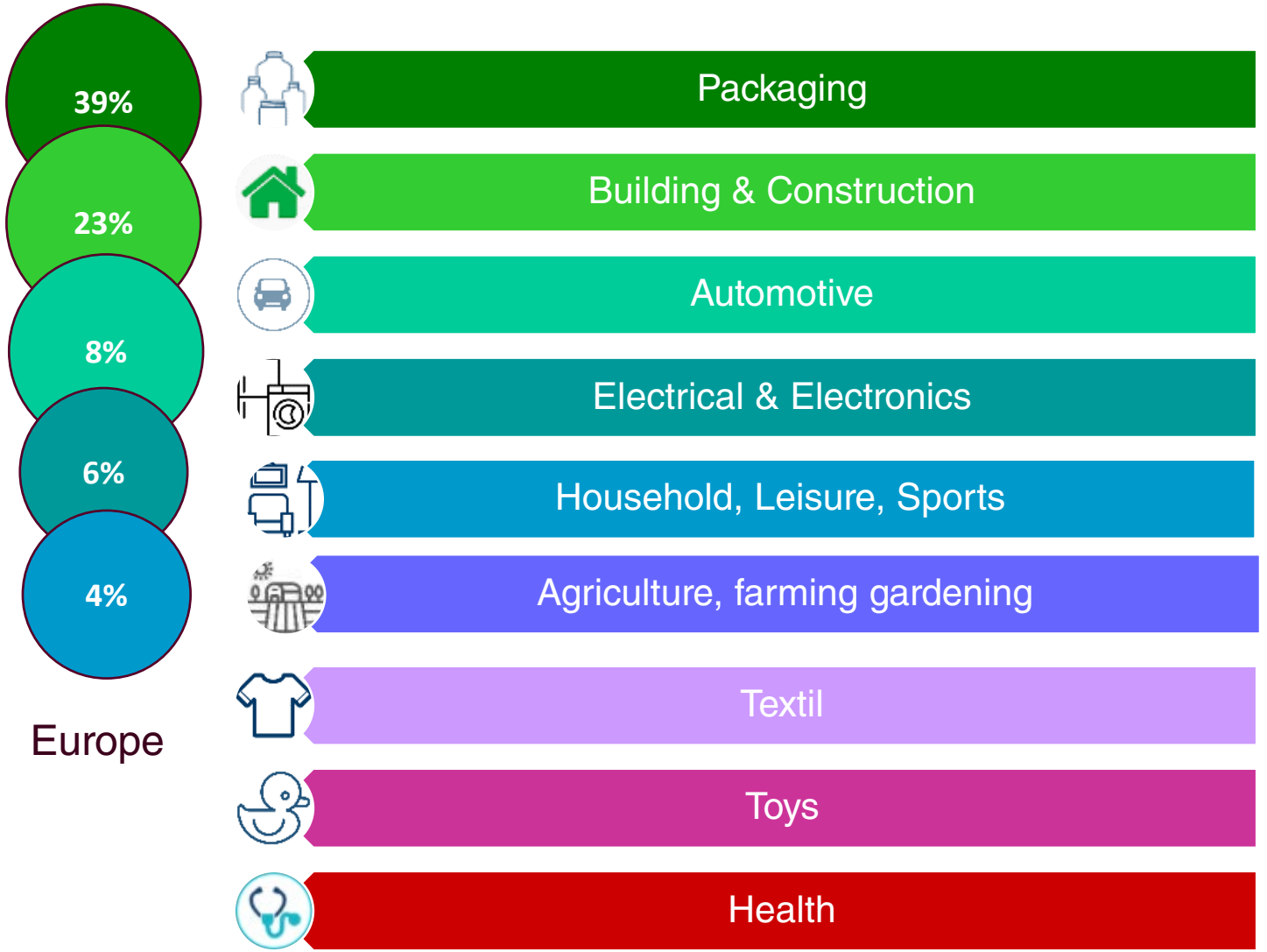
Plastic and polymer applications



Source: EIC, Plastic Europe 2023

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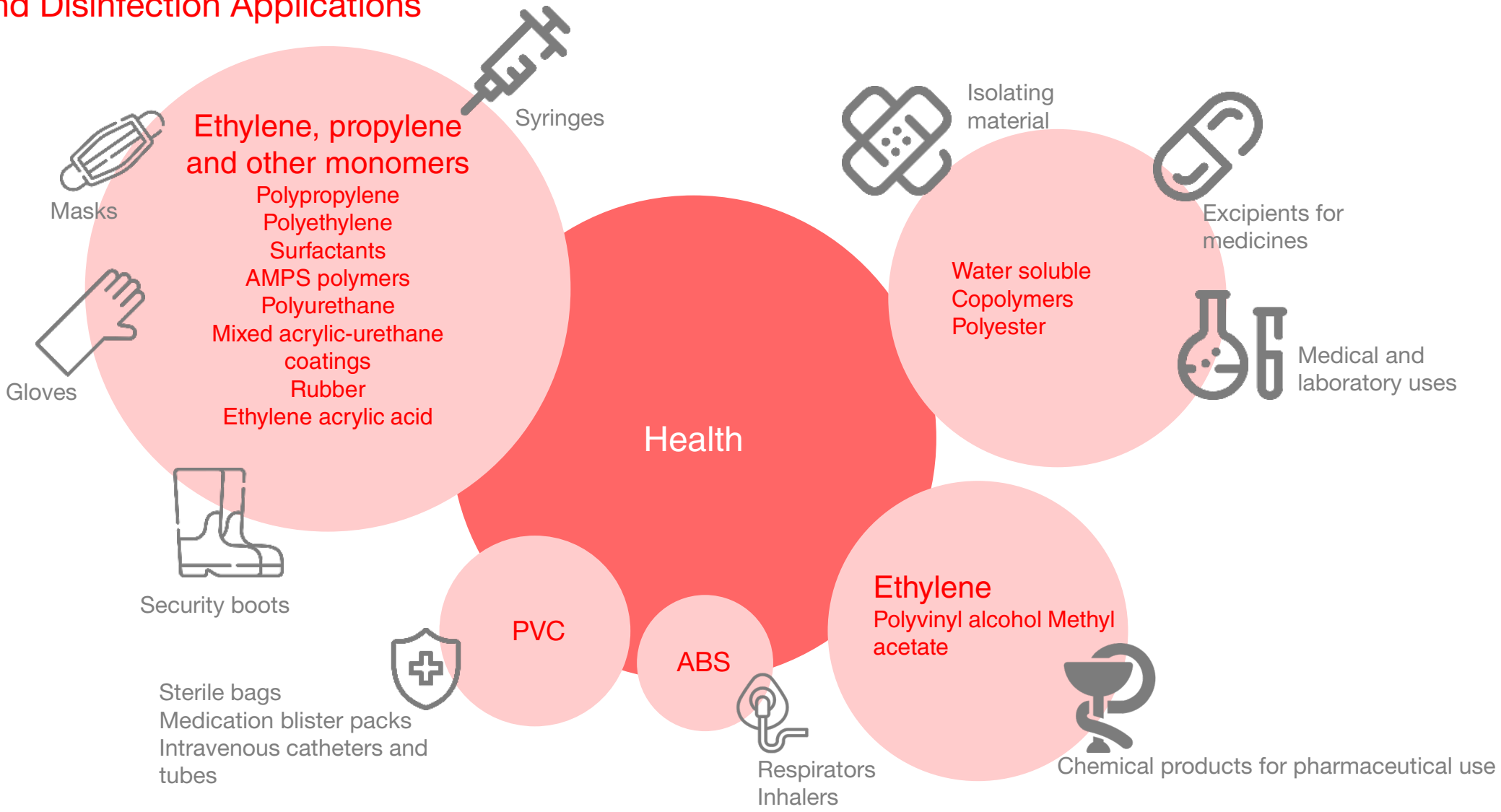
Health and Disinfection Applications



Source: AEQT

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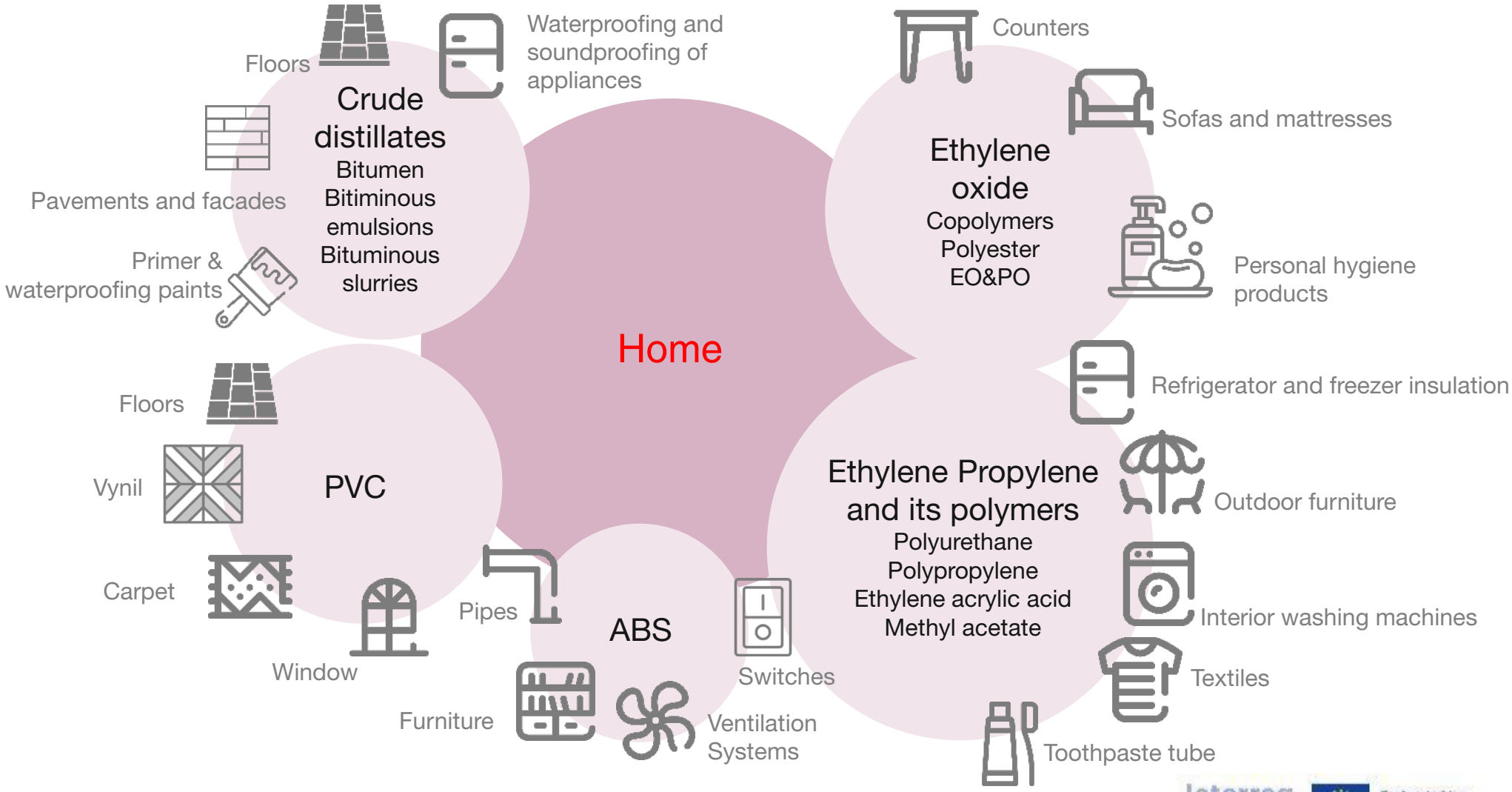
Materials for furniture and home



Source: AEQT

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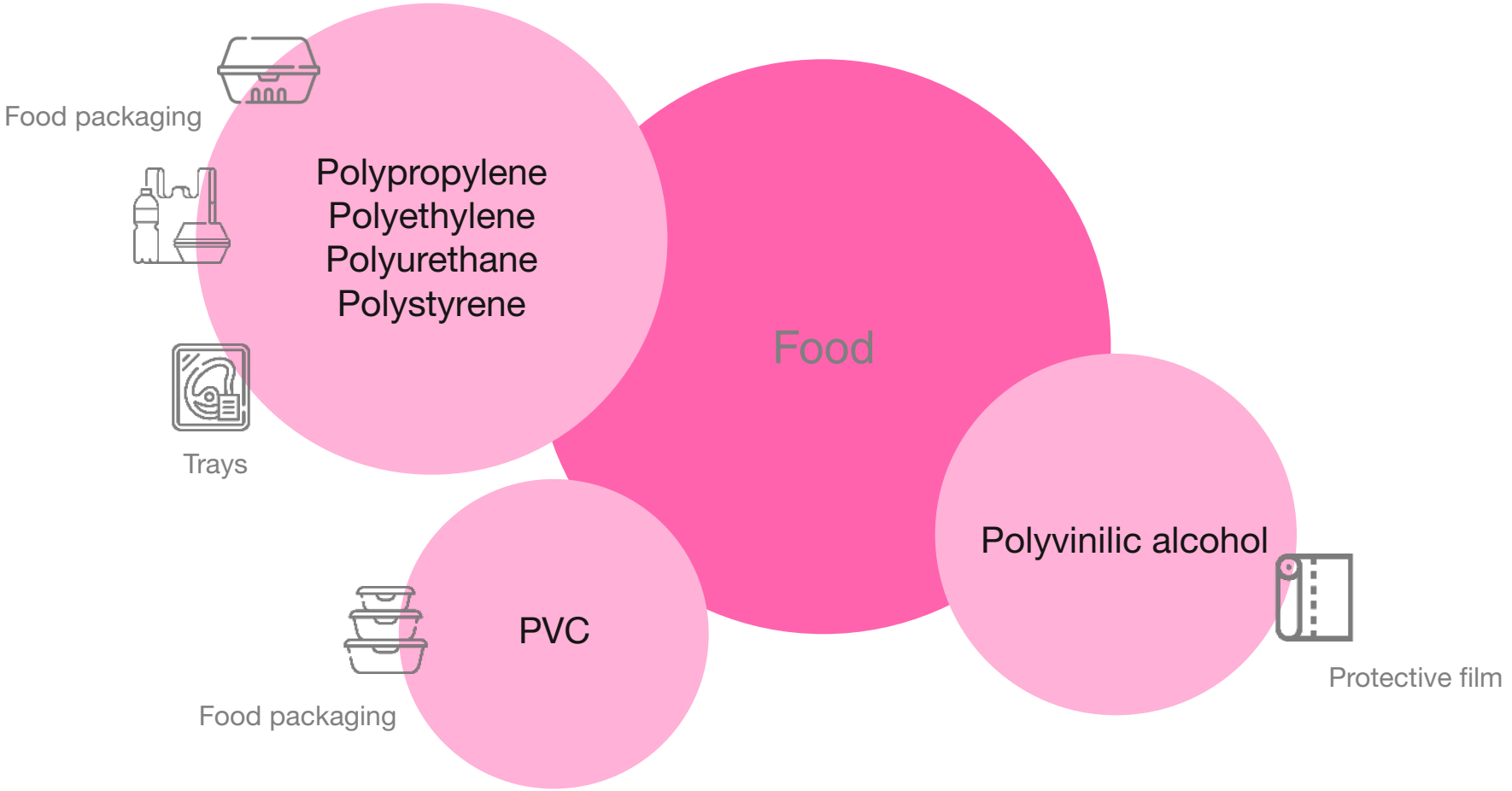
Food Applications



Source: AEQT

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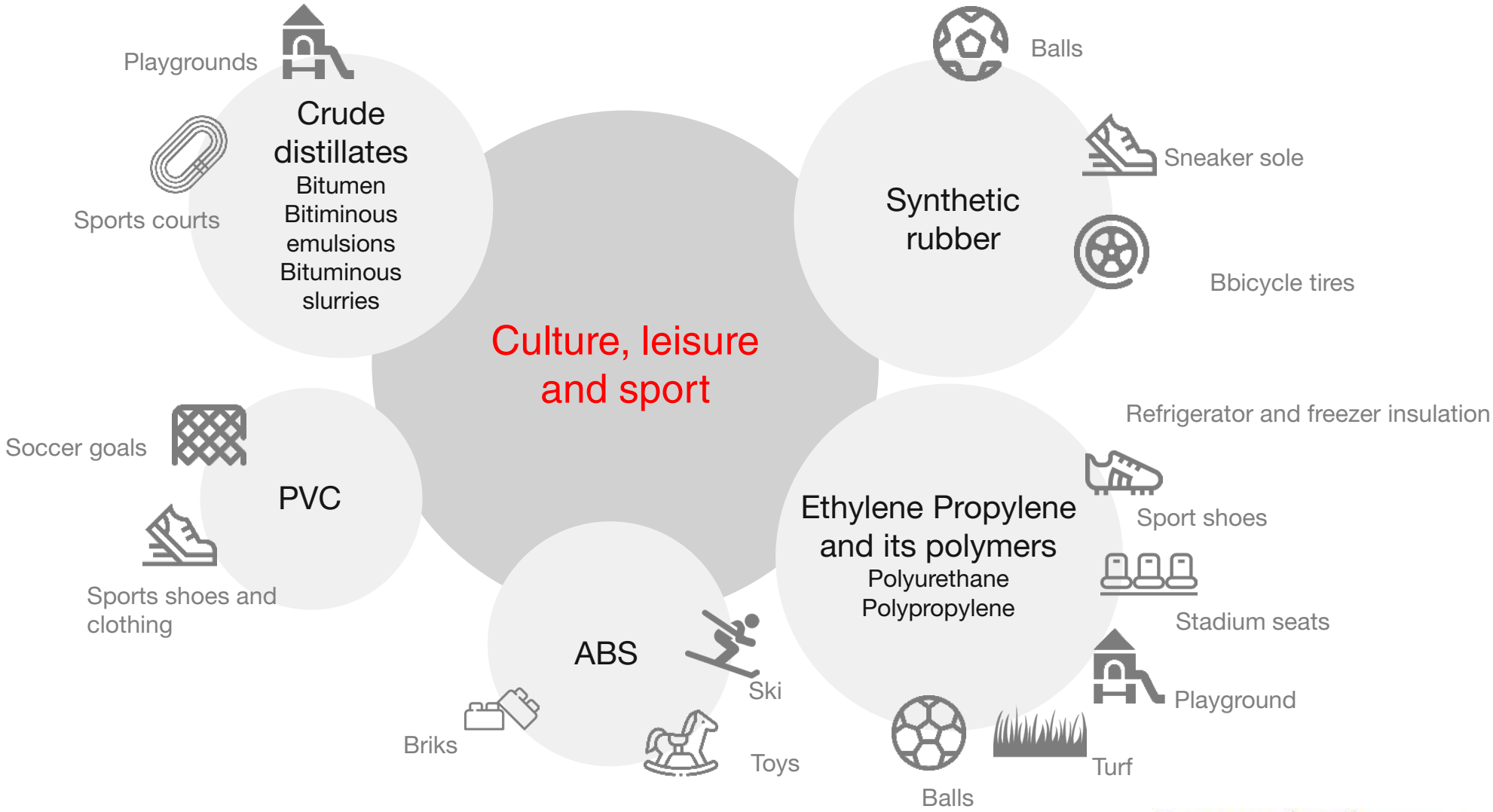
Culture, leisure and sport



Source: AEQT

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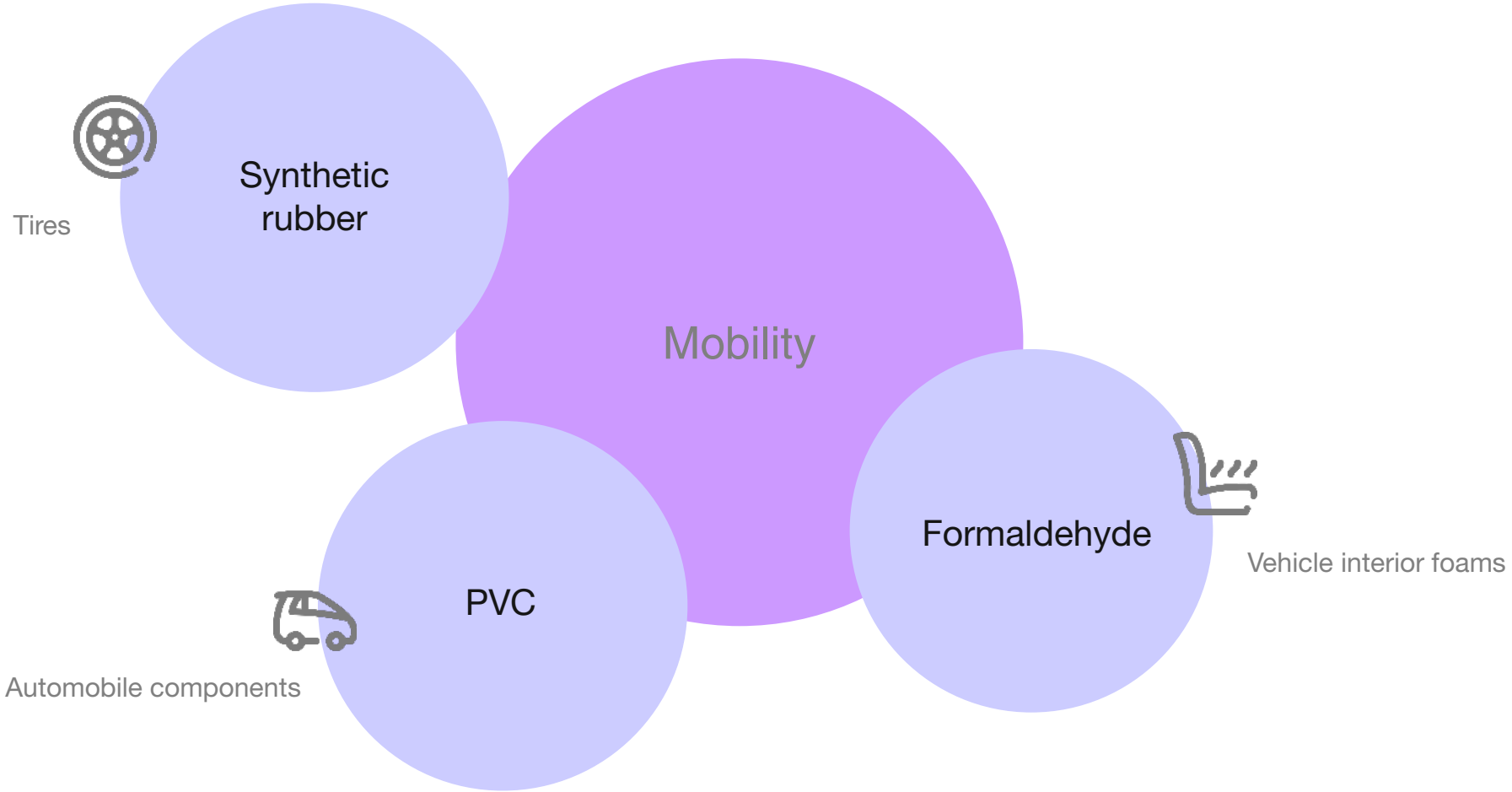
Mobility Applications



Source: AEQT

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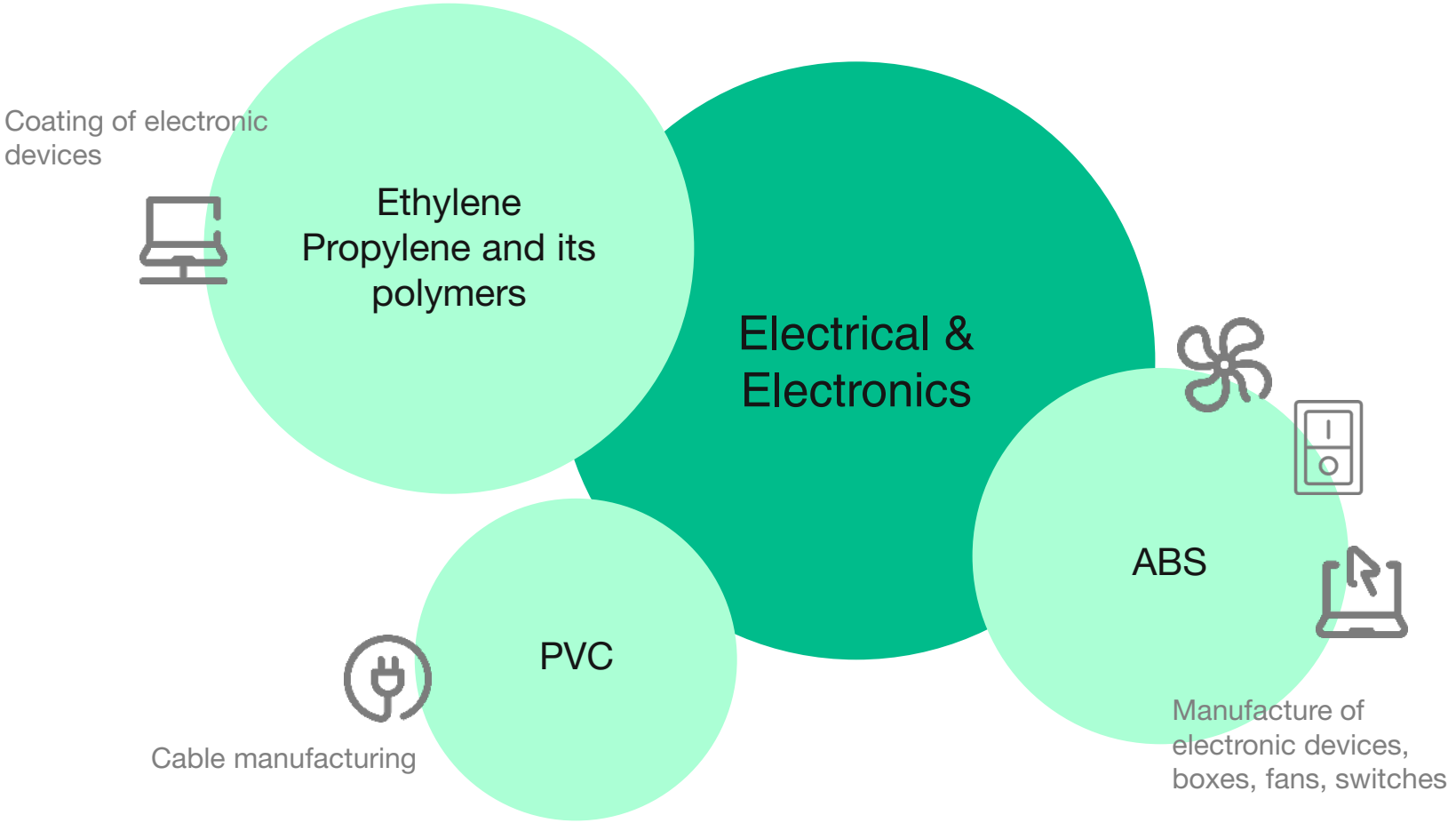
Electrical & Electronics Applications

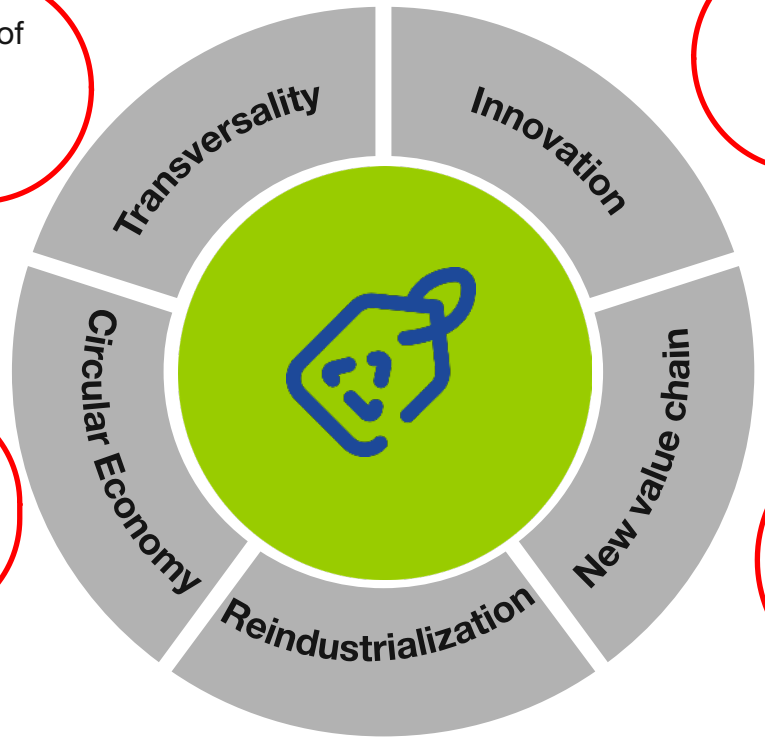


Source: AEQT

Importance of plastics for the industry

Plastics find application in a wide variety of sectors and applications, from packaging and construction to healthcare and electronic applications.

The development of New Plastics and more sustainable materials throughout their entire life cycle is a source of innovation and requires research in order to overcome technical and regulatory challenges.



The optimization of the use of plastics, as well as their recycling and reuse, are of great importance to avoid the contamination of seas and terrestrial ecosystems.

The development of new processes and production routes, eliminating the dependency on materials of fossil origin, causes the value chains to be modified, incorporating new actors and raw materials.

Bioeconomy and waste to chemicals processes can favor the reindustrialization of certain regions.

Source: ACCIÓ

4. EU Policy

- European strategy for plastics in a circular economy
- Single-use plastics
- New Action Plan for the Circular Economy
- EU Initiatives

EU initiatives

The European Union has committed to the circular economy and the green transformation

European strategy for plastics in a circular economy	A vision for a smarter, more innovative and sustainable Europe and which goes from design to production considering the needs of reuse, repair and recycling.
Single-use plastics	Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment
EU Mission: Restore our Ocean and Waters	Address to protect and restore marine and freshwater biodiversity and ecosystems, eliminate pollution, and make the blue economy carbon-neutral and circular.
A European Green Deal	The European Commission has adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.
Restricction of microplastics	On September 27, 2023, the European Union (EU) issued Commission Regulation (EU) 2023/2055 to regulate synthetic polymer microparticles ('microplastics') as substances on their own and in mixtures. The provisions in the new law will be implemented in phases, starting October 17, 2023.

Source: own elaboration

European strategy for plastics in a circular economy

Plastics and polymeric materials are essential in our daily lives, but as they are produced and used, they represent a great challenge due to the large volume of waste generated.

This has led the European Union to present a new strategy on plastics, which reflects a vision for a smarter, more innovative and sustainable Europe and which goes from design to production considering the needs of reuse, repair and recycling.

Other voices such as the Ellen Macarthur Foundation have also joined this strategy, which proposes a new economy for more circular plastics.

http://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf

Source: European Commission, ACCIÓ

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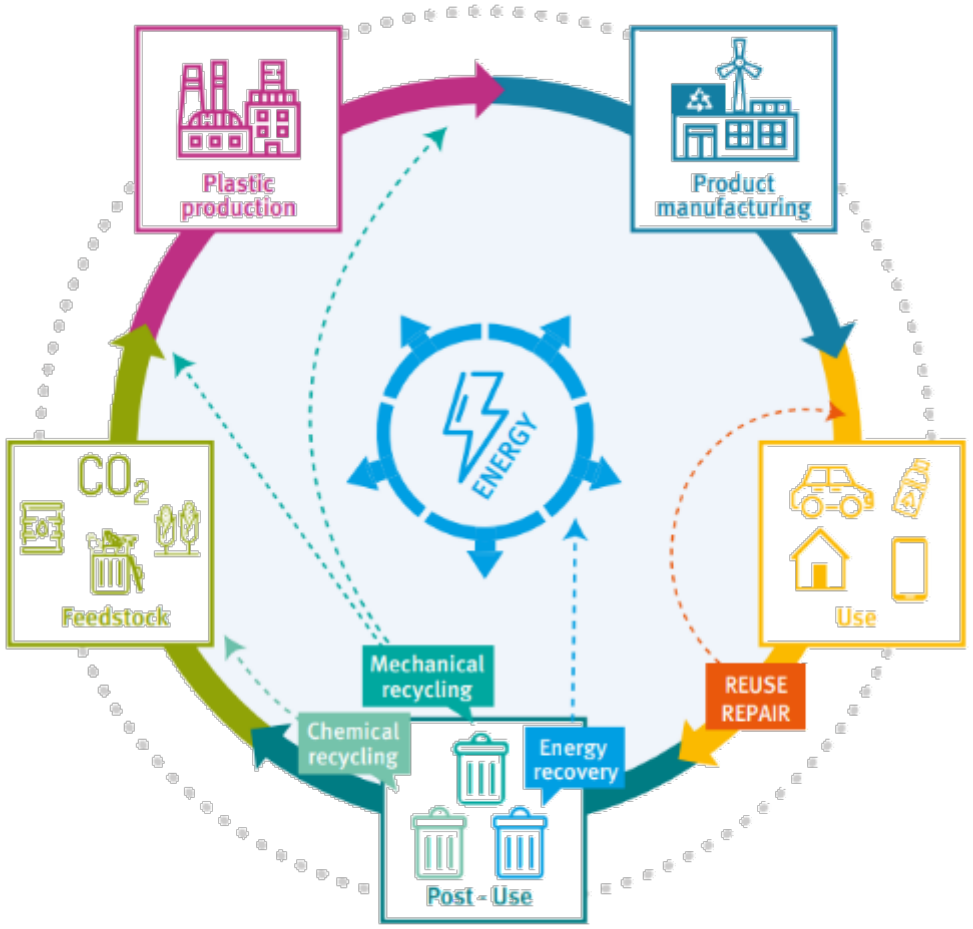
European strategy for plastics in a circular economy: the way forward

1. **Improve the economy and quality of plastic recycling.**
   a. Design for recyclability
   b. Boost demand for recycled plastics.
   c. Better and more harmonized separate collection and sorting.

2. **Stop plastic waste and littering**
   a. Prevention of plastic waste in our environment.
   b. Establish a clear regulatory framework for plastics with biodegradable properties.
   c. The growing problem of microplastics.

3. **Promote investment and innovation towards circular solutions**.
   a. Innovation is a key enabler for the transformation of the plastics value chain.
   b. EU research funding will support all these efforts

4. **Leveraging global action**
   a. The EU will continue to support international action.



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Single-use plastics

Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment

EU rules on single-use plastic products aim to prevent and reduce the impact of certain plastic products on the environment, in particular the marine environment, and on human health.

10 items

- Cotton bud sticks
- Cutlery, plates, straws and stirrers
- Balloons and sticks for balloons
- Food containers
- Cups for beverages
- Beverage containers
- Cigarette butts
- Plastic bags
- Packets and wrappers
- Wet wipes and sanitary items

Measures

1. Reducing consumption through awareness-raising measures
2. Introducing design requirements, such as a requirements to connect caps to bottles
3. Introducing labelling requirements, to inform consumers about the plastic content of products, disposal options that are to be avoided, and harm done to nature if the products are littered in the environment
4. Introducing waste management and clean-up obligations for producers, including Extended Producer Responsibility (EPR) schemes

Targets

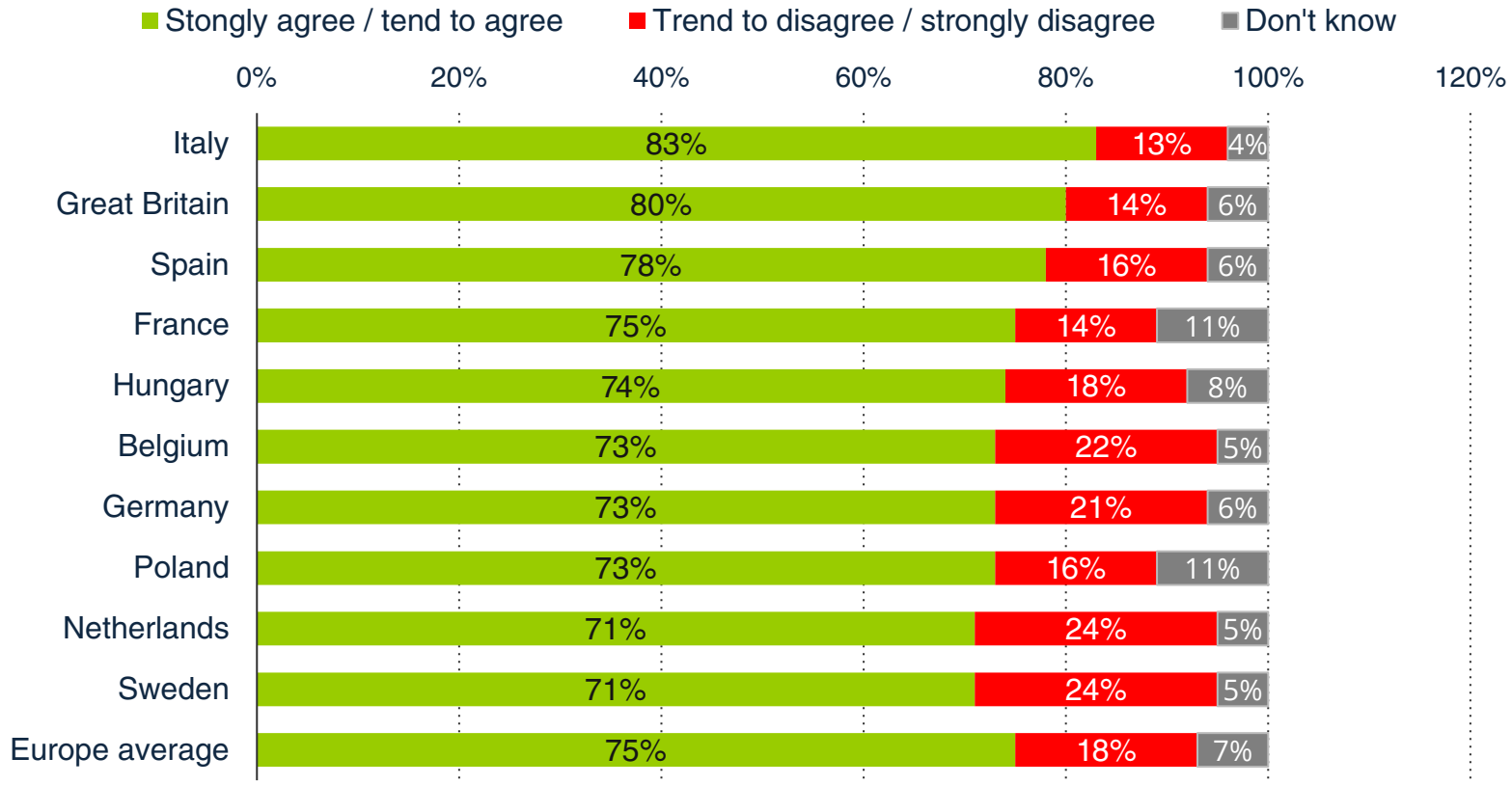
- a 77% separate collection target for plastic bottles by 2025 – increasing to 90% by 2029
- incorporating 25% of recycled plastic in PET beverage bottles from 2025, and 30% in all plastic beverage bottles from 2030

Source: EU

Opinions on banning single-use plastics in Europe 2021, by country

- On average, three-quarters of adults in Europe agreed that single-use plastics should be banned as soon as possible. The strongest support was in Italy, where 8% of respondents agreed that single-use plastics should be banned as soon as possible.

- Several of the largest single-use plastic waste generating countries are located in Europe, including the United Kingdom, France, Germany, and Spain.



Source: Statista

New Action Plan for the Circular Economy

Plastic consumption is expected to double in the next 20 years.

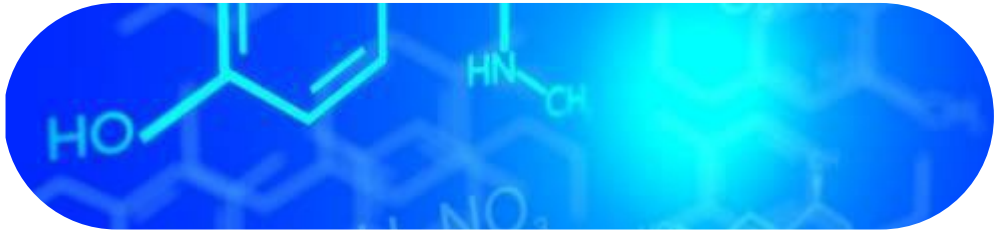
Comisión Europea

To increase the circulation of recycled plastics and contribute to a more sustainable use of plastic in general, the Commission will propose mandatory requirements for recycled content and waste reduction measures for several key products, such as packaging, construction materials and vehicles.

Application for OCS certification to all companies in the value chain.

Microplastics in the environment:

- restriction of deliberately added microplastics and management of plastic granules.
- development of labeling, standardization, certification and regulation measures for the unintentional release of microplastics, including those aimed at increasing the uptake of plastic microparticles at all relevant stages of the product life cycle;
- further development and harmonization of measurement methods for microplastics;
- reducing gaps in scientific knowledge about the risk and presence of microplastics in the environment, drinking water and food.



EU Initiatives

European Commission

European Commission Strategy

A European Green Deal

A Europe fit for the digital age

Research & Development

30% of the EU budget 21-27: €1,824 b.

United Nations Conference on Climate Change

Source: Informe Economia Circular a Catalunya, ACCIÓ

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EU Mission: Restore our Ocean and Waters

- With a 2030 target, **the EU** Mission **"Restore our Ocean and Waters"** aims to protect and restore the health of our ocean and waters going beyond research and innovation and involving the digital ocean and water knowledge system and broad public mobilisation and engagement.

- The Mission's new approach will address the ocean and waters as one, from rivers to the seas and ocean and will protect and restore marine and freshwater biodiversity and ecosystems, eliminate pollution, and make the blue economy carbon-neutral and circular.

- The Mission supports the "lighthouses" in major sea and river basins: Atlantic-Arctic, Mediterranean Sea, Baltic-North Sea, and Danube-Black Sea. The lighthouses are sites to pilot, demonstrate, develop and deploy the Mission activities across EU seas and river basins.

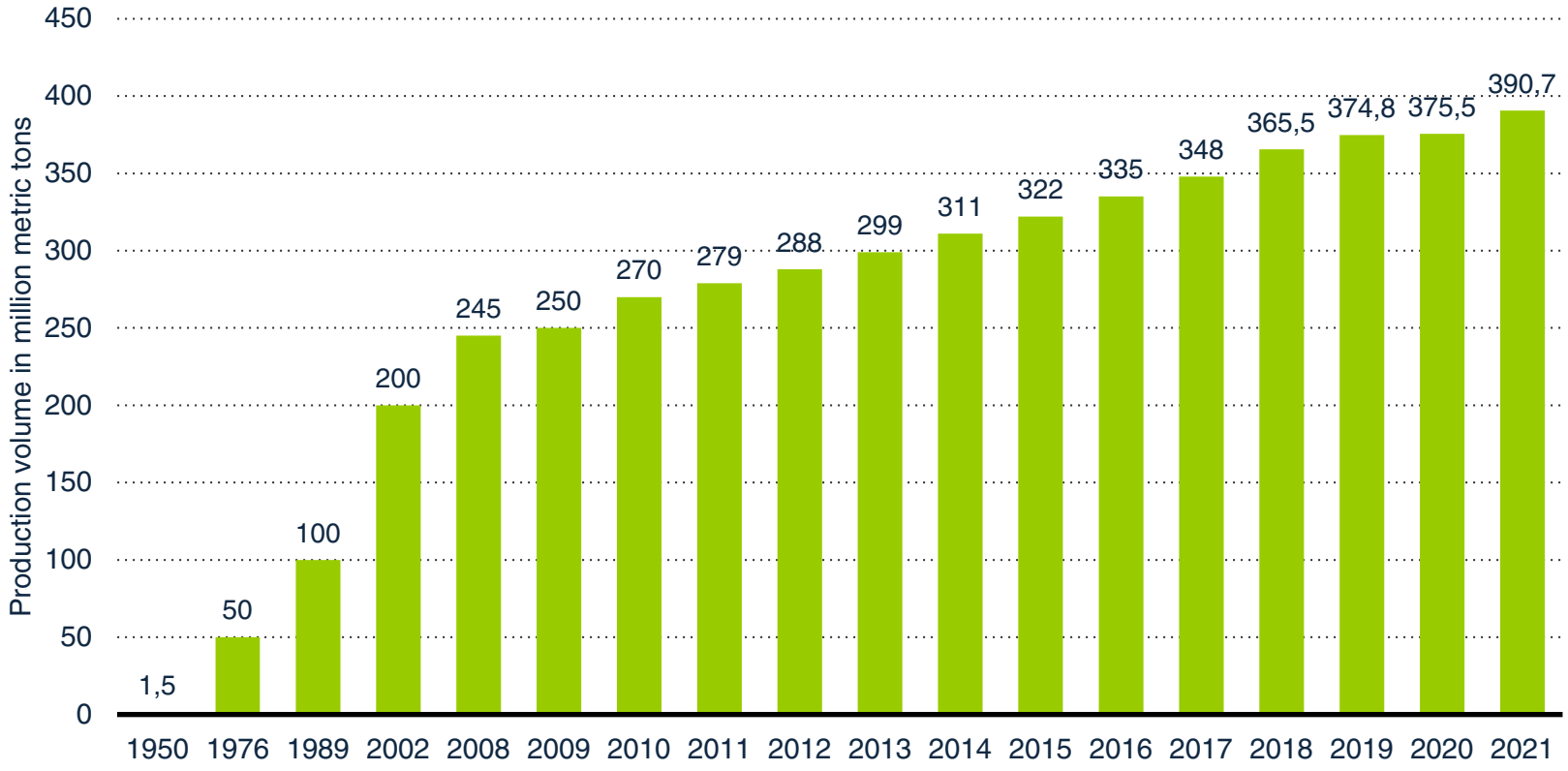
5. Main data. World

- Global plastic production
- Plastic production growth worldwide vs population growth
- Market size value of plastics
- Plastic material production by region
- Production forecast of plastics
- Manufacturing turnover of plastic packing goods
- Leading companies in the world

Annual production of plastics worldwide from 1950 to 2021 (in million metric tons)

Global plastic production 1950-2021

- **Global plastics production was estimated at 390.7 million metric tons in 2021**, an annual increase of 4%.
- Plastics production has soared since 1950s.
- Global plastic production has almost doubled since the turn of the century.
- Plastic production is set to continue growing due to rising populations, increased buying power, and further demands for plastic goods.
- The incredible versatility of this group of materials accounts for the continued growth in production year after year.
- In tandem with that growth, the market value of plastics also continues to grow.

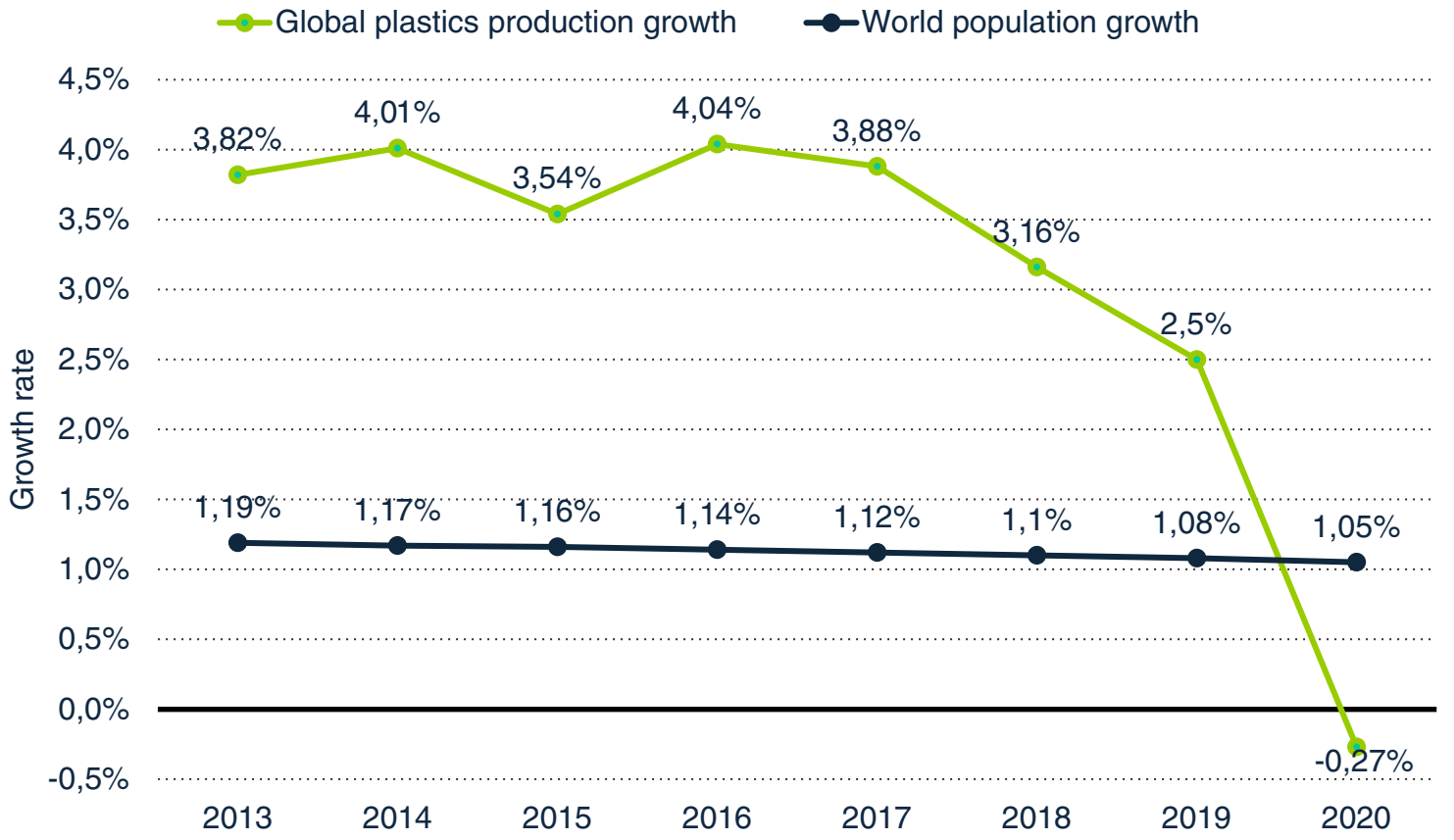


Source: Statista

Plastic production growth worldwide compared to global population growth rate from 2013 to 2020

Plastic production growth worldwide vs population growth worldwide 2013-2020

- Annual increases in global plastics production consistently outpaced population growth between 2013 and 2019.
- In 2019, the global population increased by 1.08% while plastic production increased 2.5 %.
- However, in 2020 the outbreak of COVID-19 caused plastics production to fall 0.27 % year-over-year, whereas the global population grew 1.05% that year.

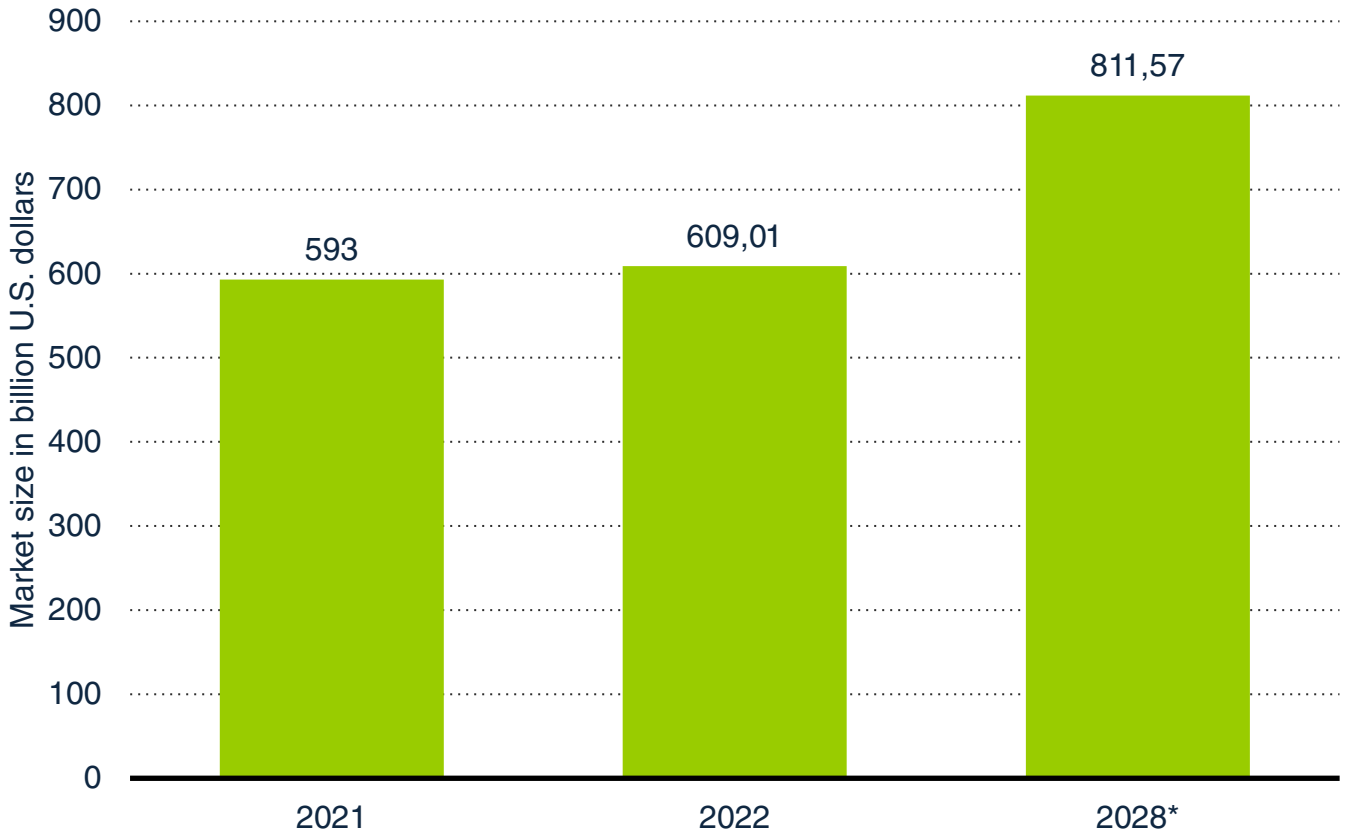


Source: Statista

Market size value of plastics worldwide from 2021 to 2028 (in billion U.S. dollars)

Global plastic market size value 2021-2028

- In 2021, the global plastics market was valued at **593 billion** U.S. dollars.
- The plastics market is projected to grow in the coming years to reach a value of more than 810 billion U.S. dollars by 2028, registering a **CAGR of 3.7%** during the forecast period of 2022 to 2030.

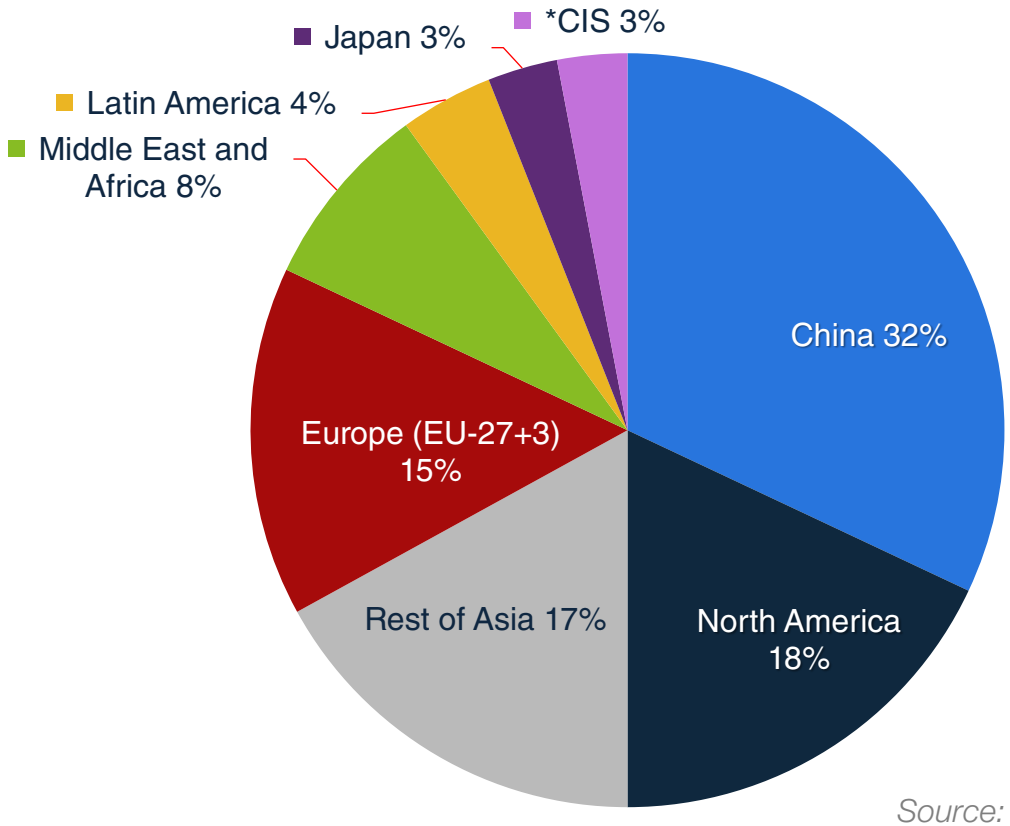


Source: Statista, Grand View Research
**2028, estimated*

Distribution of global plastic materials production in 2021, by region

Plastic material production worldwide by region 2021

- China accounted for 32% of global plastic materials production in 2021, making it the world's largest plastic producer by far.
- China's monthly production of plastics ranges (on average) from between six and eight million metric tons.
- North America was the second-largest plastics producing region that year, accounting for almost 20% of global production.



Source: Statista, Plastic Europe
**Commonwealth of Independent States (Eurasia)*

Production forecast of plastics worldwide from 2020 to 2050, by type (in million metric tons)

Global production volume of thermoplastics by type 2020-2050

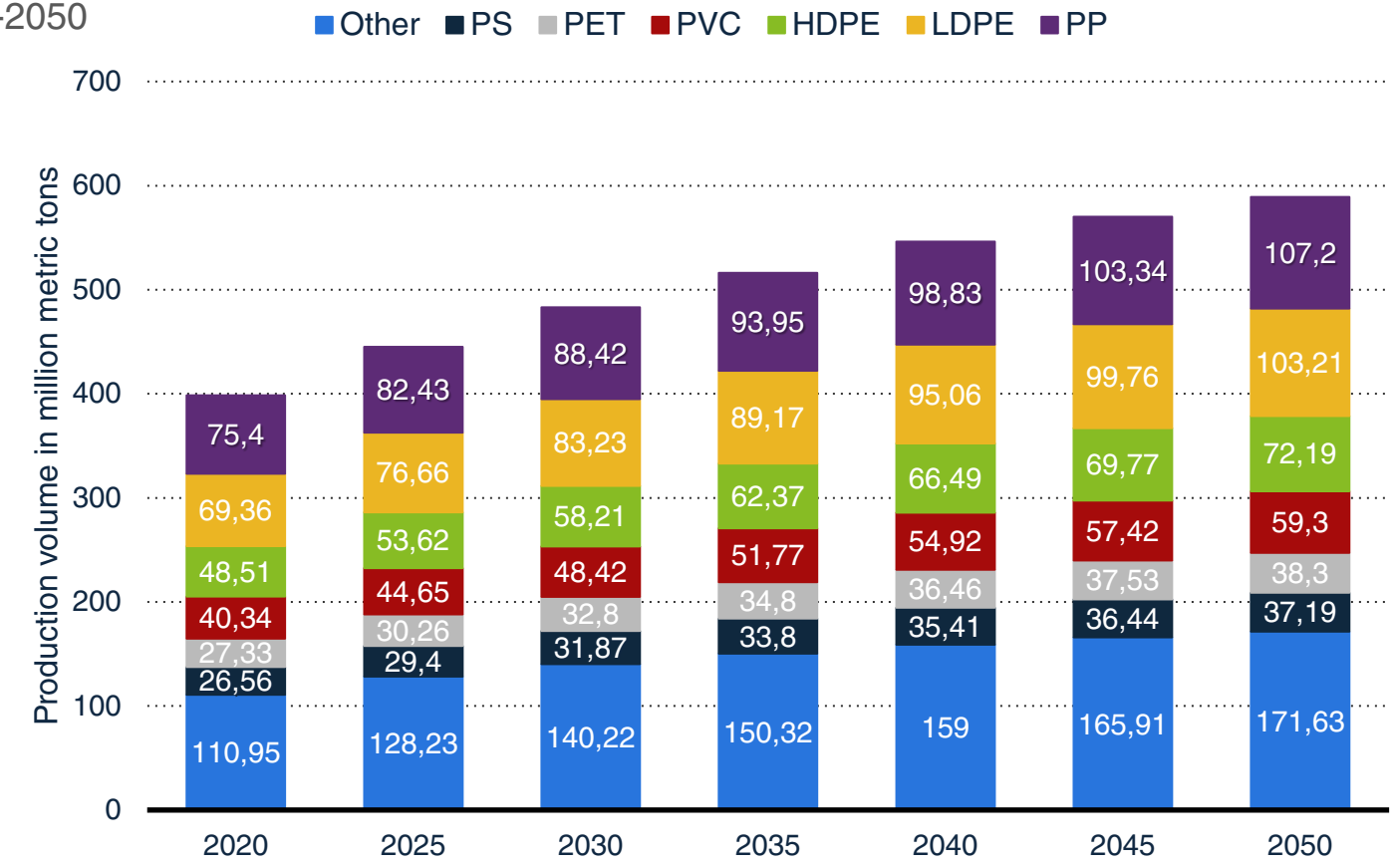
Almost 400 million metric tons of thermoplastics are projected to be produced globally in 2020.

Although there are thousands of different plastics, there are approximately seven broader types of plastic that are produced and consumed in large quantities: polyethylene terephthalate (PET), high-density polyethylene (HDPE), polyvinyl chloride (PVC), low-density polyethylene (LDPE), polypropylene (PP), polystyrene/styrofoam (PS), and miscellaneous plastics.

Polyethylene (PE) is the most widely produced plastic worldwide and is used to produce many products, such as packaging. The second-most produced plastic is polypropylene (PP), of which more than 70 million metric tons worth was produced in 2020.

Of that amount, around 75.4 million metric tons is attributable to the production of polypropylene (PP).

PP production is forecast to grow to 107 million metric tons by 2050.



PP: Polypropylene
LDPE: Low density polyethylene
HDPE: High density polyethylene

PVC: Polyvinyl chloride
PET: Polyethylene Terephthalate
PS: Polystyrene

Source: Statista

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Leading companies in the world

ExxonMobil

ExxonMobil produced 9.2 million metric tons of polyethylene (PE) in 2022. This was a slight increase compared to the production volumes in 2021. Polyethylene is the most produced plastic in the world.

Saudi Basic Industries Corporation (SABIC)

Saudi Basic Industries Corporation (SABIC) produced 4.1 million metric tons of polyethylene (PE) in 2020. This was the same production volume as in the previous year. SABIC's production of Polymer's and Industrial Solutions increased to 6.8 million metric tons in 2020.

LyondellBasell

LyondellBasell's polyethylene products generated revenue of approximately 9.61 billion U.S. dollars for the year ended December 31, 2022. This was a decrease of more than 500 million U.S. dollars in comparison to the previous year. LyondellBasell is one of the world's largest producers of plastic resins.

Dow

Dow's Packaging & Specialty Plastics segment is the highest revenue-generating segment of the company. It consists of two global businesses: Packaging and Specialty Plastics, and Hydrocarbons & Energy. In 2022, this segment had a revenue of 29.3 billion U.S. dollars.

Sinopec

Sinopec's chemicals segment produced 18.5 million metric tons (MMT) of synthetic resin in 2022. This represented a decrease compared to the previous year. The two main types of synthetic resins are thermoplastic and thermosetting. On the other hand, the production of ethylene amounted to 13.4 MMT.

Source: Statista.

6. Main data. Europe

- Plastic industry in Europe
- Plastics production in Europe
- Europe's share of global plastic material
- Manufacturing turnover of plastic in primary forms
- Manufacturing turnover of plastic products
- Manufacturing turnover of plastic packing goods
- Leading companies in Europe
- FDI in plastics in Europe

Plastic industry in Europe

53,150 companies

€405,000 M

+1.5 M jobs

57.2 Mt production in 2022

9.2 billion € trade balance in 2022

More than **10 Mt** of post-consumer plastics waste were sent to recycling in 2020

In 2021, **about 5.5 Mt** of post-consumer recycled plastics were reintroduced in the EU27+3 economy, an increase of about 20% compared to 2020

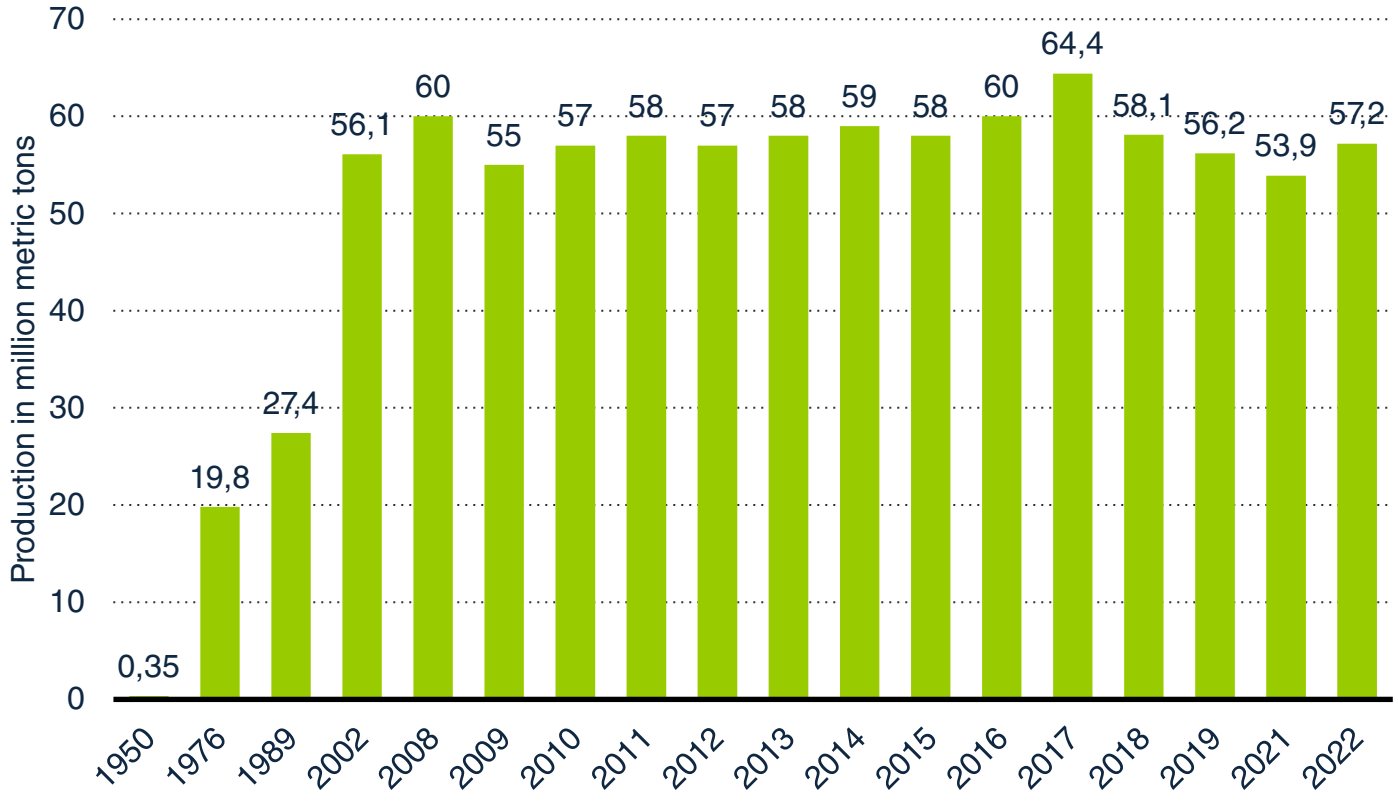
The European plastics industry (EU27) ranks **8th** in Europe in industrial value-added contribution, positioned after the manufacturing of electrical equipment

Source: Plastic Europe 2023, Statista

Annual production of plastics in Europe from 1950 to 2022 (in million metric tons)

Plastics production in Europe 1950-2022

- European plastics production totaled 57.2 million metric tons in 2022, an increase of six percent from the previous year.
- In 2020, European plastics production decreased due to the COVID-19 pandemic.
- The majority of Europe's plastic production is fossil-based.



Source: Plastic Europe, Statista

Note: EU; 1950 to 2021; Estimate Europe includes European Union 27 plus Norway and Switzerland and the UK.

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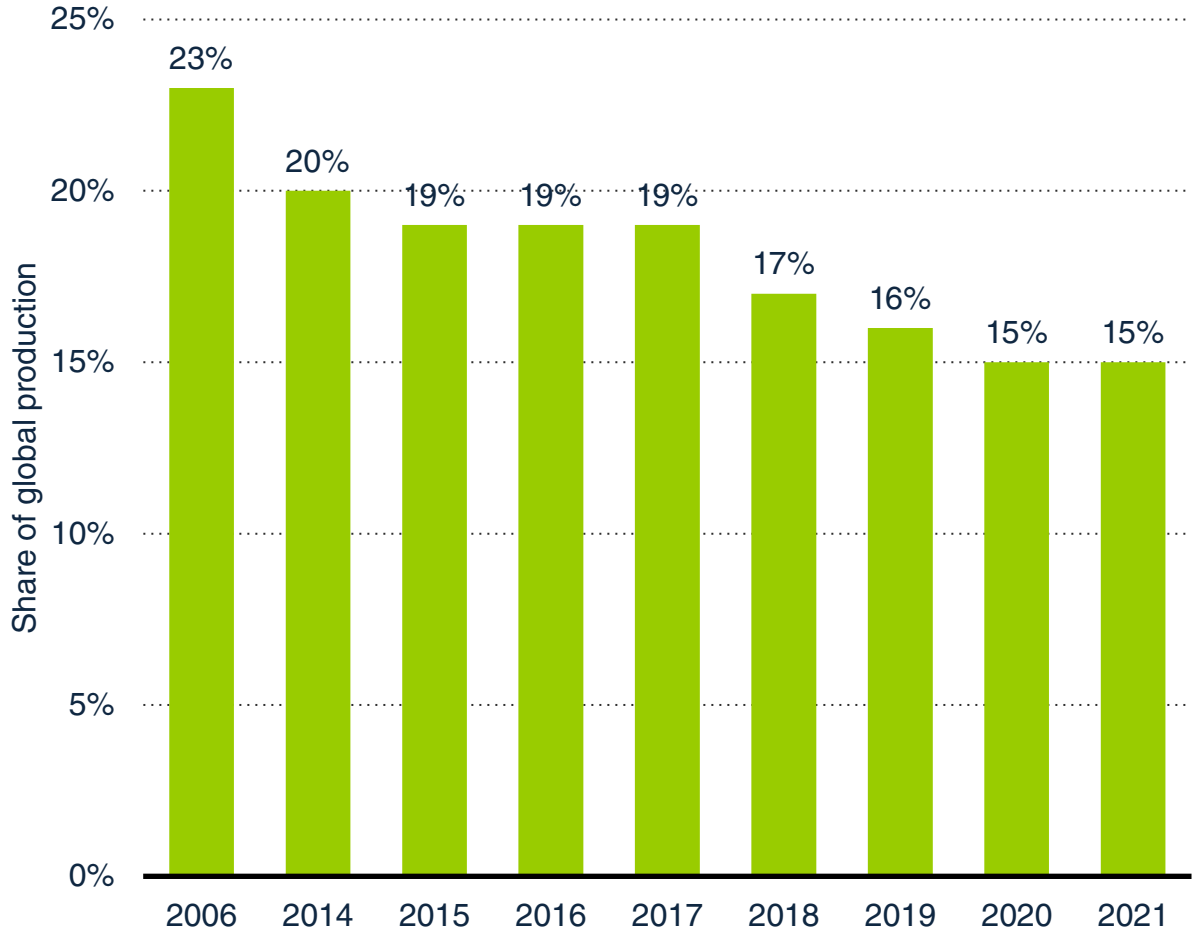
Share of global plastics materials produced in Europe from 2014 to 2021

Europe's share of global plastic material production 2014-2021

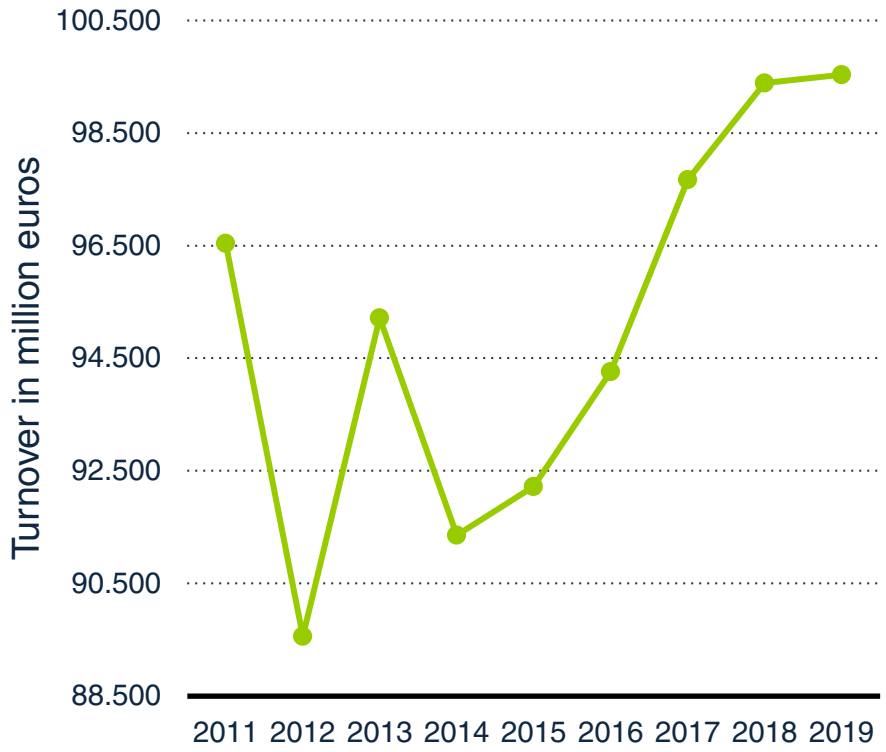
- In 2021, European (EU27+3) plastic production accounted for 15% of the total global production of plastics materials.
- This made Europe the third-largest plastic producing region worldwide that year.
- However, the weight of the plastics industry in the world has been decreasing since 2006



Source: Plastic Europe, Statista

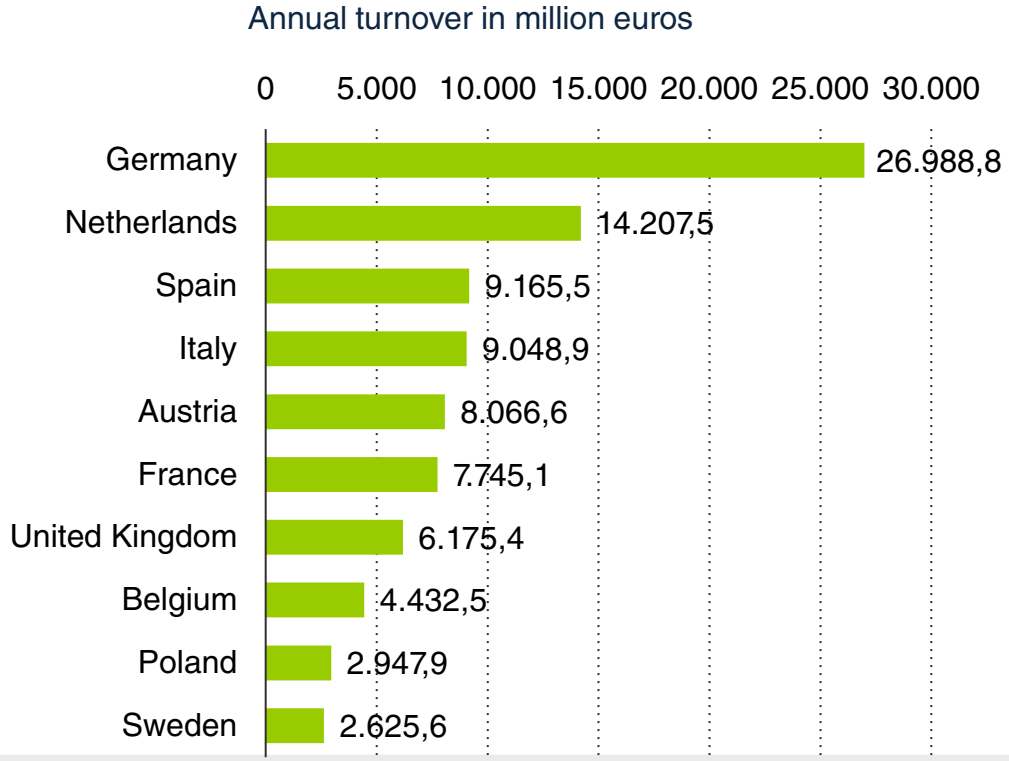
Manufacture of plastic in primary forms in the European Union (EU-27)

Manufacturing turnover of plastic in primary forms EU 2011-2019



In 2019, the turnover of the plastics in primary forms manufacturing industry in EU remained nearly unchanged at around 99.5 billion euros. Still, the turnover reached its highest value in the observed period in 2019

Manufacturing turnover of plastic in primary forms in the EU 2018, by country



In 2018, German manufacturers of primary form plastics had the highest turnover among EU-27 countries at almost 27 billion euros. The Netherlands, Spain, and Italy ranked behind Germany.

Source: Plastic Europe, Statista

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Manufacture of plastic products in the European Union (EU-27) from 2011 to 2020

Manufacturing turnover of plastic products EU 2011-2020

The turnover of the plastic products manufacturing industry in EU decreased by 11.0 billion euros (-4.58 percent) since the previous year. In total, the turnover declined to 228.4 billion euros in 2020.

Manufacturing turnover of plastic products EU 2018, by country

In 2018, Germany recorded the highest turnover from the manufacture of plastic products at 76.57 billion euros. In the top three, Germany was followed by Italy and France

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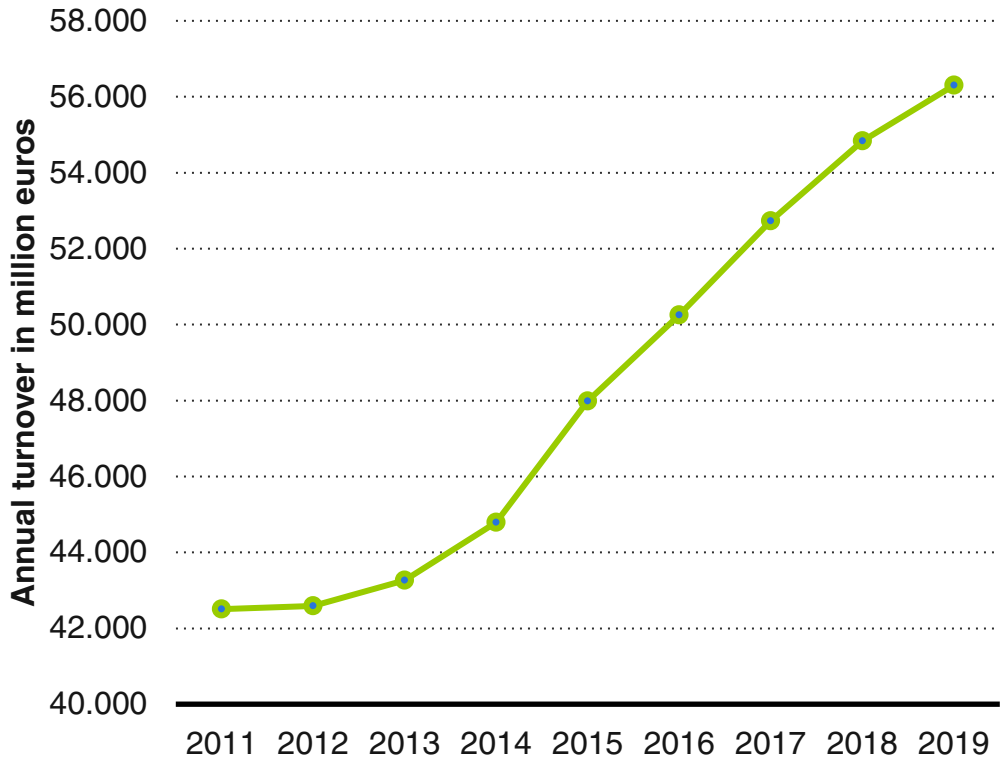
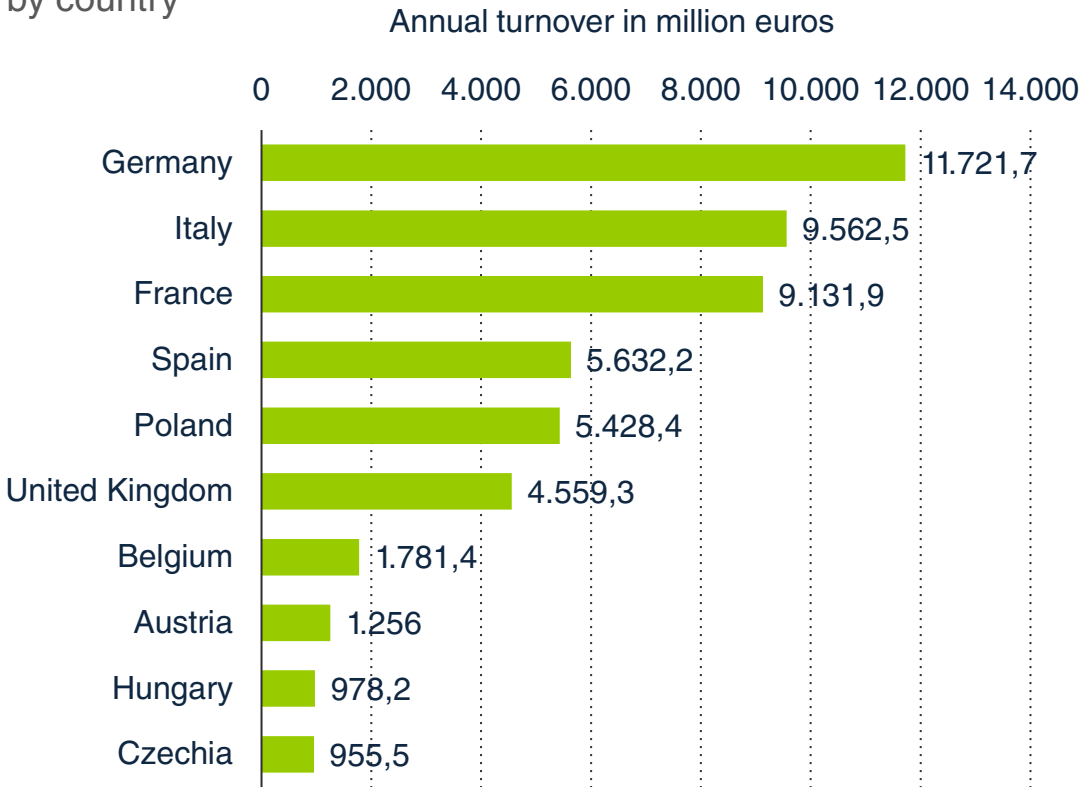
Manufacture of plastic packing goods in the European Union (EU-27) from 2011 to 2019

Manufacturing turnover of plastic packing goods in the EU 2011-2019



The turnover of the manufacture of plastic packing goods industry in EU increased by 1.5 billion euros (+2.68%) in 2019 in comparison to the previous year. While the growth in this industry is slowing down, with 56.3 billion euros, the turnover is at its peak in the observed period. Notably, the turnover in this industry continuously increased over the last years.

Manufacturing turnover of plastic packing good in the EU 2018, by country



In 2018, Germany generated the highest turnover from manufacturing plastic packing goods among other EU-27 countries, at over 11.7 billion euros. That same year, plastic packing goods manufacturing in the European Union (EU-27) generated a turnover of over 54.8 billion euros

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Leading companies in Europe

BASF

We create chemistry

BASF

BASF's revenue in the Chemicals segment amounted to approximately 14.9 billion euros during 2022

Borealis

Saudi Basic Industries Corporation (SABIC) produced 4.1 million metric tons of polyethylene (PE) in 2020. This was the same production volume as in the previous year. SABIC's production of Polymer's and Industrial Solutions increased to 6.8 million metric tons in 2020.

LyondellBasell

LyondellBasell generated approximately 26.8 billion U.S. dollars of revenue through its olefins and polyolefins segment. This was a drop of around six percent in comparison to the previous year

Covestro

Covestro's polyurethanes segment generated the most revenue for the company in 2020, at 5.02 billion euros. This was followed by the polycarbonates segment, which generated 2.98 billion euros of revenue. Revenue for both these segments fell roughly 13% in 2020 compared to the previous year. Covestro is one of the leading polymer companies worldwide.

Source: Statista.

FDI in plastics in Europe

Between 2018 and the first quarter of 2023, Europe has been one of the most dynamic region in terms of plastics FDI projects:

624 FDI projects	13,544 Capex (M€)	30,464 Jobs created
47% of the FDI projects in the world	29% of the capex in the world	26% of the jobs created in the world

Main countries in origin of investments

1. USA
2. Germany
3. Japan
4. Austria
5. Italy

- Germany (15%), Turkey (13%), United Kingdom (10%), France (9%) and Spain (8%) are the main recipient countries in terms of projects.
- The main business activities related to the projects are manufacturing (57%), sales, marketing & support (14%) and recycling (11%).

Source: fDi Markets

7. Bio-based plastic

- Bioplastics
- Global plastic production by feedstock
- Global market volume share of plastics by feedstock
- Production Capacity of Bioplastics
- Distribution of the production capacity of bioplastics worldwide
- Global market value of bioplastics
- Distribution of bio-based bioplastics market
- Market value of bioplastics
- Demand for biodegradable plastics
- Biodegradable polymer consumption

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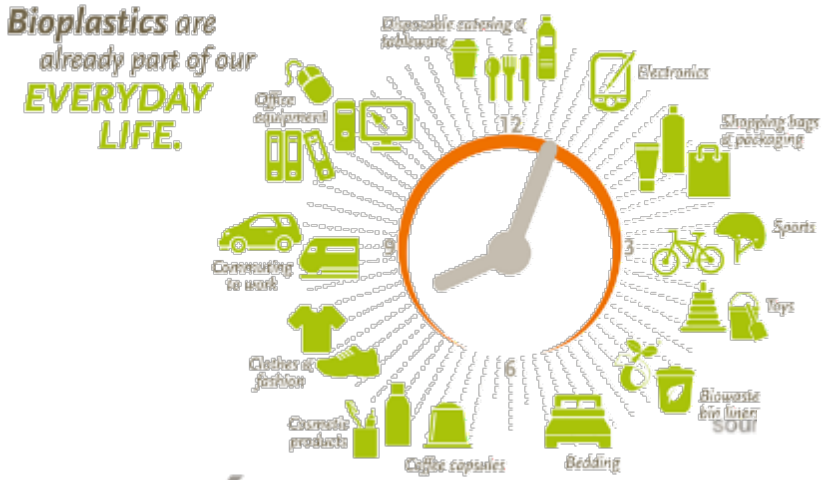
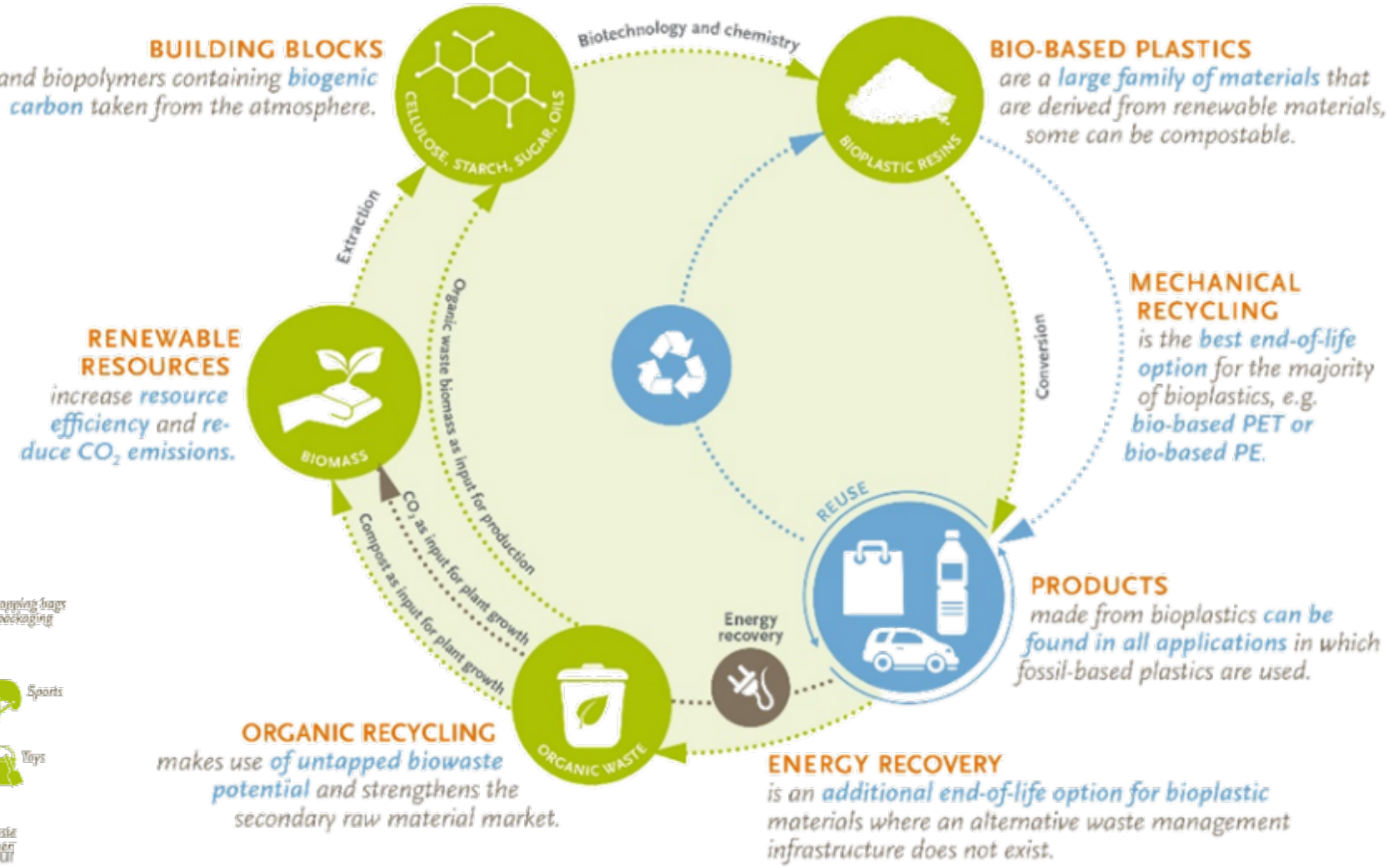
Bioplastics are not something totally new, and global production is growing, but their use should increase, so you could close the loop, through mechanical recycling, chemical recycling, hydrolysis, or other technologies.





Source: Bioplastic Europe 2022

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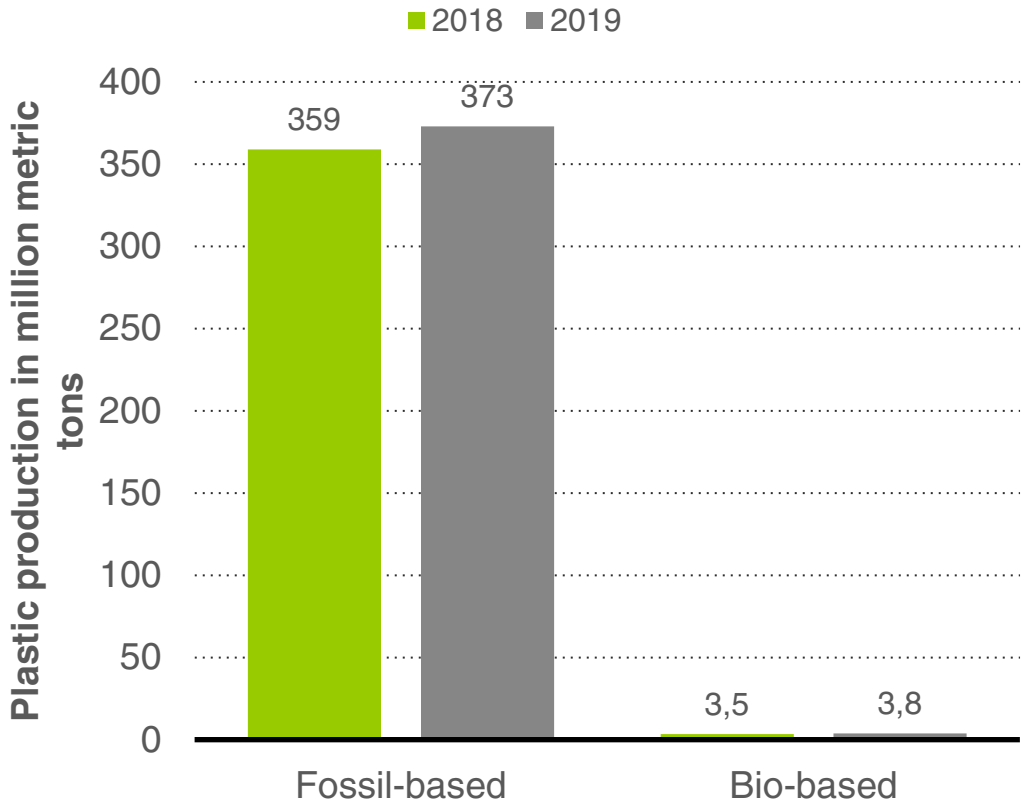
Cumulative plastic production volume worldwide from 1950 to 2018 and 2019, by feedstock type (in million metric tons)

Global plastic production by feedstock type 1950-2019

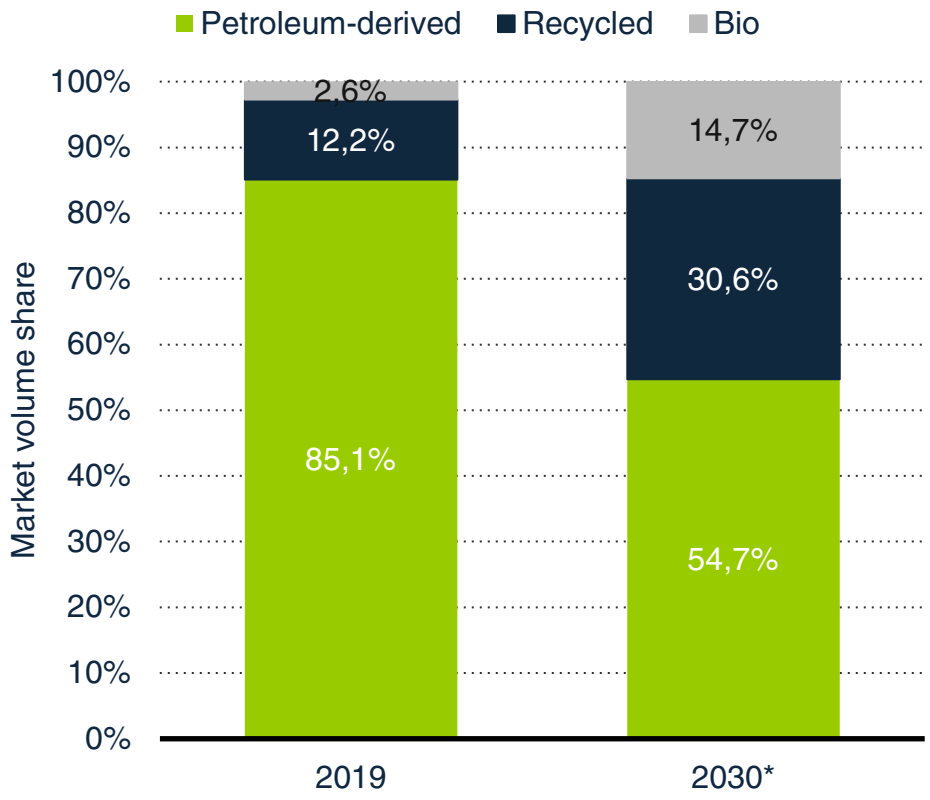
- Since 1950 and for nearly six decades, fossil **fuel-based plastics** have accounted for the large majority, if not all of global plastics production, amounting to a cumulative 373 million metric tons in 2019.
- **Bio-based plastics** accounted for a significantly lower share of plastic production at that time, reaching only 3.8 million metric tons in the same year. Bio-based plastics production amounted to approximately 300,000 metric tons less one year prior to that, in 2018.



Source: BioPlastic Europe, Statista

Market volume share of plastics worldwide

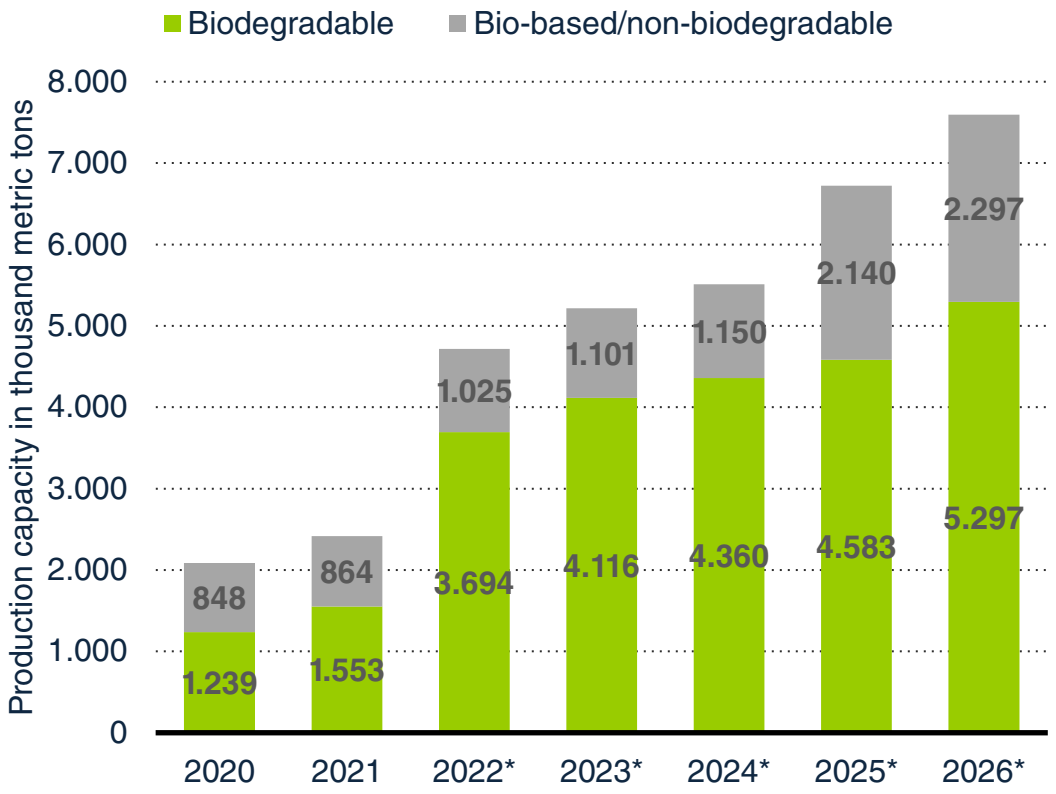
Global market volume share of plastics by feedstock 2019 & 2030



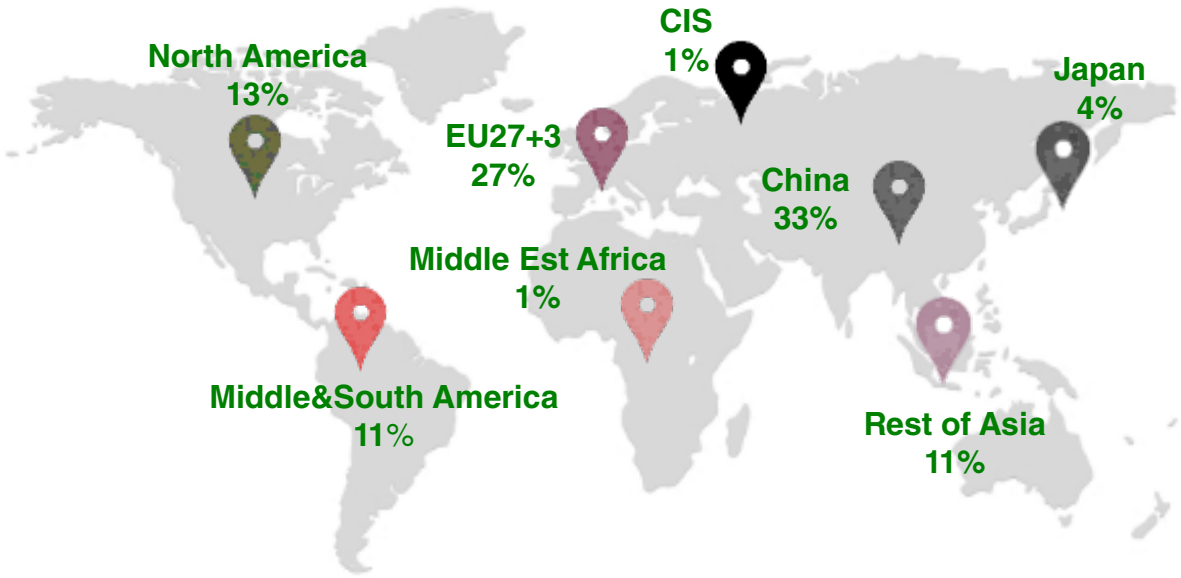
In 2019, around 85% of the plastic produced worldwide was petroleum-derived. By 2030, it is expected petrochemical-based plastics will account for only 54.7% of global plastics production, while recycled plastics and bioplastics will account for a larger proportion of the market.

Source: BioPlastic Europe, Statista
**2030, estimated*

Production Capacity of Bioplastics



Bio-based & Bio-attributed plastic production by regions of the word (2023)



The global production capacity of bioplastics increased 16% in 2021 to 2.4 million metric tons. Biodegradable bioplastics accounted for 1.6 million metric tons of the total capacity in 2021.
Growth is expected to continue in the coming years, with projections showing that global production capacities of bioplastics could reach in 7.6 million metric tons by 2026.
The main prodcution capacity is located in Asia

*Source: BioPlastic Europe, Statista, Plastics Europe 2023. *Estimated values*

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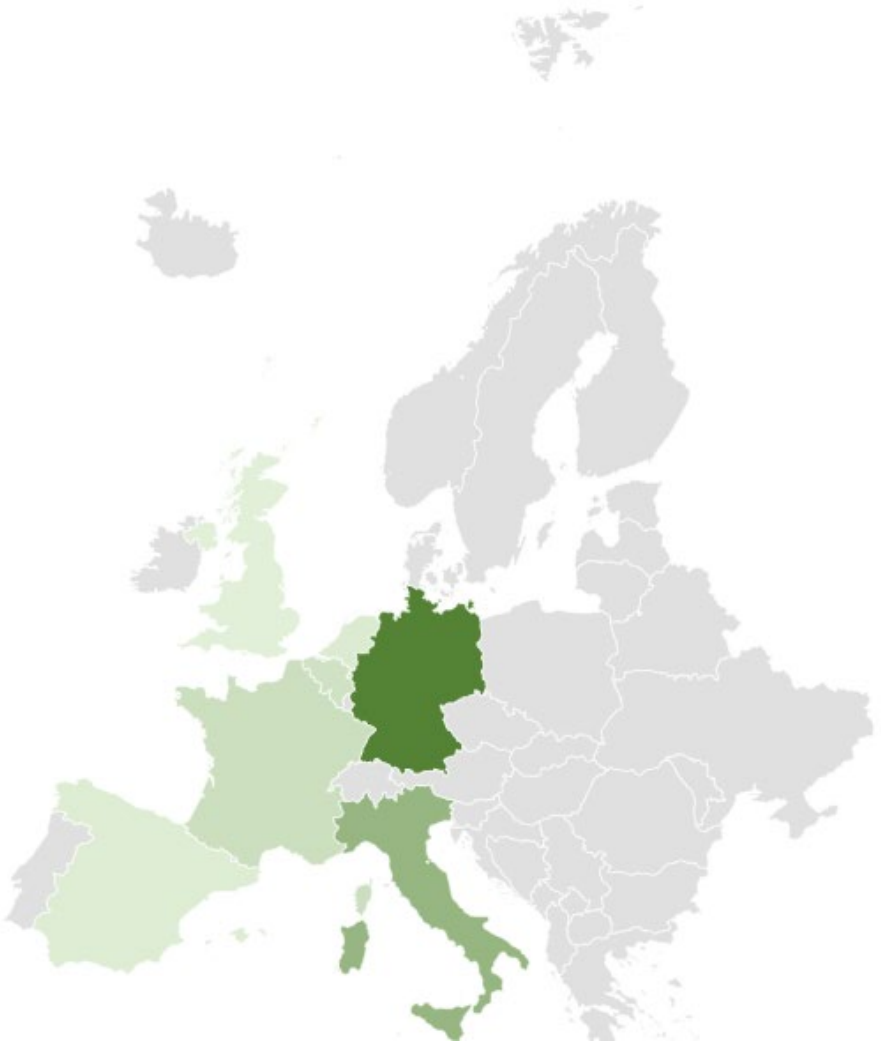
Bio-based plastics production in Europe

0.4 Mt

European bio-based plastics production in 2022

Bio-based Plastic Production	
United Kingdom	0.2%
Netherlands	2.5%
Belgium	6.5%
Germany	50.9%
France	8.1%
Spain	1.6%
Italy	27.0%
Other EU27+3 Countries	3.20%



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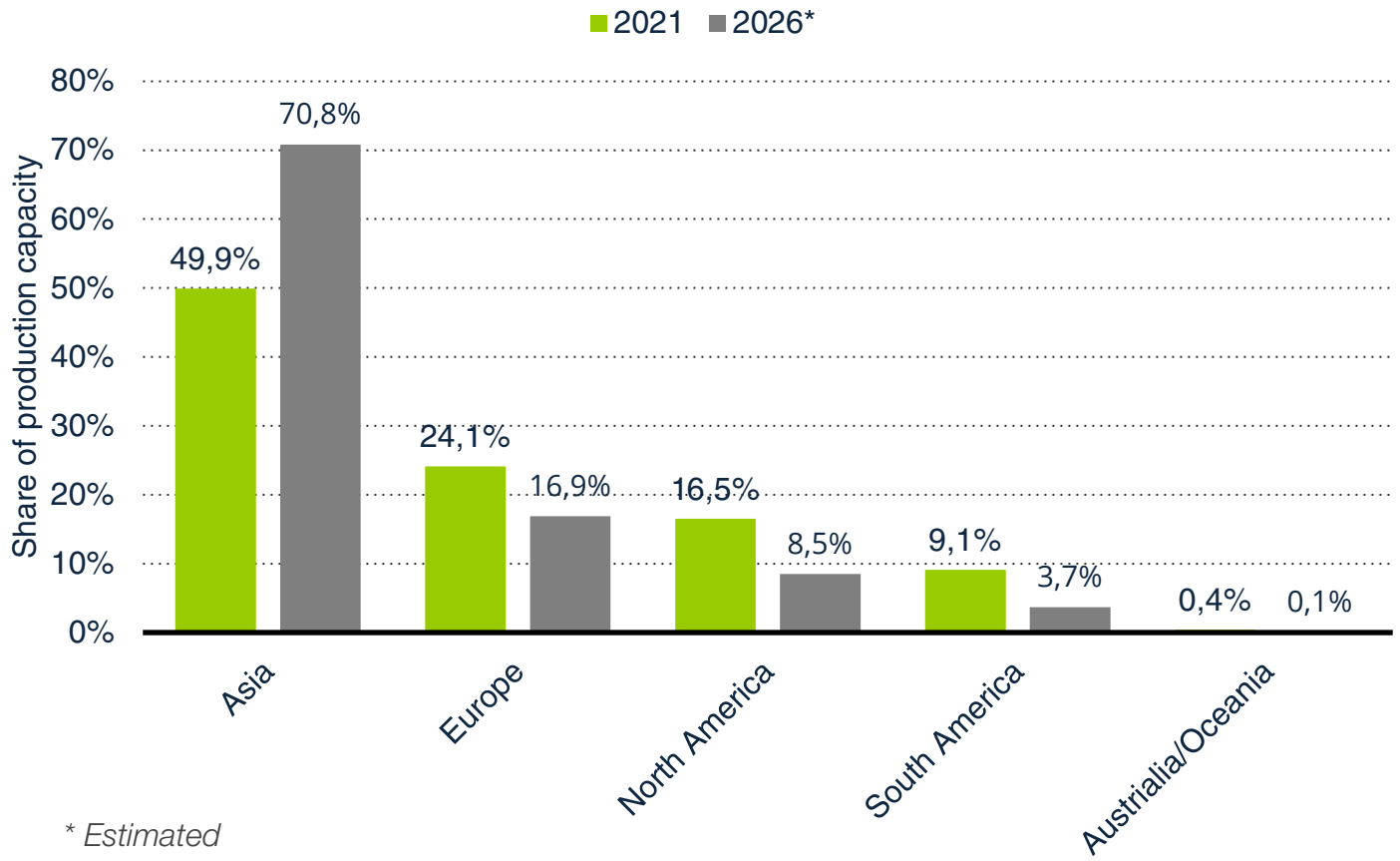
Distribution of the production capacity of bioplastics worldwide in 2021, with a forecast for 2026, by region

Global bioplastic production capacity distribution 2021-2026, by region



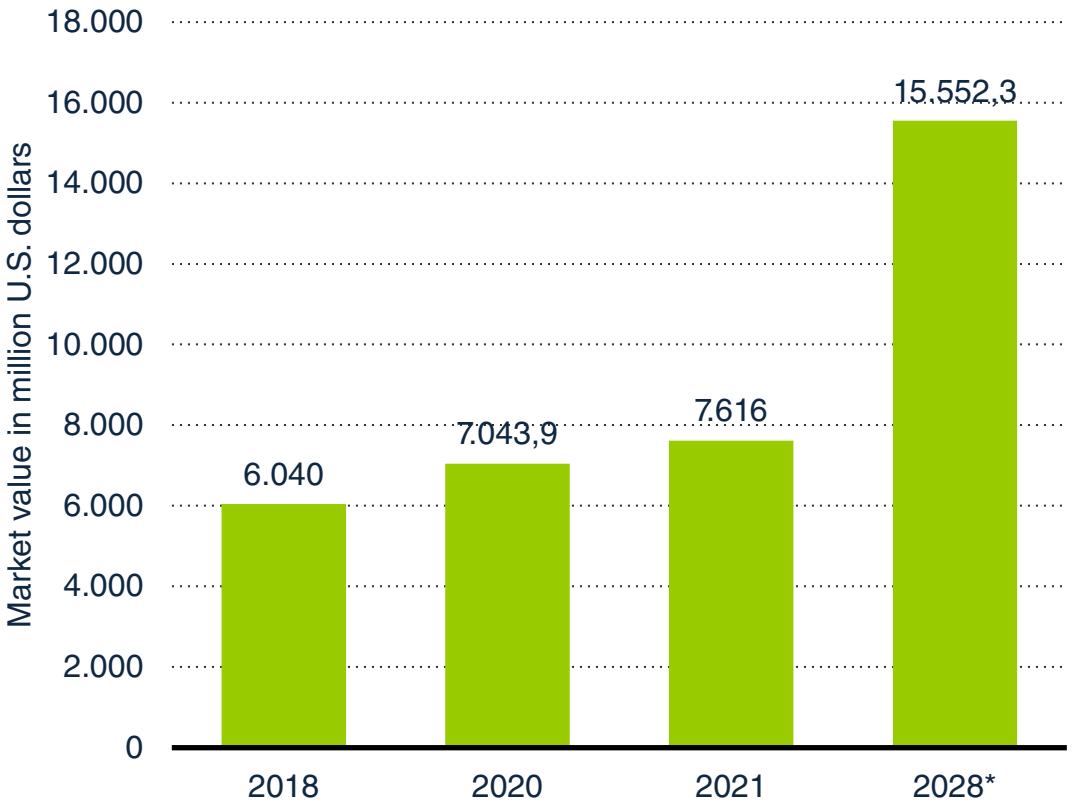
* *Estimated*

The global production capacity of bioplastics was 2.42 million metric tons in 2021, of which Asia accounted for half.
By 2026, Asia's share of bioplastics production capacities is forecast to increase to more than 70%.

Source: BioPlastic Europe, Statista

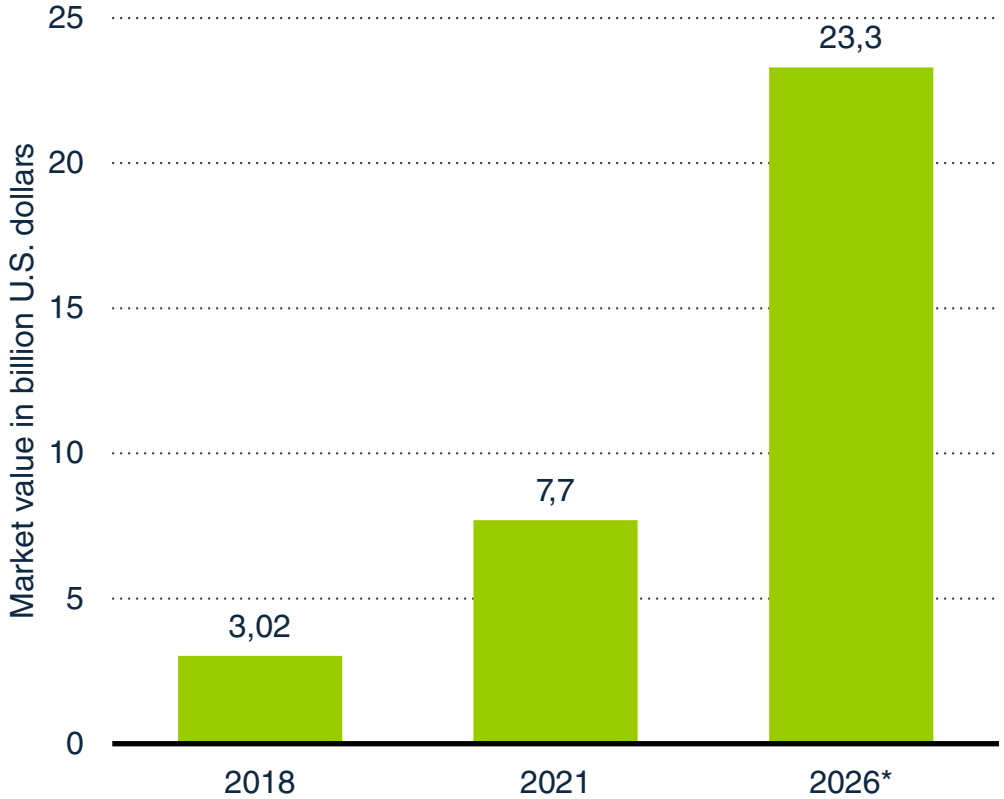
Market value of bioplastics worldwide

Global market value of bioplastics 2018-2028



Bioplastics had a global market value of approximately 7.6 billion U.S. dollars as of 2021. By 2028, it is expected that the global market value of bioplastics will reach 15.55 billion U.S. dollars

Global biodegradable plastics market value 2018-2026



The market value of biodegradable plastics in 2021 was nearly eight billion U.S. dollars. It is forecast that the market value of global biodegradable plastics will grow threefold by 2026, to 23.3 billion U.S. dollars

Source: BioPlastic Europe, Statista

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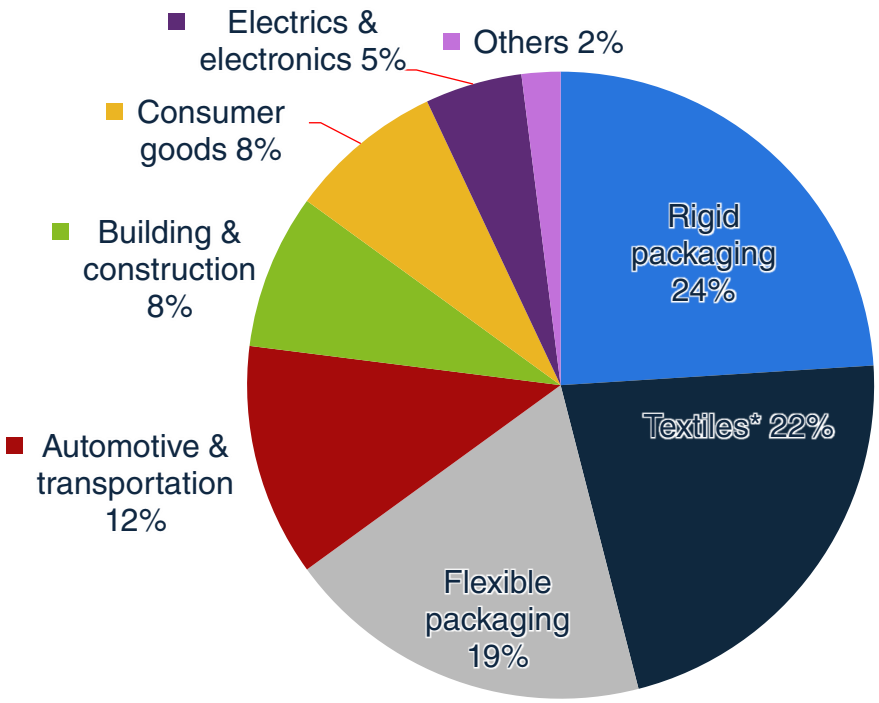
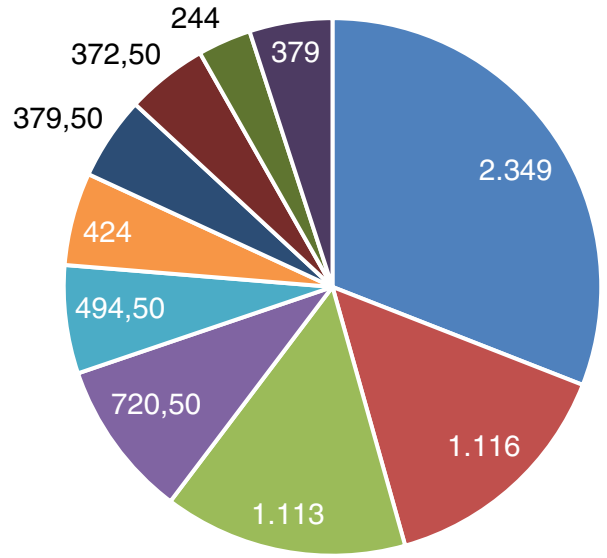
Distribution of bio-based bioplastics market

Global bio-based plastic market shares **2021**, by segment



In 2021, the packaging segment accounted for almost half the global bio-based bioplastic market. Rigid packaging had the largest share of the market, at 24%, with flexible packaging representing 19%.

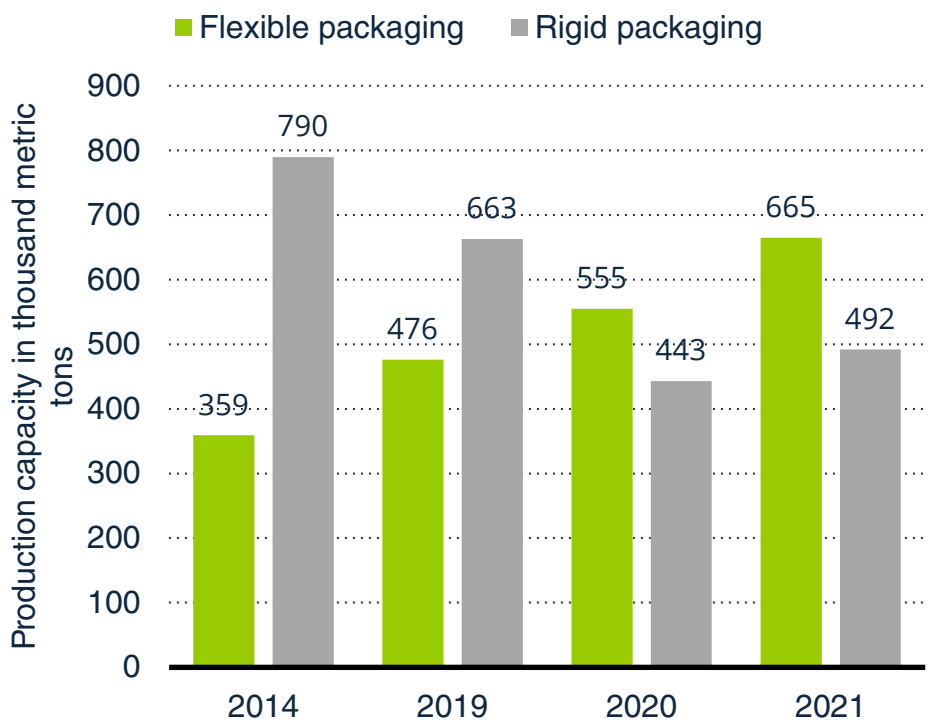
Forecast bioplastic production capacity worldwide **2026,** by market segment (in 1,000 metric tons)



Source: BioPlastic Europe, Statista

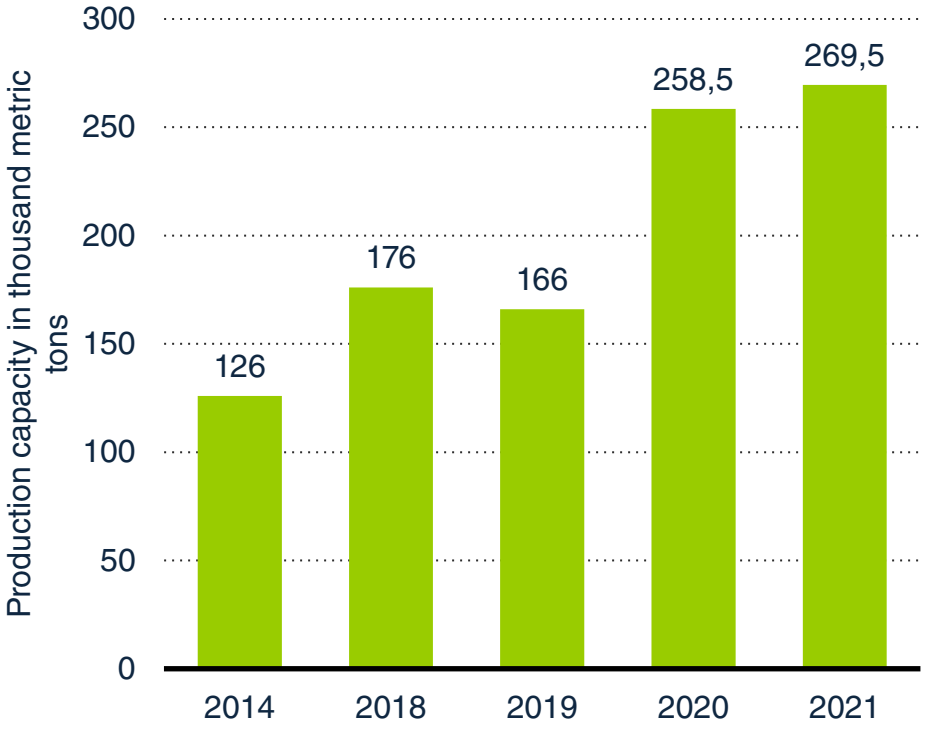
Production capacity of bioplastics

Global bioplastic production capacity for packaging 2014-2021, by type



In 2021, the global production capacity of bioplastics for flexible packaging was 665,000 metric tons. Rigid packaging made from bioplastics had a production capacity of 492,000 metric tons as of 2021, which was a notable decrease from its production capacity in 2014

Global bioplastic production capacity for consumer goods 2014-2021



In 2021, the global production capacity of bioplastics for consumer goods was roughly 279,000 metric tons. That was a notable increase from the consumer goods bioplastics production capacity in 2014, which was 126,000 metric tons

Source: BioPlastic Europe, Statista

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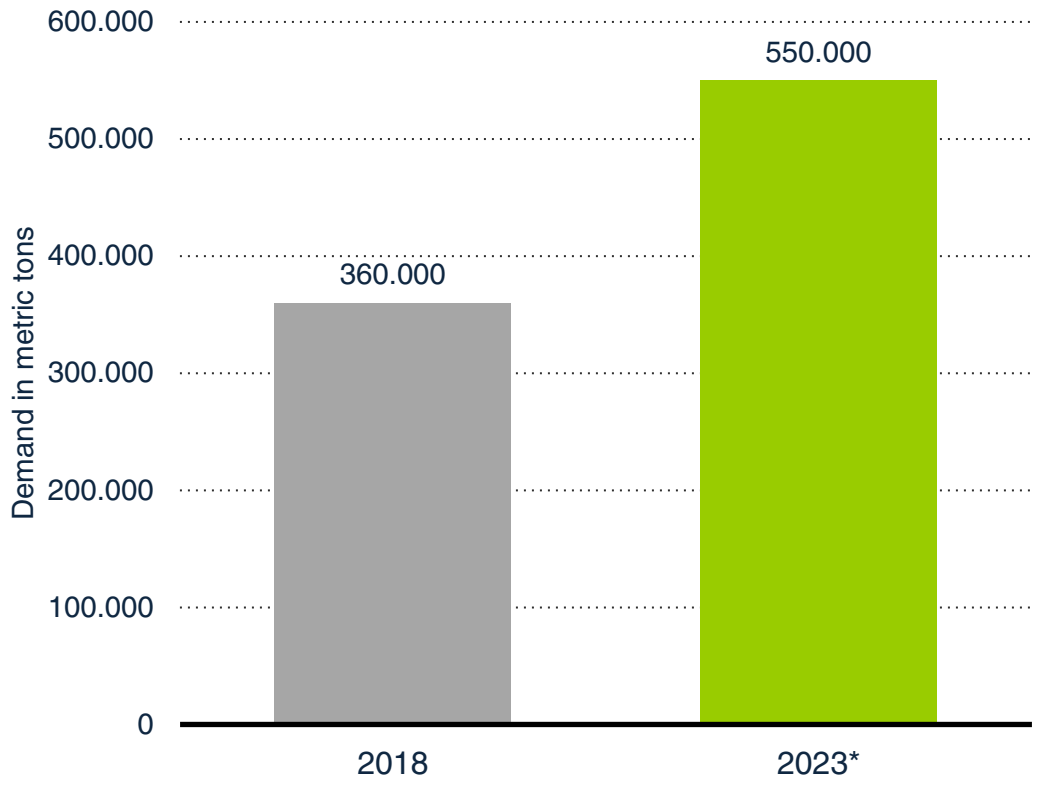
Demand for biodegradable plastics worldwide in 2018 and 2023 (in metric tons)

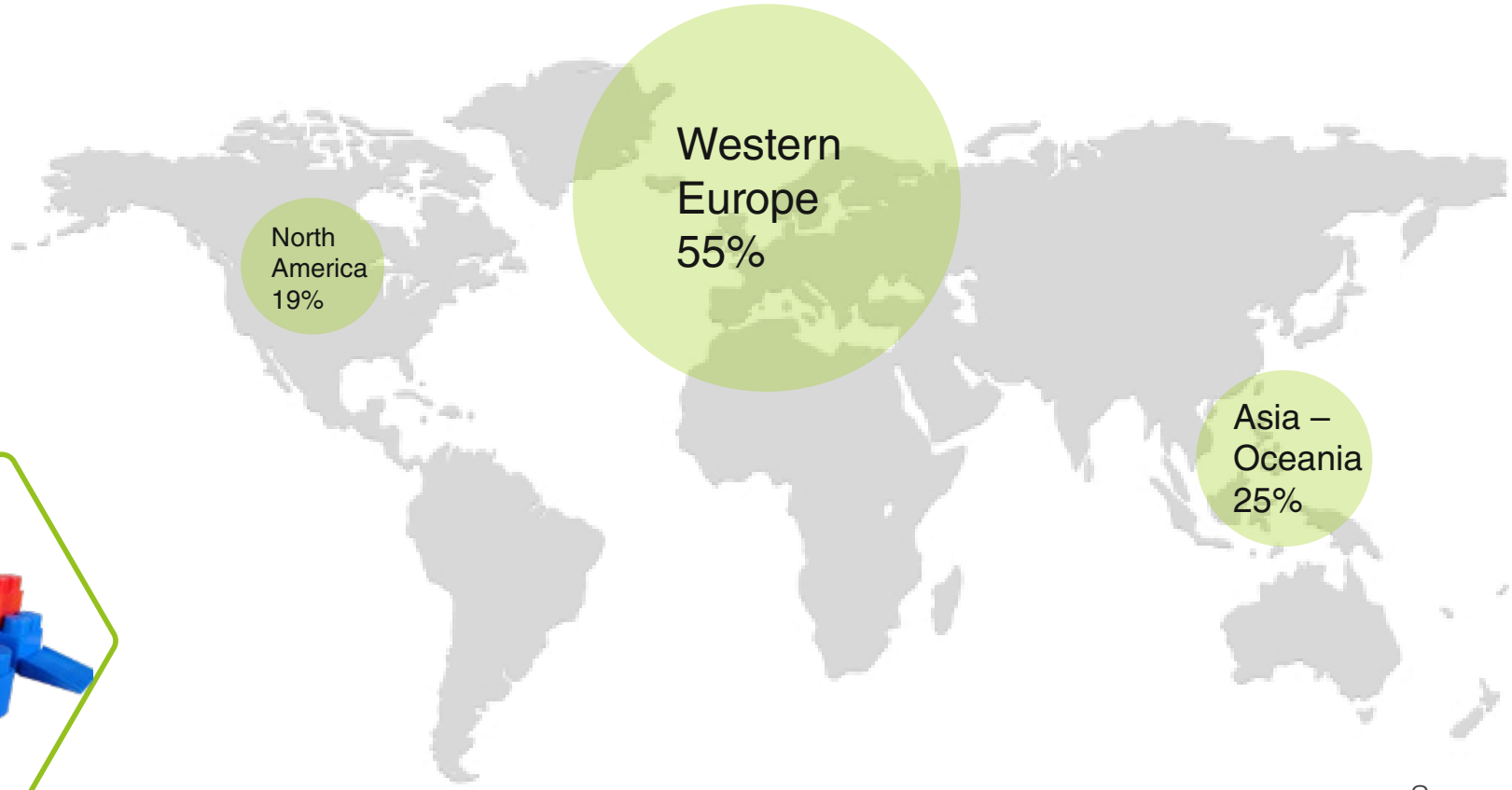


*2023, estimated

- The demand for biodegradable plastics is expected to grow by an average of **9%** percent each year between 2018 and 2023, resulting in an anticipated global demand amounting to nearly 550,000 metric tons in 2023.
- While the market growth is promising, biodegradable polymers' market growth has been slower in regions that have not mandated their use than in those with mandates in place.

Source: Statista, Chemweek

Distribution of biodegradable polymer consumption worldwide as of 2018, by region

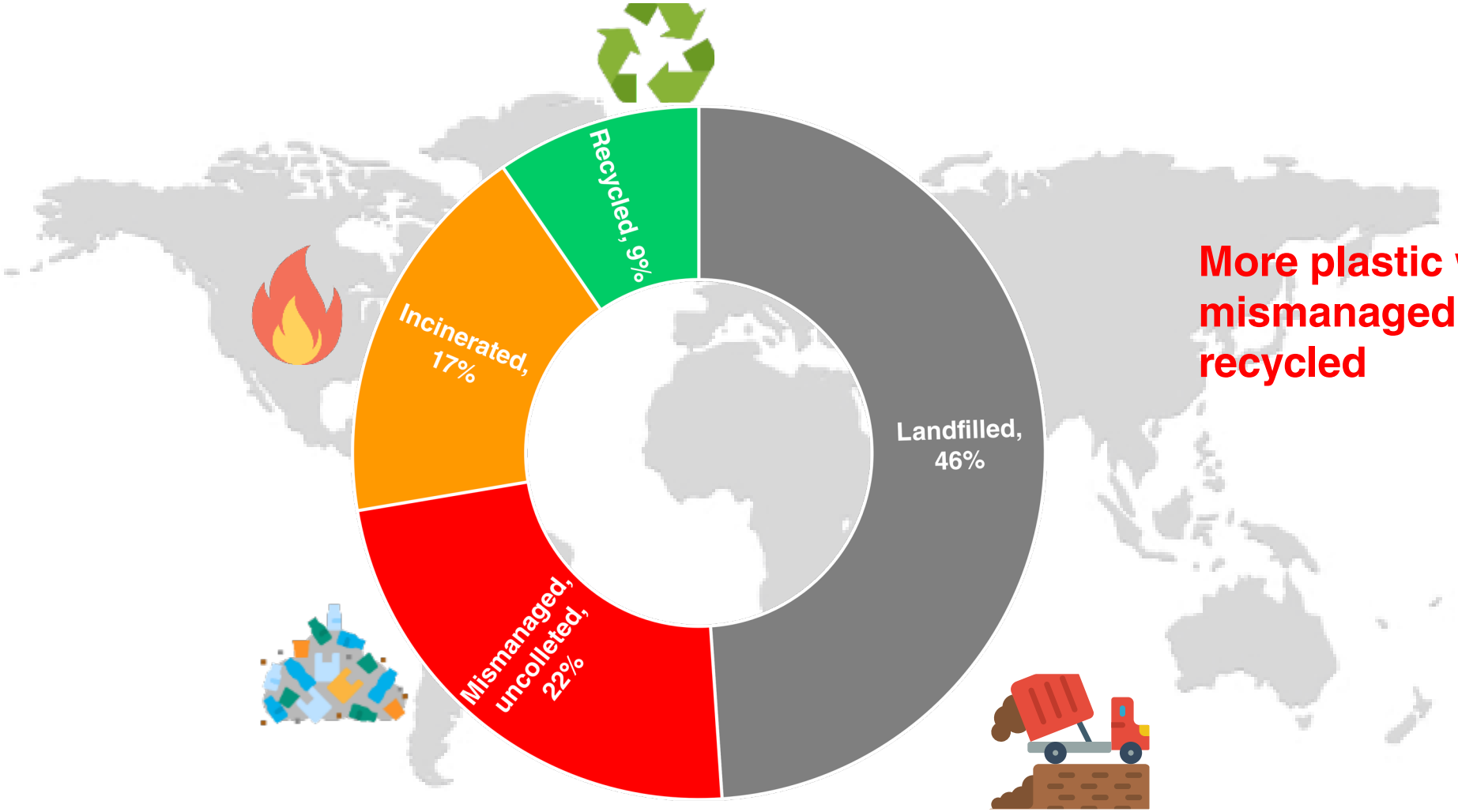


Source: Statista

8. Recycling

- Plastic end of life treatment in the world
- Europe. Plastic end of life treatment
- Treatment of plastic waste by countries
- Waste treatment Packaging plastics
- Recycled content in Europe

Plastic end of life treatment in the world



More plastic waste is mismanaged than recycled

Source: UN Beat plastic Pollution. 2023

Europe. Plastic end of life treatment

2030: 50%

In 2020, **35%** of post-consumer plastic waste was sent for recycling, but across Europe, 23% was still sent to landfill

Recycling

35%

Energy recovery

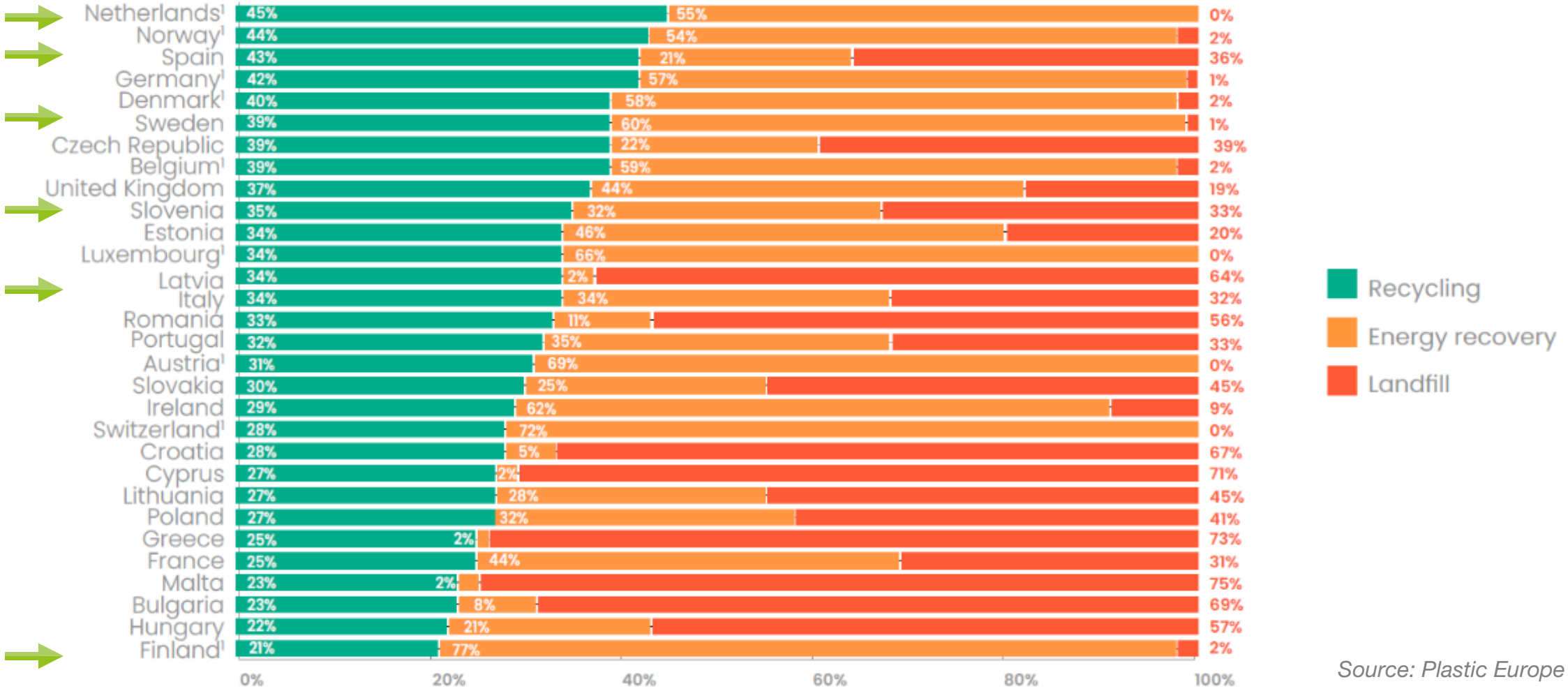
42%

Landfill

23%

Source: Platsic Europe 2022

Treatment of plastic waste by countries (2020)



Source: Plastic Europe 2022

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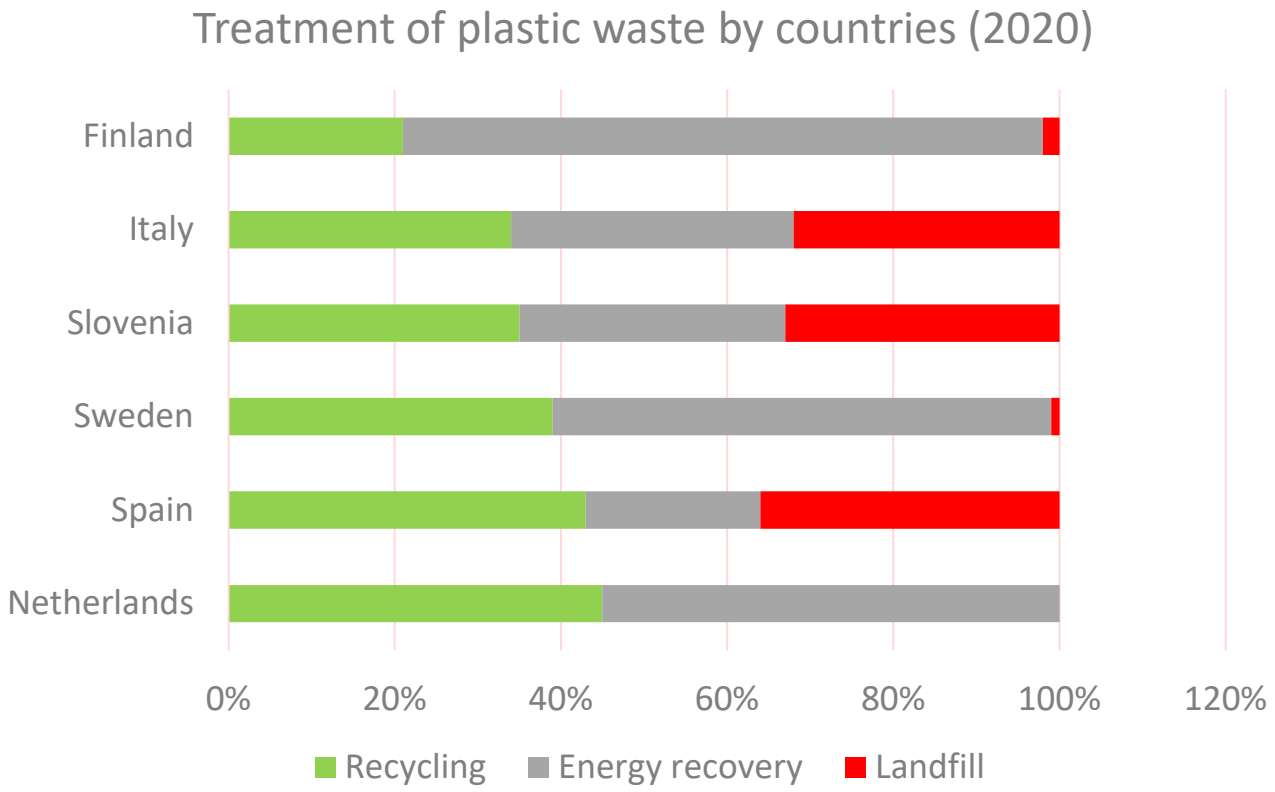
Treatment of plastic waste by countries

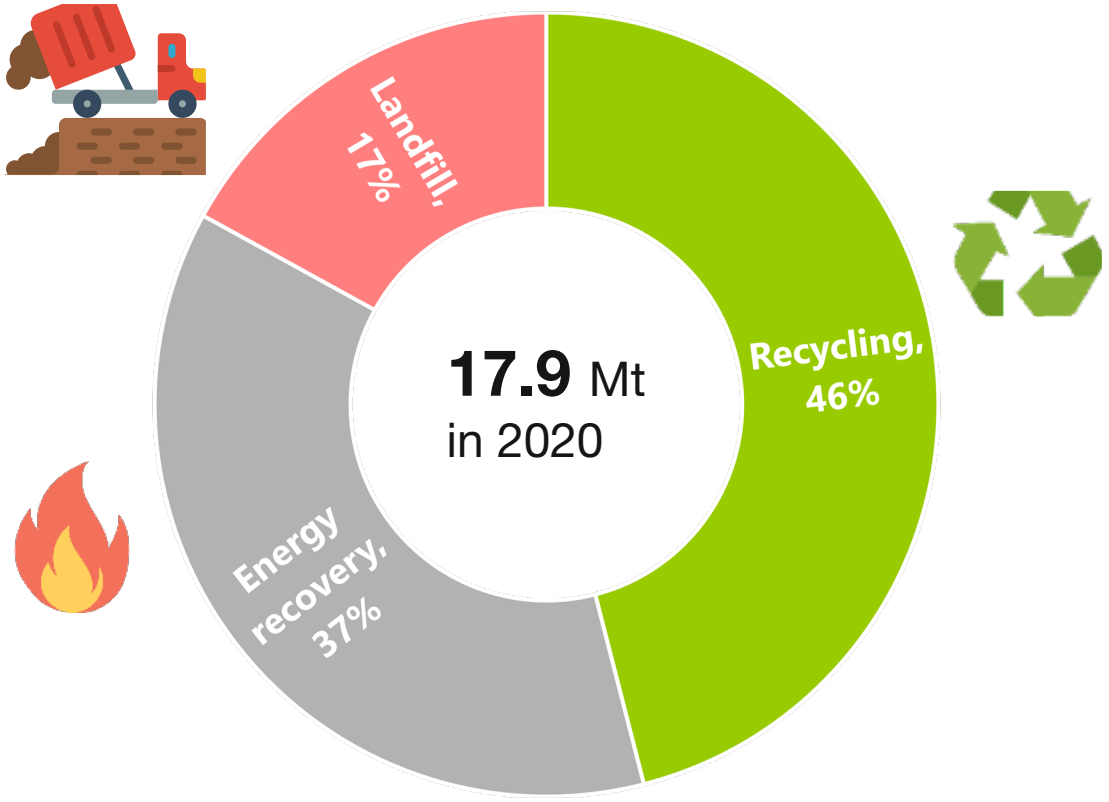
- Finland is below the European average in recycling plastics.
- Italy, Spain, and Slovenia are above the European average in the deposit of plastic waste in landfills.
- In 2020 and in the study regions, the most used method of plastic waste treatment is energy recovery.
- The Netherlands and Spain are the countries with the highest rates of recycling of plastic materials.



Source: Plastic Europe 2022

Increase in the recycling rate of plastic packaging since 2018

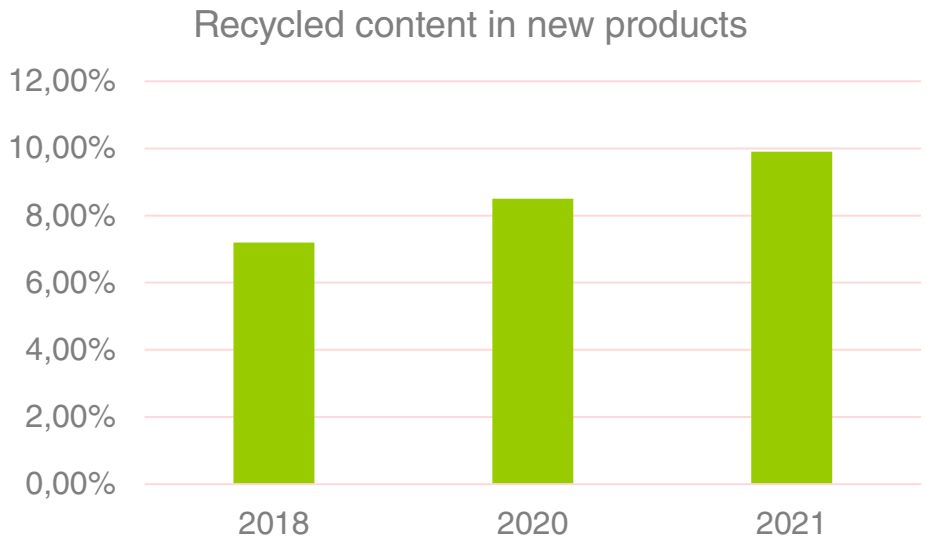
In 2020, the overall European recycling rate for post-consumer plastic packaging reached **46%,** compared to 42% in 2018, an increase of around 9.5%.

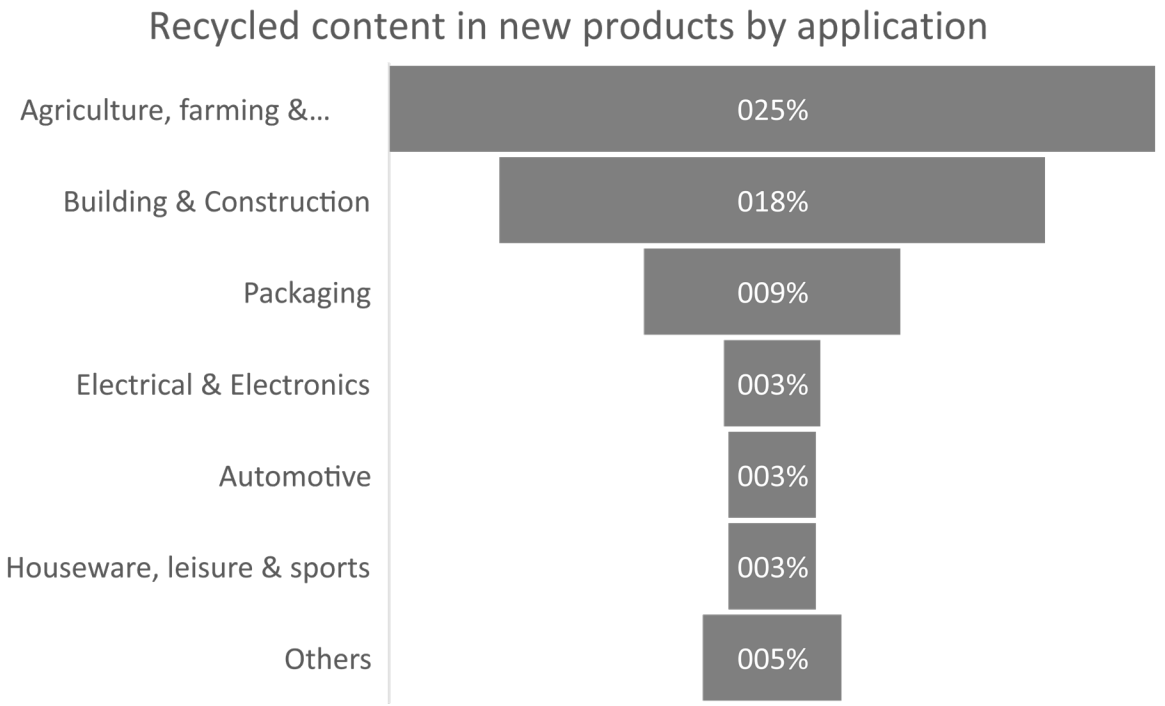


Source: Plastic Europe 2022

Recycled content in Europe

In 2021, 5.5 million tonnes of post-consumer recycled plastics were used in new products and parts in the EU27+3, representing a recycled content rate of around 10% in plastic conversion and an increase of around 20% compared to 2020.





Source: Plastics Europe

9. Chemical Recycling

- Plastic recycling ways
- Plastic recycling
- Types of chemical recycling
- Thermal cracking
- Chemical Cracking
- Biological Cracking
- Chemical recycling processes by type of polymer

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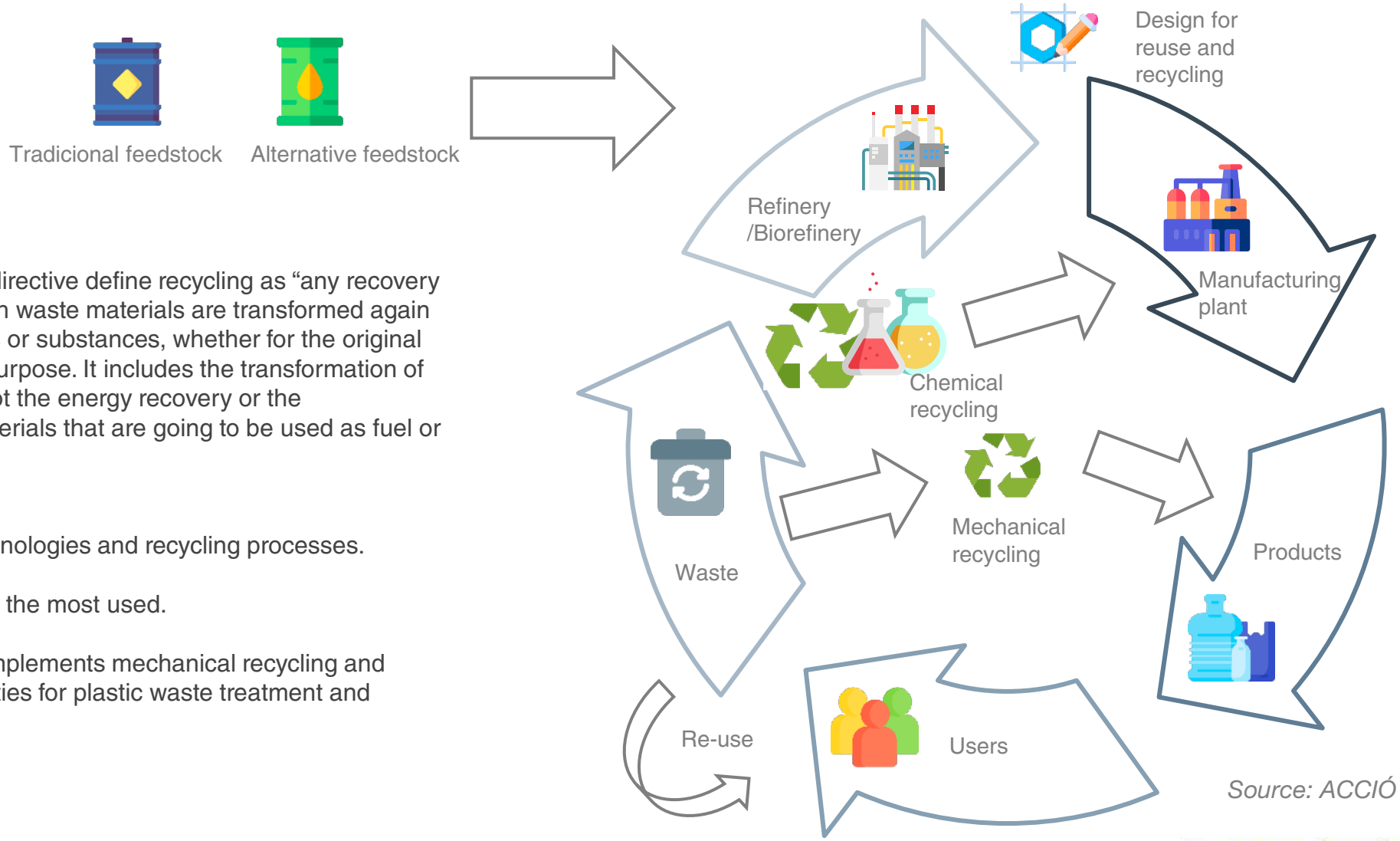
Plastic recycling ways



Source: ACCIÓ

The waste framework directive define recycling as “any recovery operation through which waste materials are transformed again into products, materials or substances, whether for the original purpose or any other purpose. It includes the transformation of organic material, but not the energy recovery or the transformation into materials that are going to be used as fuel or for landfill operations”.

There are different technologies and recycling processes.

Mechanical recycling is the most used.

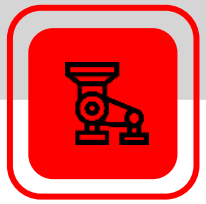
Chemical recycling complements mechanical recycling and introduce new possibilities for plastic waste treatment and management

Plastic recycling

Mechanical recycling

Mechanical recycling is a recovery process that, through temperature and grinding, converts plastic waste into a recycled material that can be used for the same application or for a different one.

In this process, the polymer chain is maintained, that is, there is no chain break, except for that due to possible degradation of the polymer itself.



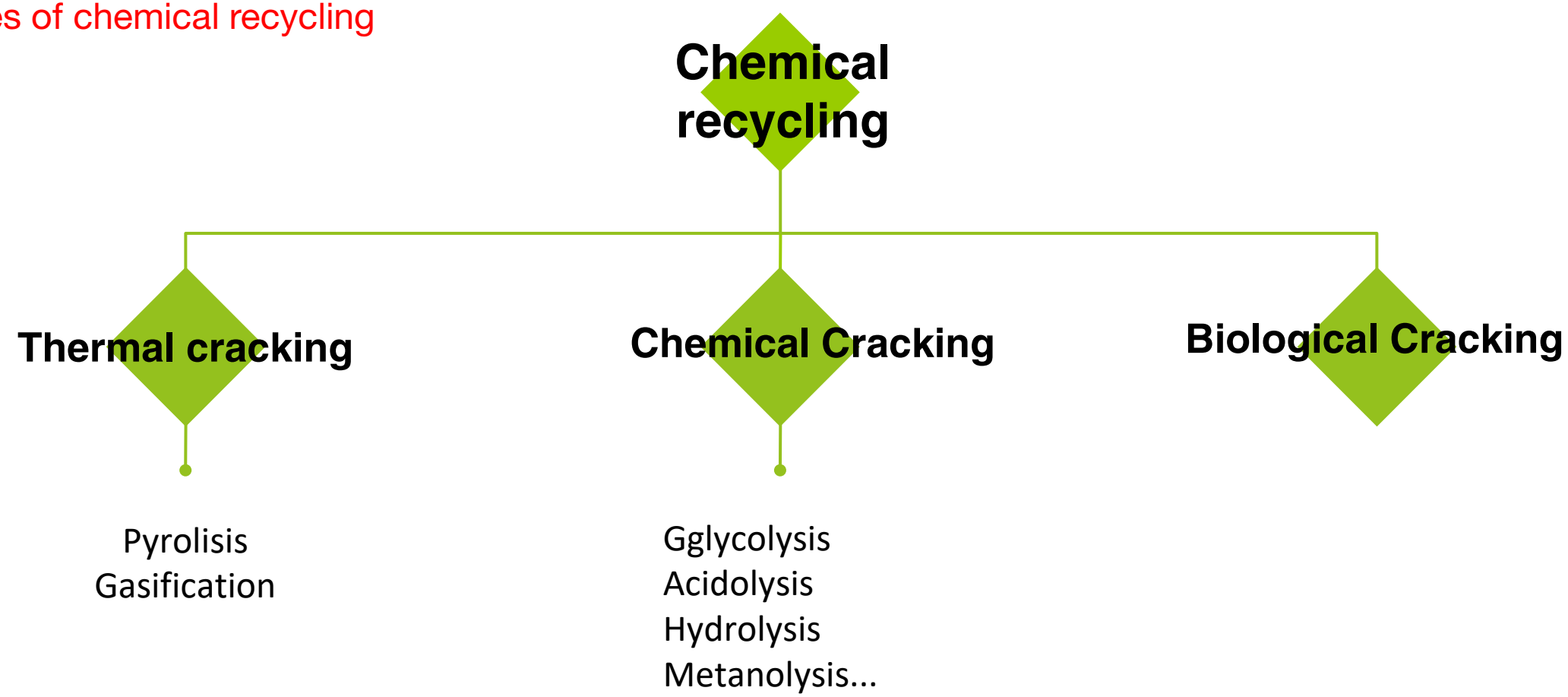
Dissolution recycling

Dissolution recycling is a recovery operation in which plastic waste is subjected to the action of solvents and other chemical agents through which the different polymers are dissolved and thus separated from the entire waste.
The purpose of this operation is to separate polymers, or even additives in order to obtain separated materials that can later be incorporated as recycled raw materials, without breaking the polymer chain.

Chemical recycling

Chemical recycling or molecular recycling according to ISO 15270:2008 is the "conversion to monomer or production ofnew raw materials by changing the chemical structure of plastic waste through cracking, gasification or depolymerization, excluding energy recovery and incineration".

Types of chemical recycling



Source: Reciclado químico en España

Thermal cracking

Thermal cracking (Thermolysis).

- The breakage of the polymeric chain occurs thanks to the action of temperature and in some cases through the use of catalysts.
- The main processes or techniques are pyrolysis (in the absence of oxygen) and gasification (with oxygen).
- Generally, thermolysis takes place under more stringent conditions than in total combustion.
- It is applicable to residues composed of both addition and condensation polymers.
- The new raw materials obtained by pyrolysis and gasification, pyrolysis oil and synthesis gas respectively, are reintroduced into the production cycle, replacing the traditional raw material to obtain new products, such as new polyolefins or methanol.
- Both processes are aimed at recycling mixed plastic waste.
- In the case of pyrolysis, mixtures richer in PE, PP and PS are sought, since the higher proportion of Carbon-Carbon bonds in these polymers improves the performance of the process.

Source: Reciclado químico en España

Chemical Cracking

Chemical Cracking (Chemiolysis)

- Usually referred to as solvolysis or depolymerization.
- The breaking of the polymeric chain occurs thanks to the action of a reagent, which can be a solvent, together with the application of temperature and in some cases pressure and catalysts, obtaining monomers or oligomers.
- It is applicable to waste composed of condensation polymers.
- Generally, the solvolysis process is more selective, which is why it is usually applied to monomaterial waste such as PET, PA, PU, polymethylmethacrylate (PMMA) or polylactic acid (PLA).

Source: Reciclado químico en España

Biological Cracking

Biological Cracking:

- Biological cracking is a promising technique, though it is in its early stages.
- It uses microorganisms to mineralize polymers and enzymes as biocatalysts to degrade polymers into monomers or oligomers.
- Chain breaking occurs through the use of enzymes as biocatalysts, degrading both addition and condensation polymers into monomers or oligomers.
- In a second step assimilation of the decomposed polymer (monomer or oligomers) by means of microbials and its mineralization creates CO_2, H_2O, and CH_4.
- Enzymes are very selective, so it must be selected appropriately.
- Currently, biological cracking is limited to the recycling of PET and polyester fibers, although it is potentially a method that can be applied to any plastic waste.
- These techniques work on biopolymers, as well as conventional polymers.

Source: Reciclado químico en España, AIMPLAS

Chemical recycling processes by type of polymer

Most plastic waste could be chemically recycled.

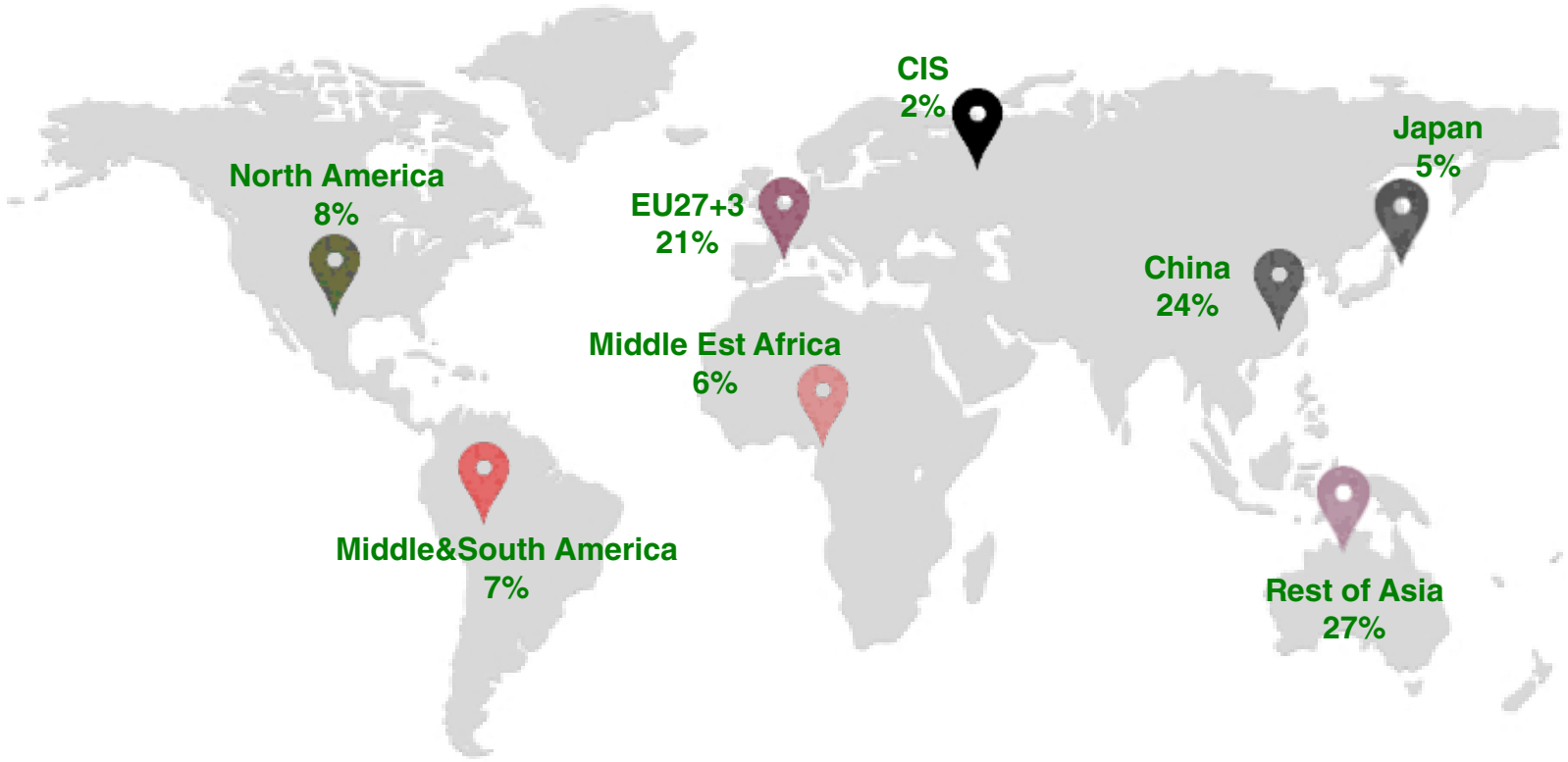
	PE	PP	PET	PS	PA	PC	PVC	PU	PRFV	PRFC	Mixed
Thermal cracking											
Chemical cracking											
Biological cracking											

Source: Reciclado químico en España

Post-consumer recycled plastics production (mechanical & chemical) in the world

35.5 Mt

Global post-consumer recycled plastics production in 2022



Source: Plastics Europe Facts 2023

ACCIÓ Catalonia Trade & Investment
Generalitat de Catalunya Government of Catalonia
Interreg Europe
Co-funded by the European Union
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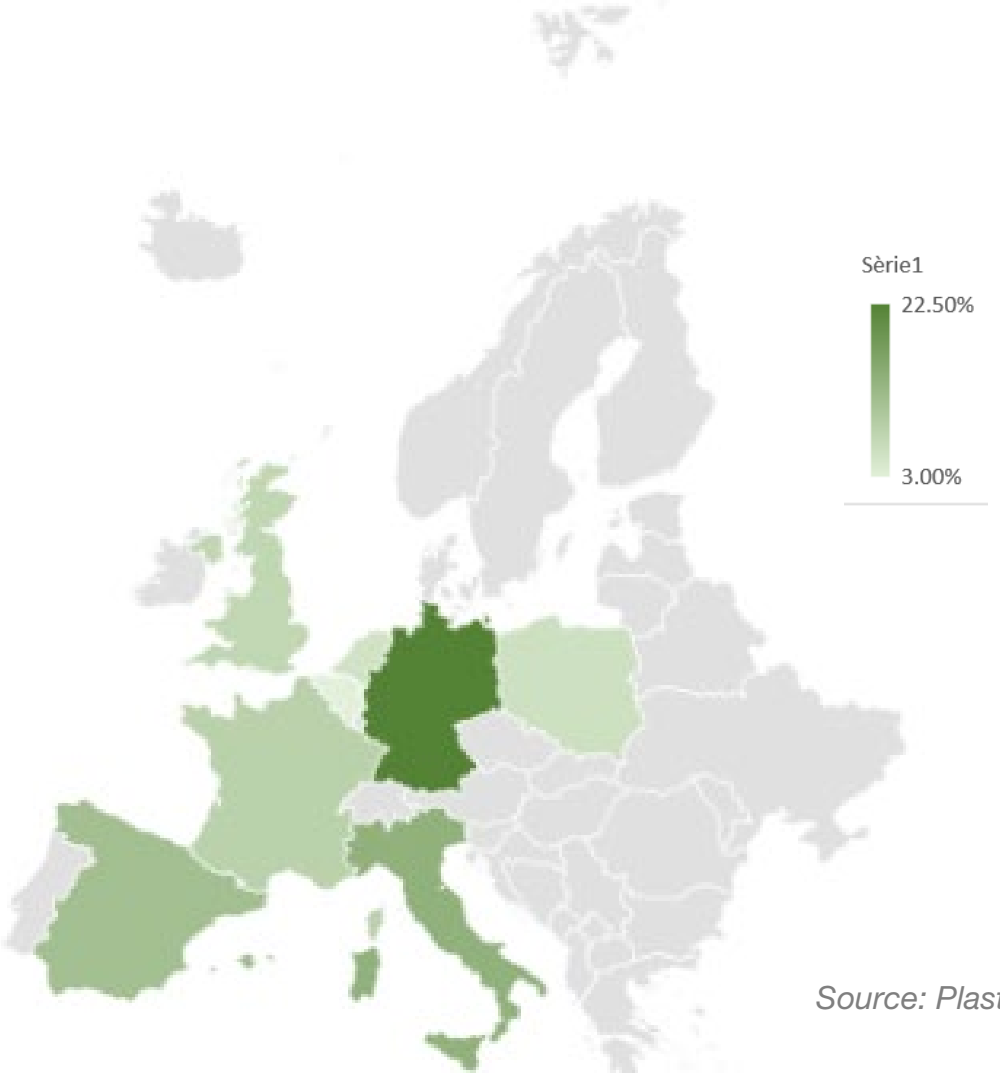
Post-consumer recycled plastics production (mechanical & chemical) in Europe

7.7 Mt

European post-consumer recycled plastics production in 2022

Post-consumer recycled production	
United Kingdom	7.50%
Netherlands	5.40%
Belgium	3.00%
Germany	22.50%
France	8.50%
Spain	11.60%
Italy	14.10%
Poland	5.90%
Other EU27+3 Countries	21.50%



Source: Plastics Europe Facts 2023

ACCIÓ Catalonia Trade & Investment

Generalitat de Catalunya
Government of Catalonia

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10. Plastic Pollution

- Plastic Pollution
- Plastic waste emitted
- International Policies
- UN Plastic treaty
- Plastic waste leakage
- Waste in the coastline
- The problem of microplastics
- Source of microplastics
- Removal microplastics technologies
- Emerging techniques for removal microplastics

Plastic Pollution

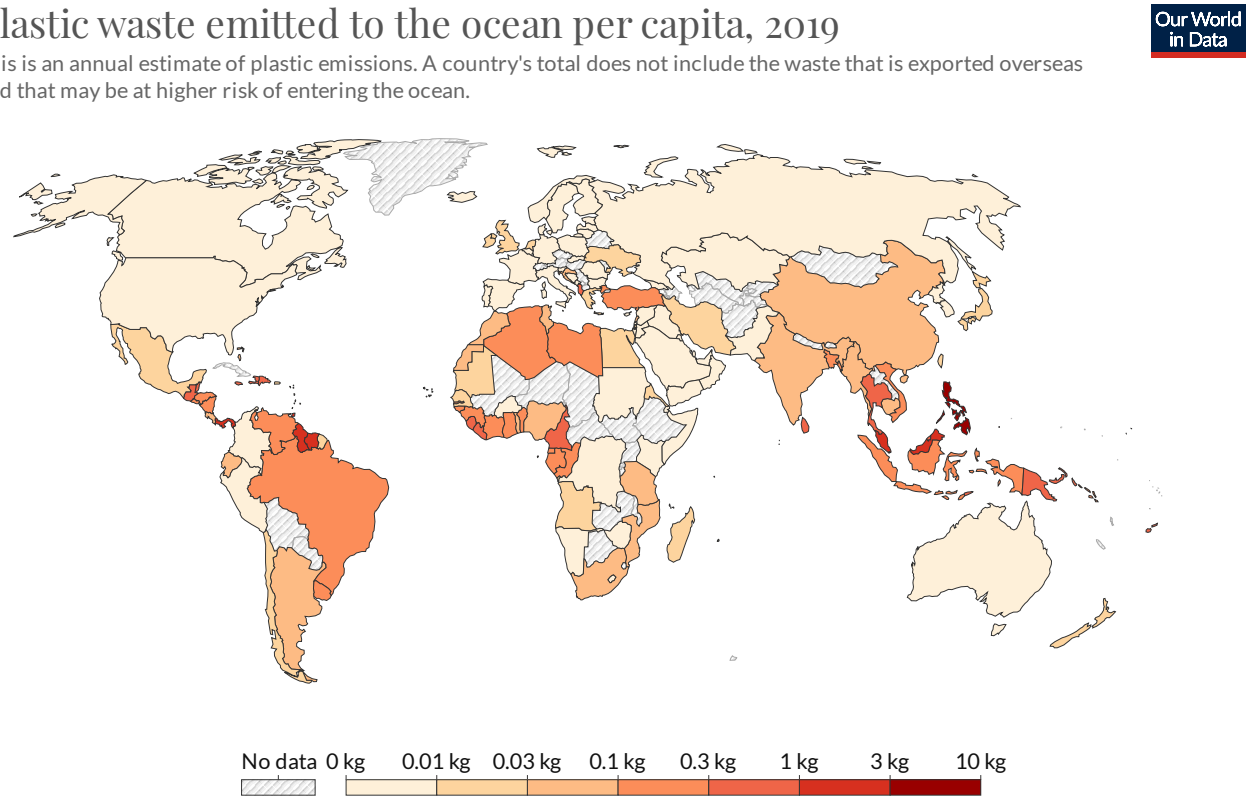
Every minute, the equivalent of one garbage truck of plastic is dumped into our ocean

- Plastic pollution has become one of the most pressing environmental issues, with impacts om ecosystems, biodiversity, climate and human health, as rapidly increasing production of disposable plastic products overwhelms the world's ability to deal with them.
- Plastic pollution can alter habitats and natural processes, reducing ecosystems' ability to adapt to climate change, directly affecting millions of people's livelihoods, food production capabilities and social well-being.
- Without new and effective control measures, plastic production is set to double in 20 years and plastic waste leaking into the ocean is projected to triple by 2040.

Source: UN. Envronment programme, Natonal Geographics, UNESCO,

Plastic waste emitted

- Most of the plastic trash in the oceans flows from land.
- Trash is also carried to sea by major rivers, by rain, wind, overflowing storm drains and littering – and transported out to sea. A smaller but still significant amount, such as fishing gear, is lost or simply dumped into the ocean.
- Once at sea, much of the plastic trash remains in coastal waters. But once caught up in ocean currents, it can be transported around the world.
- Once plastic gets into the ocean, it doesn't decompose but instead tends to break down into tiny pieces due to the action of the wind, salt and wave.
- These particles, called microplastics, are really not easily cleaned

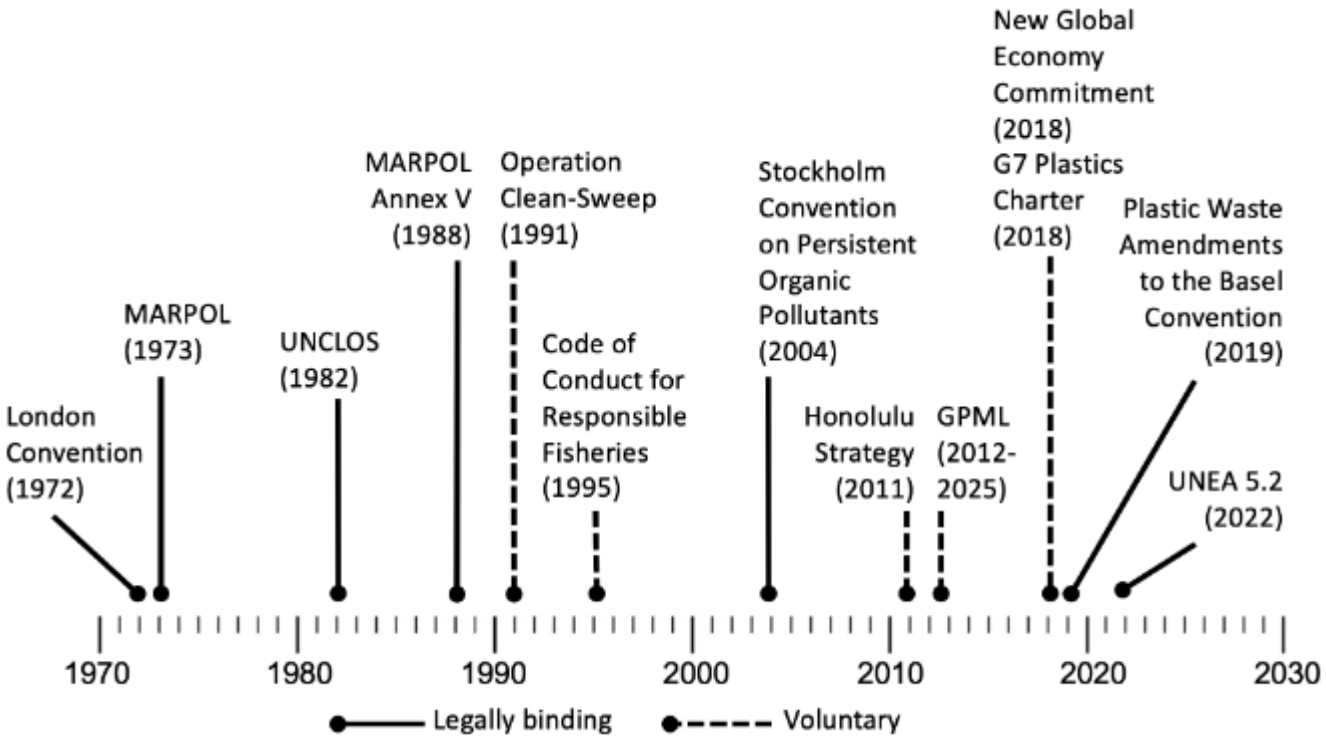


Source: UN. Envronment programme, Natonal Geographics, Our World in Data, https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0281596

International Policies

International policy and maritime-law interventions may have played a role in slowing the increasing trend of plastic waste in the oceans

International policy interventions and maritime law.



Source: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0281596

UN Plastic treaty

Intergovernmental Negotiating Committee (INC) to develop an international legally binding instrument on plastic pollution, including in the marine environment.

In February 2022, a landmark resolution was adopted to develop a legally binding international instrument on plastic pollution, including in the marine environment, with the ambition to complete negotiations by the end of 2024.

The instrument will be based on a comprehensive approach addressing the complete life cycle of plastic.

The second session of the INC, has been held at the end of May 2023 in Paris and has concluded with a mandate for the President of the INC, with the support of the Secretariat, to prepare a zero draft of the agreement before the next session, which will have place in Nairobi, Kenya, in November 2023.

More than 1,700 participants in Paris (more than 700 Member State delegates from 169 Member States and more than 900 NGO observers) attended the session, hosted by France at the headquarters of the United Nations Educational, Scientific and and Culture (UNESCO) in Paris.

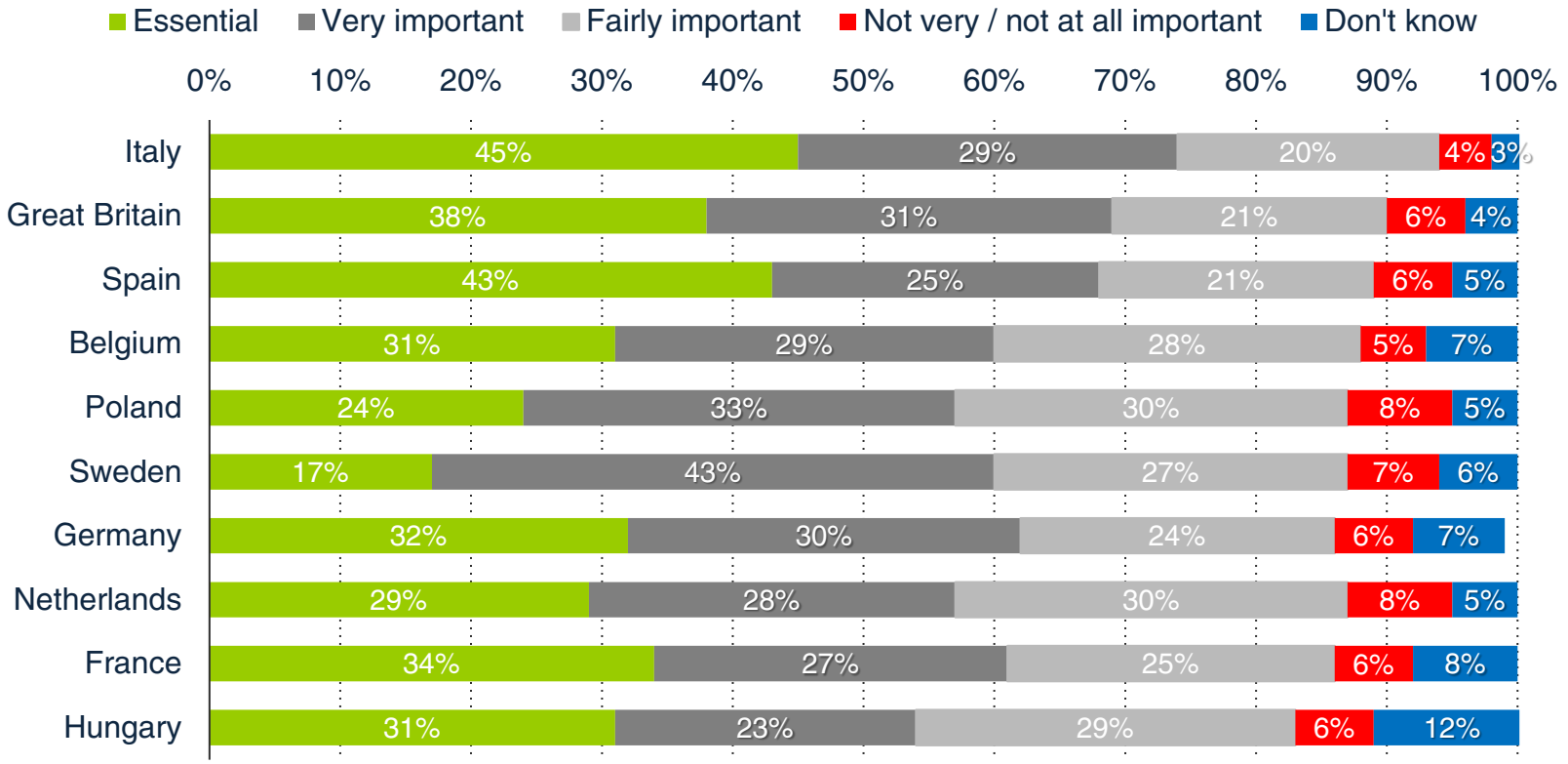
Source: UN Environment programme

Support for an international treaty to combat plastic pollution in Europe 2021

A poll by WWF and IPSOS of more than 20,000 people from 34 countries shows strong support for the world's first plastics treaty to create binding global rules that apply to all countries, rather than a voluntary global agreement.

The largest share of adults who believed such a treaty was essential to combat plastic pollution was in Italy, at 45%.

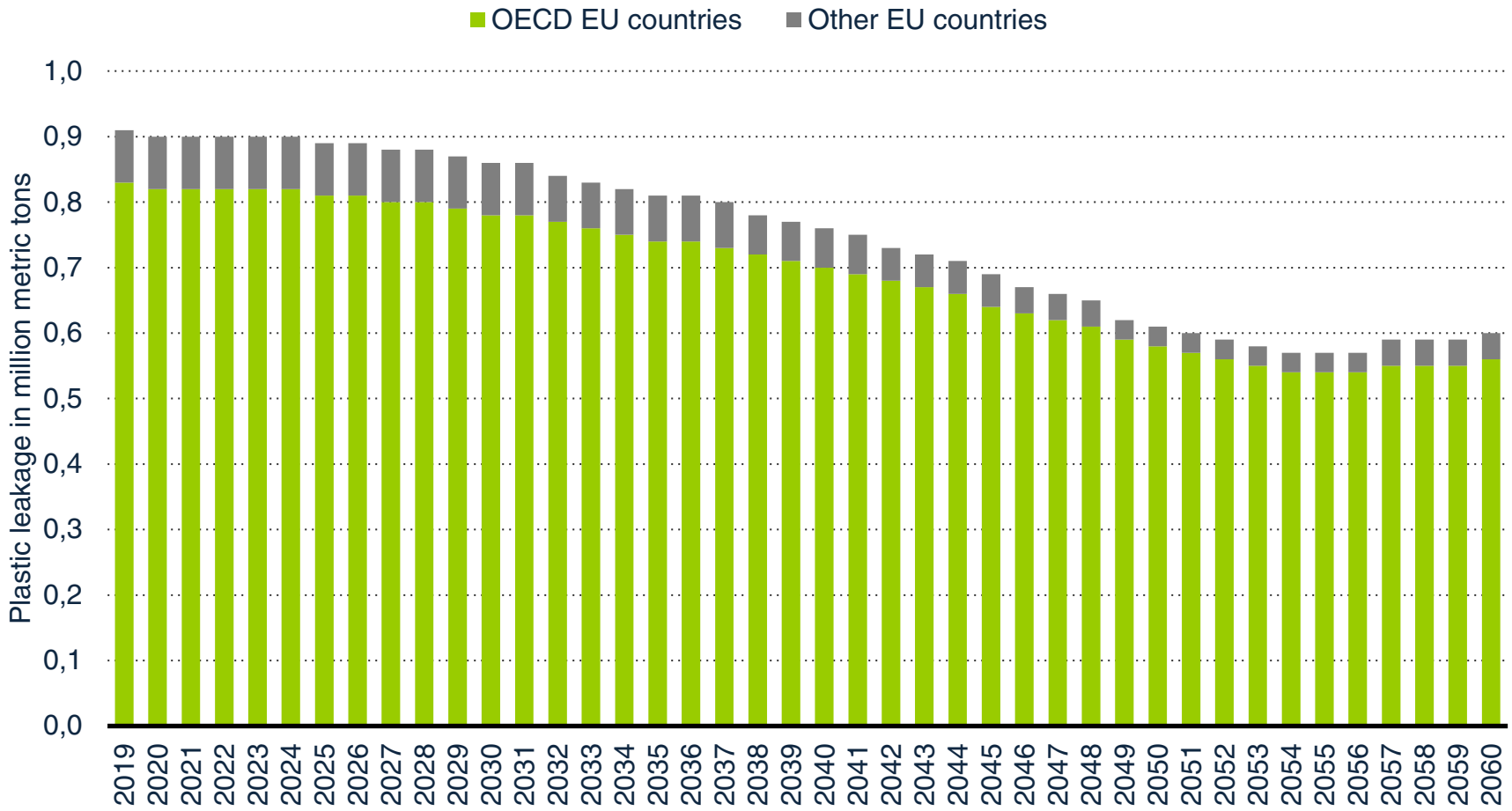
Spain followed, with 43% of adults believing a treaty on plastic pollution was essential.



Source: Ipsos; WWF, Statista

Plastic waste leakage to the environment from the European Union 2019-2060

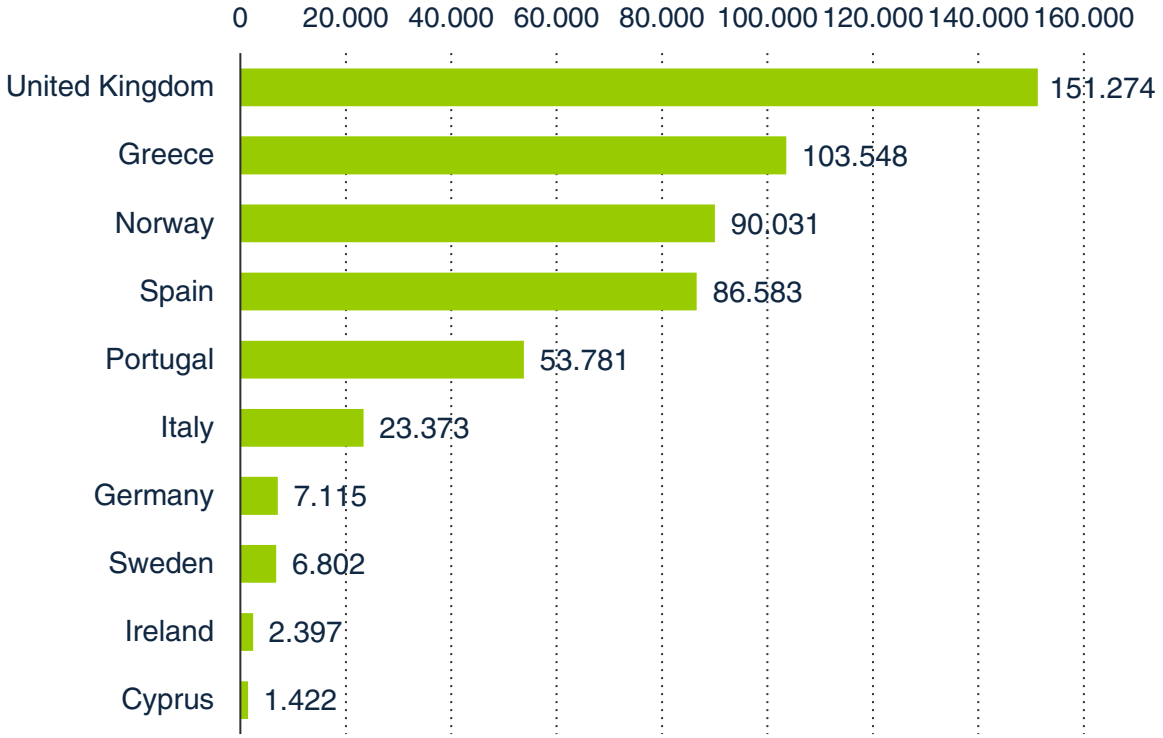
- The European Union was responsible for some 0.9 million metric tons of plastic leakage to the environment in 2019.
- It is projected that annual leaked macro- and microplastics to the environment attributable to the European Union will decrease over the coming decades.
- Mismanaged plastic waste is a major source of plastic leakage to the environment.



Source: Statista

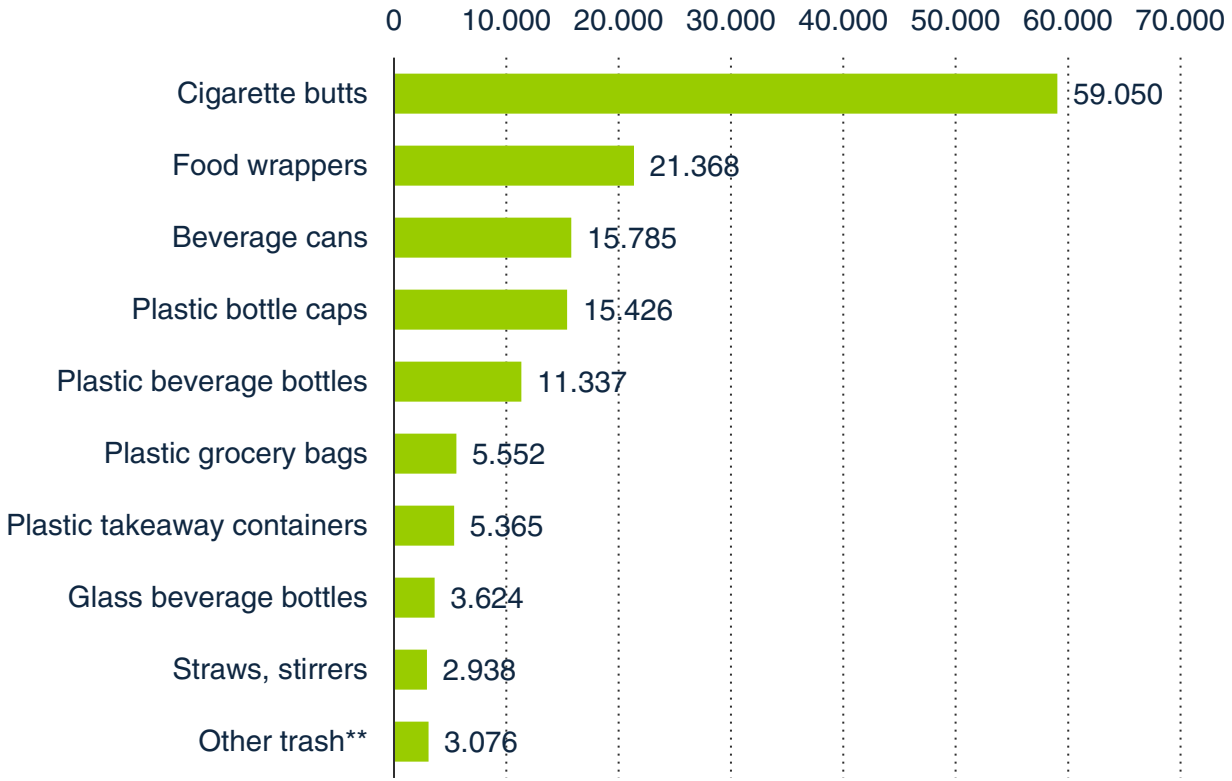
Waste in the coastline. Europe

Number of waste items found along the coastlines in Europe 2020, by country



Volunteers around the United Kingdom collected more than 150,000 waste items

Number of waste items found along the coastlines of Europe 2020, by type



During the International Coastal Ocean Cleanup day in September 2020, thousands of people across Europe volunteered to collect waste from coastlines. The most found waste items were cigarette butts, with roughly 59,000 collected. The second most found waste items were food wrappers, with 21,368 found.
** Other trash: include indiscernible plastic pieces, clothing and metal pieces.

Source: Statista

The problem of microplastics

- The enormous rise in the production of the plastics causes a significant amount of plastic waste on the land entering water bodies.
- If the particle size is small at the micro level (less than 5 mm in diameter), it has significant potential for blocking the fine pores of filtration and membrane systems. Microplastics (MPs) have stability and longer residence time in water bodies.
- The ability of the MPs to adsorb other toxic pollutants present in the aquatic environment can also cause dangerous diseases to human and aquatic life. A major threat is posed by microplastics: plastic fragments of less than 5mm entering the food chain as non-degradable contaminants and accumulating in animal tissue.
- Generally, MPs are categorized into primary and second micro pollutants. Primary MPs are microplastics that generate directly from manufactured plastics and secondary MPs are those fragmented from large plastic particles.
- The occurrence of microplastics (both primary and secondary) in water primarily takes place through the discharge of sewage/wastewater treatment plant effluent and surface run-off.
- Removal of microplastics becomes challenging owing to their wide occurrence and small size, which usually allows them to escape the sieving/filtration processes.
- Microplastics characteristics, including size, shape, and surface properties, can significantly affect the behavior of MP particles in various MP removal technologies, and therefore, determine the removal efficiency.
- Conventional wastewater treatment plants are not fully efficient for their removal and hence final effluent contains significant amounts of microplastics.

New restriction for intentionally added microplastics

The EU has issued legislation to regulate microplastics under Annex XVII of REACH.

- The new rules will prevent the release to the environment of about half a million tonnes of microplastics. They will prohibit the sale of microplastics as such, and of products to which microplastics have been added on purpose and that release those microplastics when used.

- The adopted restriction uses a broad definition of microplastics– it covers all synthetic polymer particles below five millimetres that are organic, insoluble and resist degradation. The purpose is to reduce emissions of intentional microplastics from as many products as possible. Some examples of common products in the scope of the restriction are:

- The granular infill material used on artificial sport surfaces– the largest source of intentional microplastics in the environment;
- Cosmetics, where microplastics is used for multiple purposes, such as exfoliation (microbeads) or obtaining a specific texture, fragrance or colour;
- Detergents, fabric softeners, glitter,fertilisers, plant protection products, toys, medicines and medical devices, just to name a few.

- Products used at industrial sites or not releasing microplastics during use are derogated from the sale ban, but their manufacturers will have to provide instructions on how to use and dispose of the product to prevent microplastics emissions.

Source: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_4581

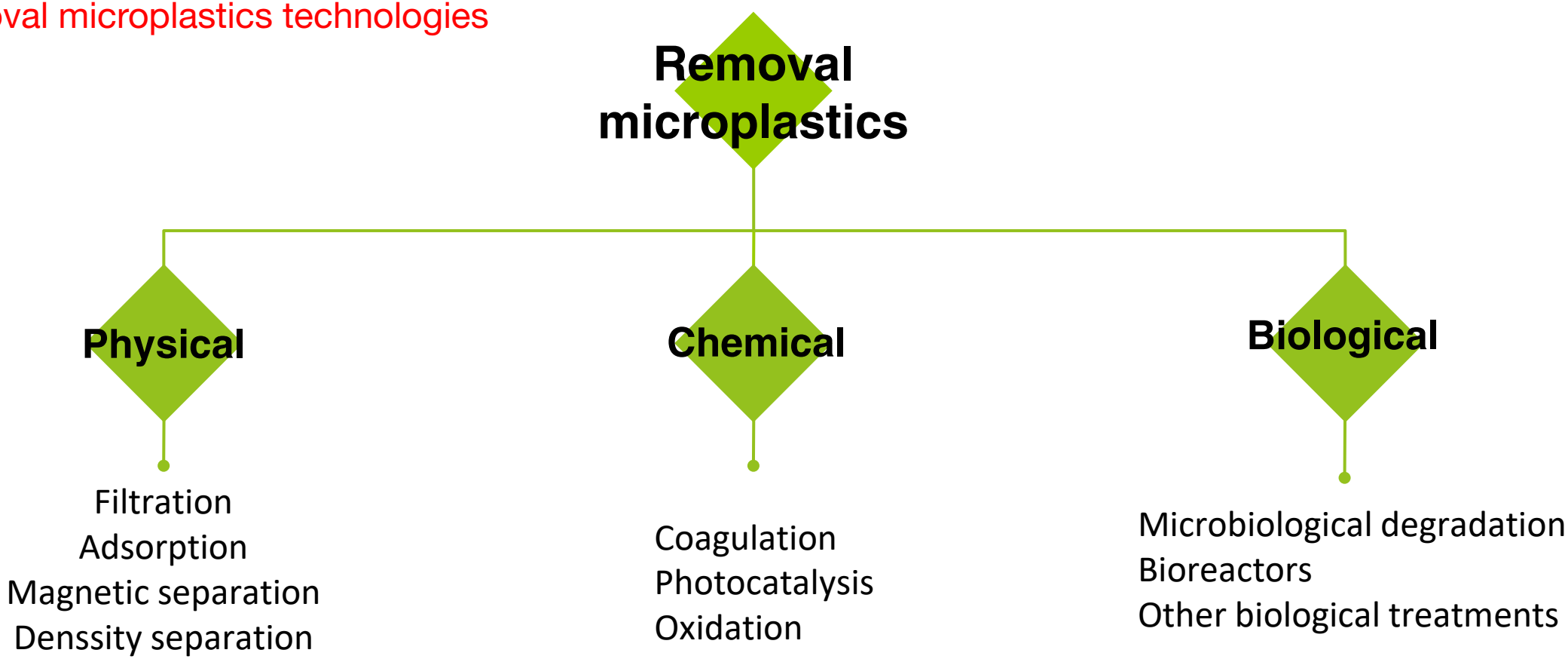
Source of microplastics

It is estimated that more than a third of the microplastics floating in the oceans come from synthetic fabrics, which are produced in washing processes.

Car tires are the second most important source, with 28% resulting from erosion while driving.

IUCN, 2019
Armstrong, Martin. "Where The Ocean's Microplastics Come From." Statista, Statista Inc., 11 Aug 2022, https://www.statista.com/chart/17957/where-the-oceans-microplastics-come-from/

Removal microplastics technologies



Source: W. Gao, Y. Zhang; A. Mo, et al. "Removal of microplastics in water: Technology progress and green strategies", Green Analytical Chemistry. Dec 2022. Elsevier.
"Existing and emerging technologies for microplastics removal from wastewater and stormwater", FanLEStic-sea project 2021. Interre Baltic Sea Region
S. Singh et el. "Removal of microplastics from wastewater: available techniques and way forward", Dec. 2021. Water Science&Technology
Mohammad R Alrbaihat1 and Qusay Abu-Afifeh"Eco-friendly microplastic removal through physical and chemical techniques: a review", Annals of Adavances I Chemistry. HSPI Innoplastic*
Wasser 3.0. EIB

Physical technologies (I)

Filtration

Membrane filtration technology has been widely used in both drinking water plants and wastewater treatment plants. Various membrane filtration technologies are used to control MP contamination, including microfiltration, ultrafiltration, dynamic membrane, reverse osmosis, and membrane bioreactors.
Additionally, media filtration technologies such as sand filtration and the use of activated carbon particles are also used in Drinking water treatment plants.
The membrane filtration approach was often combined with other technologies, such as the use of coagulants or biocatalysts processes.
The main problem they can present is contamination of the membrane and blockage of the passageway.
Ultrafiltration is the most effective for removing MP, but its disadvantages include low flow, high incidence of membrane clogging, and the need to apply pressure.
New generation filters with a membrane of nanocellulose could trap de MP without the need for a chemical agents or mechanical action.

Adsorption

Adsorption removal is quite effective in removing nanoplastics and small microplastics, especially smaller than 10μm.
The adsorption mechanism involves electrostatic or hydrogen bonding interactions.
Furthermore, adsorbents can be designed with suitable porosity so that they can efficiently absorb and separate MP from water.
The pore structure can guarantee the rapid passage of solvents, with sufficient contact between the MP and the adsorbents.
Among the adsorbents we can highlight Zn and AL hydroxide, metal-organic Zn foams, aerogel, biochar

Physical technologies (II)

Magnetic separation

In recent years, magnetic separation has been developed for MP removal. In the removal process, magnetic nanoparticles with large specific surface were used as adsorbents to combine with MPs, then magnetized MPs can be easily and quickly separated from water through magnetic force.

The action of magnetization of MPs is involved with multiple types of mechanisms as hydrophobicity, complexation, electrostatic interaction, electron interaction, among others.

In addition, to ensure that the quantity of magnetic adsorbents exceed the total of MPs in water, it is usually necessary to add a large amount of magnetic adsorbents. Thus, there is an issue how to fully eliminate additive magnetic materials after treatment.

However, this approach needs large-scale application to verify its effectiveness. Thus, elimination of residuals of magnetic adsorbents should be seriously considered, in order to reduce the potential environmental risks.

Density separation

Density separation is a commonly used method to extract microplastics from sediments or sand using the principle of the difference in specific density of sediments (e.g., 2.6 g cm–3) and plastics (0.1–1.7 g cm–3).
In density separation, dense solutions that have been proposed include sodium polytungstate (density: ~3.2 g cm–3), zinc chloride ($ZnCl_2$, density: ~1.8 g cm–3), zinc bromide ($ZnBr_2$, density: 1.7 g cm–3), and sodium iodide (NaI, density: ~1.8 g cm–3)
Due to the higher densities of these salt solutions compared to most microplastics (0.9–1.5 g cm–3), less dense microplastics float and separate out from the more dense, sinking, sediment materials.

Chemical technologies (I)

Coagulation

Coagulation is typical treatment approach in DWTP, and also effective to remove MPs in water. In the coagulation process, suspended MPs particulates are destabilized and aggregated by the addition of coagulants, then form large flocs via interaction, and finally cause their separation from water matrices.
The approach of coagulation has been applied in both DWTP and WWTP.
Currently, multiple types of coagulants were used in the removal of MPs. Of them, aluminum salts and iron salts are most commonly used kinds of coagulants. However, the residual of these inorganic salts would pose a potential toxic risk on aquatic organisms.

The coagulation has advantages such as simple operation and low cost, but of disadvantages of coagulant residuals and potential secondary pollution. After coagulation treatment, residuals of metal coagulants would further induce ecological toxicity.

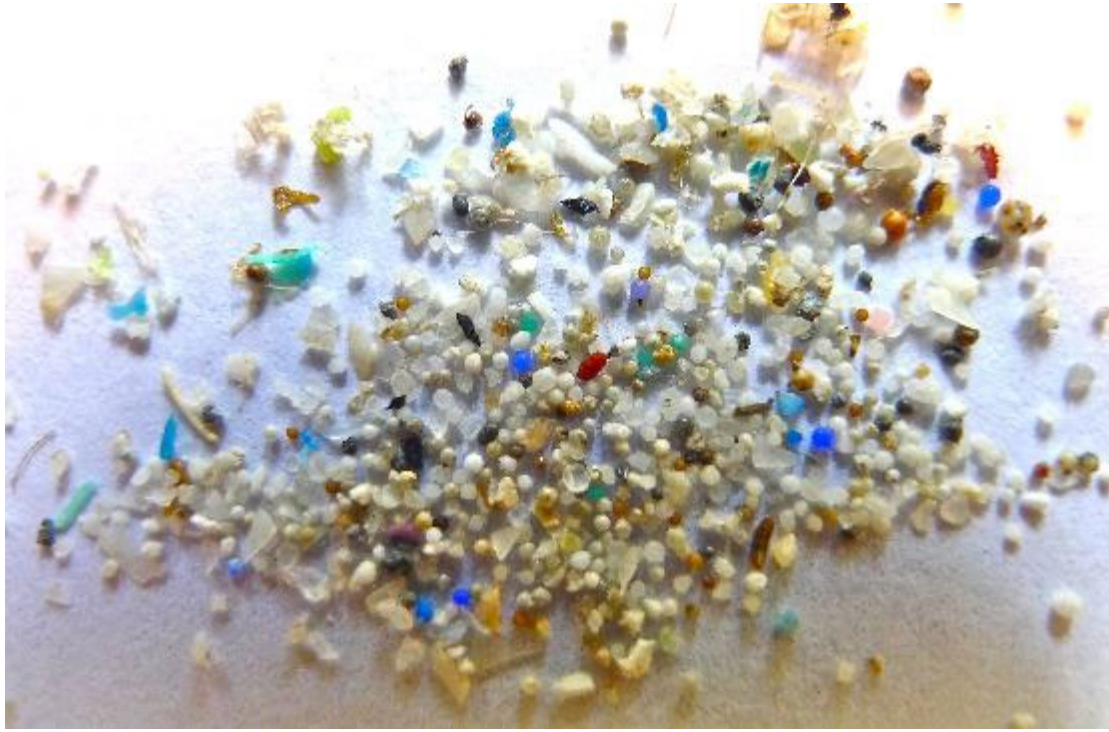
Oxidation

The chemical oxidation approach is based on the breakdown of PM into small molecules or mineralization.
This method has been widely used to mineralize multiple types of organic contaminants through the oxidizing action of radicals, such as $SO_4^{\bullet-}$ and $HO^{\bullet}$.
After the oxidation treatment, multiple kinds of short-chain organic compounds such as alkenes, alcohol, monocarboxylic acids, dicarboxylic acids, and esters were found in the post-treatment solution.
After the treatment, the PM could be directly mineralized into gaseous inorganic products, such as CO_2, without other intermediate products in the reaction solution.
However, some problems with this technology are high power consumption and the need for complex reaction devices.

Chemical technologies (II)

Photocatalysis

Photocatalysis treatment is based on generation of hydroxyl radicals through electronic excitation of a semiconductor oxide by natural light or artificial light source.
This technology has been demonstrated effective for oxidization of MPs in water.
In addition, photocatalysis could cause complete mineralization of MPs, and was considered as a green and cost-efficient approach for MPs pollution abatement.
Degradation efficiency of photocatalysis varied among different types of MPs.



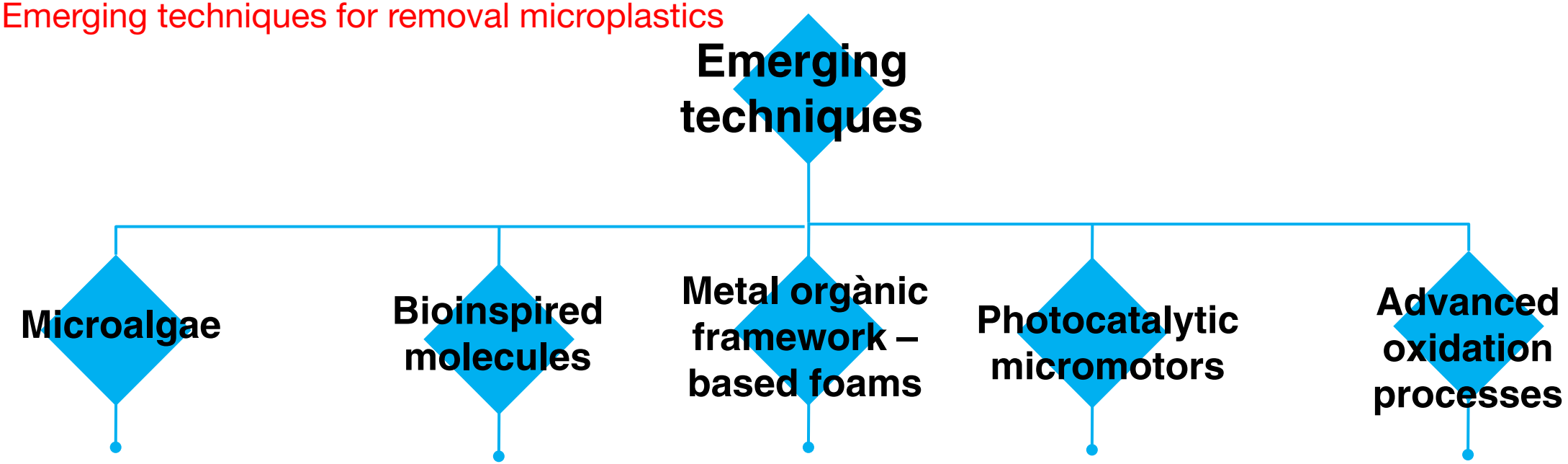
Biological technologies

Biodegradation

Biological degradation of natural and some synthetic polymers occurs when polymer depolymerisation takes place as the result of enzyme secretions by some microorganisms.

Polyurethanes in particular are sensitive to microbial attack, although polyether polyurethanes are more resistant to biological degradation than polyester polyurethanes

Emerging techniques for removal microplastics



Microalgae may offer a possibility for microplastic removal, as microalgae have been seen to colonize microplastic particles thus altering the buoyancy of aggregates. This results in differential settling rates compared to unaggregated particles.

These bioinspired molecules consist of an inclusion unit (UI) and a capture unit (CU), which combine to form an inclusion compound (IC). In this, IU is the bioinspired component, and the CU component has the ability to bind to the various materials through functional groups. After the capture of the microplastics in the inclusion cavity, the embedded water molecules are displaced.

MOFs are porous structures that are the combination of metals and organic ligands. With a large surface area, porosity, and versatile functionality, these chemical moieties help trap a variety of contaminants. In order to trap microplastics, the material must have sufficient porosity, a proper framework to capture the contaminant, and high durability.

Micromotors are miniature self-propelled devices that have been used in the removal of petroleum, metals/metalloids, and various organics. Being photocatalytic, these micromotors could move themselves in the water due to photocatalytic reactions taking place on the particles. Removal was achieved by phoresis.

Advanced oxidation processes are one of the most suitable methods for the mineralization of various persistent organic pollutants. Reactive oxygen species, such as the hydroxyl radical, the sulfate radical, are commonly used to mineralize some microplastics.

Source: https://iwaponline.com/wst/article/84/12/3689/84990/Removal-of-microplastics-from-wastewater-available

11. Regional Plastic Ecosystem

Regional Plastic Ecosystem

Tampere Region / Finland

Catalonia / Spain

Fryslân / The Netherlands

Lombardy / Italy

Värmland /Sweden

Savinja-Šalek Region /Slovenia

Plastic sector in Tampere Region / Finland

Plastic Sector in Finland

500 companies

€ 2,400 M turnover

600 t of plastic products produced annually

Export 60.0%

Plastic packaging
Production: 133,300 t
Recycled: 56,208 t

Plastics Products sales amount **9,9% of Chemical sector sales** (2019)

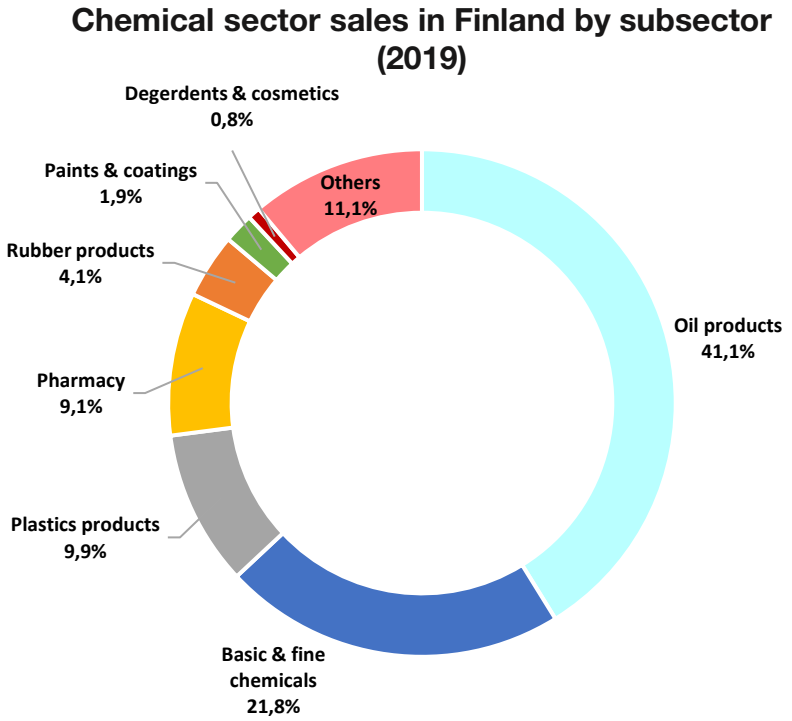
Plastic product sales in Finland is around 2.4 billion € (2019).

Source: Suomen ympäristökeskuksen raportteja 2 | 2022, and www.kemianteollisuus.fi

****Data from Finland as a whole***

ACCIÓ Catalonia Trade & Investment
Generalitat de Catalunya Government of Catalonia
Interreg Europe Co-funded by the European Union PLASTIX

Plastic Sector in Finland



- In Finland, approximately 600 thousand tons of plastic products are produced per year. In addition to domestic production, an almost equivalent amount of plastic raw materials is imported and a significant part of domestic production is exported abroad.

- End use of plastic products follows the general distribution of Western Europe: most plastic is used in packaging (40%); in the construction industry (24%); in the electrical and electronics industry (6%); in agriculture (6%) and in cars and means of transport (3%). For other uses, such as household items, 21% of plastic products end up in clothes and furniture

- Plastics industry comprise of around 500 companies.

- Sales of plastic products accounted for 9.9% of the total sales of the chemical sector in Finland.

Source: Suomen ympäristökeskuksen raportteja 2 | 2022, and www.kemianteollisuus.fi

Co-funded by the European Union

The plastic value chain in Tampere Region

non-exhaustive list

Production of raw materials that include even production of polymers

Manufacturing: Plastic conversion and product manufacturing

End of life treatment, collection, classification, mechanical recycling, chemical recycling, energy recovery

Amerplast
nmc
Muoviteknikka V. Riittinen Oy
FINNCONT CONTINUITY
Muovityöstö Kivelä
KESTOMUOVI
MOLOK
Leomuovi Group
muovityö
proplast oy
VMT Plastic Solutions 50
Tampereen Liikeacryl
Aksen Muovityö Oy
JITA
amcor
artekno
ELECSTER
FIBOX Enclosing Innovations
TT GASKETS
wavin
walki
WIPAK
PREMIX

PIRKANMAAN JÄTEHUOLTO
remeo
HYÖTYPAALAUS
urbaser
WASTEWISE GROUP
L&T
TE Group Oy
STENA RECYCLING
REVISOL
KUUSAKOSKI RECYCLING

Ecosystem agents in Tampere Region

Universities

Tampere University

R&D Tech centers

VTT

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

Luke
LUONNONVARAKESKUS

Clusters & Associations

Sumi Oy

KEMIANTEOLLISUUS

muovipoli

Suomen Pakkaustuottajat Oy
Finlands Förpackningsproducenter Ab
Finnish Packaging Producers Ltd

RINKI

Suomen Maatalousmuovien Kierrätys Oy

Comercial fair & Congress

MUOVI YHDISTYS
THE FINNISH PLASTICS ASSOCIATION

MUOVITEOLLISUUS RY
Finnish Plastics Industries Federation

BUSINESS FINLAND

Public Administration

Elinkeino-, liikenne- ja ympäristökeskus

Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

ACCIÓ
Catalonia Trade & Investment

Generalitat de Catalunya
Government of Catalonia

Interreg Europe

Co-funded by the European Union

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National initiatives

Plastics roadmap for Finland 2.0:
A sustainable circular plastics economy involves numerous goals arising from various acts, commitments and programmes.

- Main goals
  - reduce littering of the environment and other environmental harm caused by plastics,
  - avoid unnecessary consumption of plastics and promote the reuse of plastics,
  - enhance the recycling of plastics and recyclability of plastic products and
  - replace virgin plastic manufactured from fossil raw materials with recycled plastics or sustainably produced renewable materials.

- At the EU level, these include the waste directives, the directive on singleuse plastics (SUPD), circular economy programmes, the plastics strategy, the marine strategy, the chemicals strategy and regulation on chemicals, legislation on food contact material and the regulation on the use of recycled plastic in food packaging, as well as the Member States' contribution partly being based on the rate of plastics recycling.

- At the national level, the circular plastics economy is steered, for example by the Waste Act and waste decrees, voluntary Green Deal commitments, the programme of measures of Finland's marine strategy and the national waste management plan. Plastics-related goals are also included in several pending EU initiatives.

- These diverse goals jointly define the operating environment for the circular plastics economy and pave the way for the achievement of the goals laid out in the Plastics Roadmap

National incentives: Circular Economy Green Deal

- The Circular Economy Green Deal consists of common frameworks and criteria, and of commitments to promote a low-carbon circular economy by the parties that wish to participate. Green Deal is voluntary, and no formal agreements are concluded.
- The Circular Economy Green Deal enables the parties involved to identify circular economy actions in their own operations that have the greatest impact. The participants are expected to make a commitment to activities such as collaboration and collecting data on their own field of operations.
- It has six focus areas:
  1. Resource-wise buildings
  2. Circulating soil and rock materials
  3. Resource-wise production and circulating materials
  4. Sustainable consumption business and sharing economy
  5. Resource-wise energy production
  6. Renewing food chain

Policies in Tampere Region (III)

National incentives: National Waste Plan

From Recycling to Circular Economy
National Waste Plan to 2027

Vision of the National Waste Plan to 2030:

1. Material-efficient production and consumption save natural resources and mitigate climate change.
2. The volume of waste has decreased from the present. Recycling and reuse have risen to a new level.
3. High-quality waste management is part of a sustainable circular economy.
4. Circular economy markets function well. Recycling and reuse create new jobs.
5. Valuable raw materials present in recycled materials even in small concentrations can be recovered.
6. Material cycles cause no harm and hazardous substances are used less and less in production.
7. Cooperation between operators in the sector promotes high-quality material cycles.
8. Reliable and comprehensive data supports the circular economy. Information is available for use in digital form.
9. There is high-quality research and experimentation in the waste sector and expertise on waste management is of a high standard.
10. Legislation supports circular economy innovations and the conditions where it operates.

Source: National Waste Plan of Finland

Finland's Roadmap to Circular Economy 2.0

Renewal of the foundations of competitiveness and vitality

- Their objective is to develop the economy in such a way that, in Finland, circular economy solutions are focused on competitiveness and an economic growth strategy. For Finland, the circular economy could create added value amounting to several billions of euros a year and boost the competitiveness of Finnish companies in the global markets, creating tens of thousands of new jobs. The pursuit of a carbon-neutral circular economy has created the world's fastest growing market: by 2030, global investments amounting to 90 trillion US dollars would be needed for the targets set in the Paris Agreement to be reached (We Mean Business Coalition, 2016).

Transfer to low-carbon energy

- In a circular economy, we still need energy for producing well-being. That energy must be sustainably produced, renewable and low carbon. In addition, it must be possible to promote the efficient use of energy. To enable the development of a circular economy and the limiting of global warming to 1.5 degrees, Finland should consider raising its level of ambition both with its national policy and with the European Union's climate and energy policy.

Source: Sitra.fi, The Critical Move: Finland's Roadmap to Circular Economy 2.0

Finland's Roadmap to Circular Economy 2.0

Natural resources are regarded as scarcities

- The processing of natural resources and materials and the manufacture of products generate a major part of the global greenhouse gas emissions. Finnish consumption and production habits can no longer be based on the limitless use of natural resources, and a circular economy is needed for reaching a sustainable level and the climate targets set by the Paris Agreement. Key measures include returning materials to the cycle again and again, the material efficiency of products and the adoption of circular economy business models. The circular economy also plays a central role when solving challenges related to the scarcity of natural resources, such as the sufficiency of earth metals. The use and processing of natural resources and the manufacture of products have environmental impacts in different countries and continents. Finland should pay attention to where in the world making investments would reduce the harmful environmental impacts of industrial production the most.

Everyday decisions working as a driving force for change

- The economic game will not proceed to the next level, the level required by the circular economy, without the everyday choices made by all of us. Almost 70 per cent of Finland's greenhouse gas emissions are related to housing, transportation and food. At the present rate, the Finnish way of life would require natural resources of almost four planet Earths. By taking advantage of the existing sustainable solutions, we could cut our everyday emissions by up to 37 per cent, when we use the emissions level of 2010 as the point of comparison. This could be easily implemented without too many people feeling that they need to give up something – they would rather feel like they are gaining new benefits in their everyday lives. By 2030, we should strive to cut our carbon footprint in half from the level of 2010, as also proposed in the Government Report on Medium-term Climate Change Plan (2017) (link in Finnish). This requires that we adopt a new kind of approach to ownership, in terms of culture, taxation and income distribution. Everybody should have the opportunity not to own things.

Source: Sitra.fi, The Critical Move: Finland's Roadmap to Circular Economy 2.0

Policies in Tampere Region (VI)

Regional initiatives

Regional Development Programme 2022–2025 of Tampere Region and Smart Specialisation Strategy:

Regional Circular Economy Vision 2040 for Tampere Region

Pirkanmaa's environmental program

YMPÄRISTÖVIISAS PIRKANMAA 2040

Pirkanmaan ympäristöohjelma

- **Pirkanmaa is one of the Hinku regions**

The Hinku regions and the Hinku communities in each region jointly commit to reducing the regions' greenhouse gas emissions by 80 per cent from the 2007 levels by 2030.

Instruments in Tampere Region

RRF financing

EU Programmes for international co-operation

EU funding

ERDF Programme 2021-2027 of Finland, Specific Objective 2.3: Promoting the transition to a circular economy

Nacional Funding

Funding for bio- and circular economy innovation in plastics is available from a variety of sources. The main funding channels for companies are Business Finland and EU funding in various forms. Grants are also available from ministries and ELY centres for business development and pilot projects.
Industry size

Regional Funding

Challenges & Opportunities

Opportunities

- Improving the separate collection of plastics from the construction and industrial sectors.
- Development of chemical conversion of plastics - new companies
- Improving separate collection and further processing of rigid plastics.

Challenges

- Fragmentation of material flows and quantities and supply logistics at regional level. For example, agricultural plastics
- Plastic separate collection and low recycling.

Social Dialogue

- Participation of citizens is an essential part of all political decision making and implementation in Finland.
- New waste legislation obligates separate collection of plastic from households and companies.
- Awareness plays a crucial role in ensuring that citizens and companies sort their plastic waste.
- Plastic bottle returning rate is very high in Finland and people are very motivated to return bottles to the recycling system because of the deposit system.

Changes expected in the instruments and policies to improve their impact and their contribution to the implementation of the European plastics strategy in in Tampere Region

The Regional Development Strategy and Programme of Tampere Region will be updated in 2024-2025 partly based on the results and findings of the PLASTIX project.

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Success stories: Chemical recycling

WASTEWISE GROUP

WasteWise Group

Innovative technology enables the recycling of mixed plastic waste back into raw materials for the plastic industry.

In addition to mechanical recycling, advanced chemical recycling solutions are needed. The advantage of chemical recycling is the high quality of the final products, which does not differ from the original fossil ones.

Pyrolysis plants process pre-treated plastic waste into a high-quality oil product that continues its journey to the oil refinery to replace fossil feedstock.

The refinery's final product is new raw materials for the plastics industry.

https://www.wastewise.fi/briefly-in-english/

Plastic sector in Catalonia / Spain

Plastic Sector in Catalonia

860 companies

€ 5,400.9 M turnover

25,081 jobs

Export
40.0% are exporters.
89% export to Europe

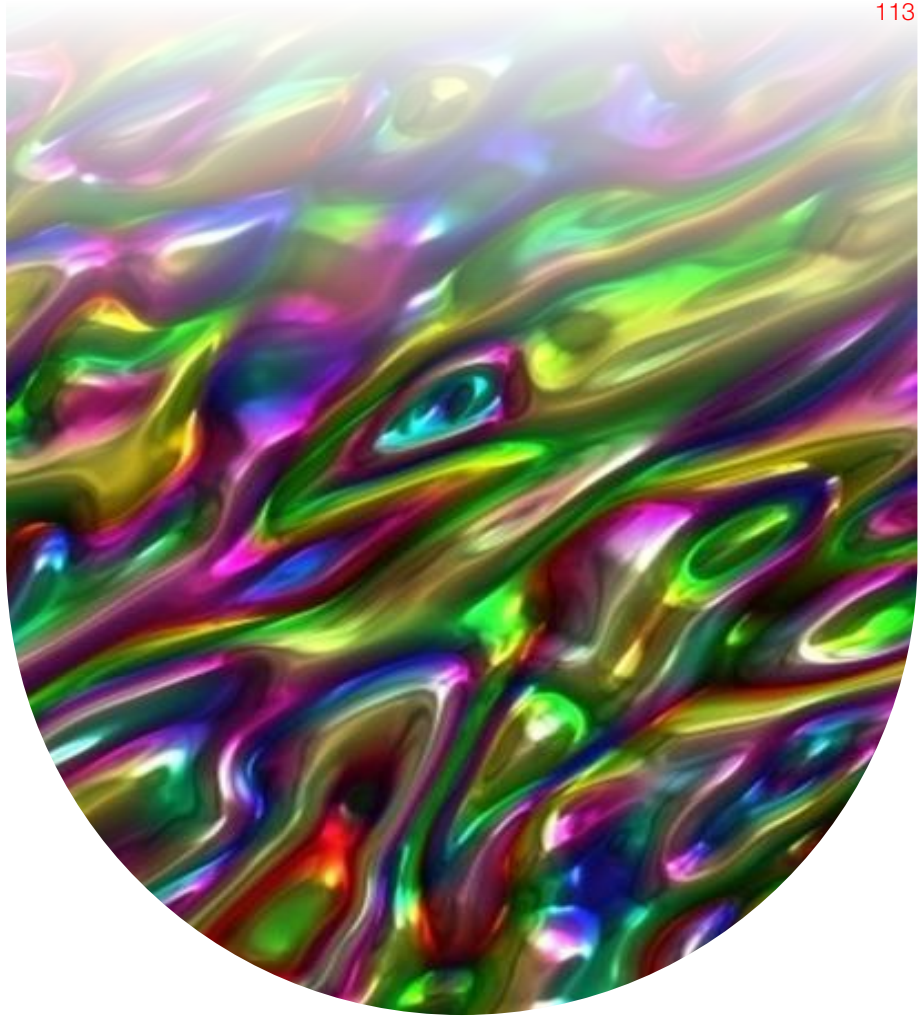
Investment in innovation**:**
0.8% turnover

Industrial Gross value added:
4.8%

279,066 tonnes post-consumer plastics waste were sent to recycling in 2021

In Catalonia, the volume of production grew by 8.8% (2021)

60% of plastic waste is recovered, either through material recovery (**25%**), which returns the plastic to the beginning of the production chain, or through its energy recovery (34%).



Source: ACCIÓ, Informe anual Industria DGI, 2022 Generalitat de Catalunya

Plastic sector in Spain

The plastic and rubber sector, having withstood relatively well, during 2020, the strong impact of the crisis caused by the COVID, improved production, employment and exports in a similar way to the average of the industry and was thus able to recover the levels that it had before the pandemic in these three variables. On the other hand, prices rose, influenced by the increase in energy costs and raw materials, which are derived from oil.

In Spain, the plastics industry is made up of more than 3,000 companies, 98% of which are SMEs.

This sector generates **93,654 direct jobs** and a business volume of **21,805.8 million euros**, a figure that represents 3.2% of the total industry in the State and **4% of the VAB.**

- Catalonia leads the sector in Spain, both in number of companies and in turnover.
- The Catalan plastic and rubber sector has a significant weight on Spain as a whole, as it represents 24% of the VAB, 25% of the turnover, 26% of the affiliates, and 28% of exports

Font: ACCIÓ, Informe anual Industria DGI, Generalitat de Catalunya

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The plastic value chain in Catalonia

non-exhaustive list

Production of raw materials that include even production of polymers

Manufacturing: Plastic conversion and product manufacturing

End of life treatment, collection, classification, mechanical recycling, chemical recycling, energy recovery

Extended Producer Responsability Scheme, policy approach that assigns producers responsibility for the end-of-life of products.

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Ecosystem agents in Catalonia (I)

Universities

Universitat Ramon Llull · Universitat de Barcelona · Universitat de Lleida · Universitat Rovira i Virgili · Universitat de Girona · Universitat Politècnica de Catalunya BarcelonaTech · UAB Universitat Autònoma de Barcelona · UVic Universitat de Vic Universitat Central de Catalunya · UNED

R&D Tech centers

CTFC · ICIQ · IQS Tech Transfer · LEITAT managing technologies · ICN2 · pack studios · Beta · eurecat · AMIC · GREiA · lequia UdG · Centre Català del Plàstic

Clústers & Associations

aeqt Associació Empresarial Química de Tarragona · ChemMed Tarragona Mediterranean Chemical Cluster · fedeQuim Federación Empresarial Catalana del Sector Químico · feiQue · Centro Español de Plásticos · aipc associació d'Indústries del Plàstic de Catalunya · Packaging Cluster · CBC Clúster Bioenergia Catalunya · MdV · Clúster Residus

Comercial fair & Congress

Expoquimia The International Chemistry Event · Equiplast · Plastics & Rubber · Hispack · graphispag

Public Administration

Generalitat de Catalunya · ACCIÓ Generalitat de Catalunya · Agència de Residus de Catalunya · Generalitat de Catalunya Departament d'Acció Climàtica, Alimentació i Agenda Rural · Generalitat de Catalunya Consell Assessor per al Desenvolupament Sostenible

Ecosystem agents in Catalonia (II): Research and innovation centre

Pack Studios accelerates packaging innovation—enabling brands to quickly bring-to-market sustainable solutions for a dynamic and demanding world.

It has a connected network with extensive packaging experience in all aspects of the value chain and has global facilities designed to design, test and develop sustainable packaging.

Design packaging to be compatible with the existing recycling infrastructure in the region. From removing metallic layers to redesigning mixed-material closures, Pack Studios can help bring packaging designs for recycling to market quickly.

From snack bags to coffee containers and even toothpaste tubes, we've helped brands transition to recycling-ready mono-material structures.

Pack Studios is built on Dow's 125 years of experience delivering ground-breaking products and technologies.

https://www.dow.com/en-us/market/mkt-packaging/pack-studios.html

Policies in Catalonia (I)

National initiatives

Spanish Circular Economy Strategy (España Circular 2030).

- Reduce the consumption of materials by 30%, taking 2010 as the reference year.
- Reduce waste generation by 15% compared to 2010.
- Reduce the generation of food waste throughout the food chain: 50% per capita reduction at the household level and retail consumption and 20% in the production and supply chains as of 2020.
- Increase reuse and preparation for reuse until reaching 10% of the municipal waste generated.
- Improve the efficiency of water use by 10%.Reduce the emission of greenhouse gases below 10 million tons of CO2 equivalent.

PERTE de Economia Circular.

€492 M

- Reduce waste generation
- Promote treatment plants
- Increase digitization

- Actions on key sectors: textile, plastic and capital goods for the renewable energy industry.
- Transversal actions to promote the circular economy in the company.

Policies in Catalonia (II): Grants for the promotion of the circular economy in the plastic sector. Circular Economy PERTE

Eligible expenses

Personnel expenses, external assistance, inventoriable material, and expendable material, among others, will be subsidized

Beneficiaries

Companies, social economy entities, and groups of companies can be beneficiaries (as long as an SME, a startup or a social economy entity participates).

Four types of projects

1. Eco-design of new packaging with bio or recycled materials or to increase their recyclability:
2. Reusable packaging and reverse logistics systems:
3. Mechanical recycling until reaching food grade:
4. Chemical recycling to treat mechanically non-recyclable waste:

Budget

- Aid intensities of between 15 and 60% depending on the size of the company and the type of project.
- It is expected that the budget for this call will be €100 million.

Source: ACCIÓ based on Spanish Government

Policies in Catalonia (III): Ley 7/2022. Waste and Contaminated Soil Law for a circular economy

Limitation of the use of plastics:

Reduction of the commercialization of single-use plastic products by 50% in 2026 and 70% by 2030, compared to 2022.

The use of reusable alternatives or other non-plastic material will be encouraged.

With the aim of reducing the consumption of single-use containers, hotel establishments must offer consumers the possibility of consuming unpackaged water for free and bulk sales will be promoted in large commercial areas.

Prohibition of placing plastic products on the market such as straws, cotton swabs, cutlery, plates, and in general any product made with oxodegradable plastic, as well as plastic microspheres of less than 5 mm, for which reason it is prohibited, for example , add microplastics to cosmetics or cleaning products.

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Policies in Catalonia (IV)

Regional initiatives

Circular Catalonia, innovation hub and meeting point for companies and institutions that provide solutions and strategies to consolidate the circular economy in Catalonia.

Catalunya Circular
L'observatori d'economia circular de Catalunya

Waste Cluster. dynamic element of the competitiveness of companies in the sector.

CLÚSTER RESIDUS
Generalitat de Catalunya

Packaging Cluster. Improve the competitiveness of the container and packaging ecosystem,

PACKAGING CLUSTER

The strategy to promote the green economy and the circular economy of the Government of Catalonia.

National pact for the industry.

One of the strategic objectives is the Circular Economy. With special emphasis on the prevention and management of waste and its incorporation as new resources.

PACTE NACIONAL PER A LA INDÚSTRIA 2022-2025

Circular economy barometer of the Catalan company 2020.

Selective door-to-door collection (PaP) consists of delivering the waste to the municipal collection service in front of the door of the house, on certain days and times determined for each fraction.
The selective collection results achieved in the municipalities that have door-to-door systems in place are generally higher, both in terms of quantity collected and in the quality of the separation (in general they are between 60 and 80% selective collection).

porta a porta

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Initiatives in Catalonia (I)

Operation Clean Sweep® (OCS) is a global initiative of the plastics industry to prevent the emission of plastic particles (chips, flakes, dust) into the environment, which can be produced involuntarily at any stage of the value chain of plastics: production, handling, transportation, transformation and recycling.

The OCS is a voluntary program for responsible management, with the purpose of helping to ensure that in all operations in which plastic pellets are handled, good cleaning and pellet control practices are applied and thus ensure that there are no leaks to the environment.

In Tarragona we already have two production companies that have obtained OCS certification and in addition, last September 27, the constitution of the Platform for Zero Loss of Pellets was signed in Camp de Tarragona, to extend and share the best practices with the rest of the value chain.

https://anaip.es/ocs/

Initiatives in Catalonia (II)

Industria de plásticos Española y Sostenible

This brand is a recognition for Spanish plastics companies that also work for sustainability, which is why it also recognizes companies that manage their impact at a social, economic and environmental level.

The objective is to highlight the Spanish plastics industry before the administration and society, as well as the contribution of national plastic products abroad and among Spaniards themselves, and to show the development of the industry in favor of the economy. circular and sustainability in its three axes: economic, social and environmental.

This brand is awarded by the association that represents the plastics transformation sector at the national level, ANAIP, an entity recognized as an interlocutor of the sector by public administrations and other national, European and international organizations, with 65 years of experience in the associative world and with a recognized track record, to those Spanish companies in the plastics sector that meet a series of sustainability criteria and indicators in the economic, social and environmental axis.

https://anaip.es/PlasticosEspanolesSostenibles/

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Generalitat de Catalunya Government of Catalonia

MORE MOnitoring Recyclates for Europe

MORE is helping the plastics industry become MORE circular by collecting the volume of recycled polymers that is used by plastics converting companies to create new products, and by stimulating a higher uptake of recycled polymers.

MORE is an online platform that collects, aggregates and anonymises the data through a short online survey.

The monitoring of the recycled polymers used in new products plays a crucial role in the transition towards a MORE circular plastic industry.

European Commission

CIRCULAR PLASTICS ALLIANCE

https://www.moreplatform.eu/.eu/

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Instruments in Catalonia

National Funding

Center for Industrial Technological Development (CDTI) Subsideies in the form of loans and grants for research, innovation and development projects

EU funding

Horizon Europe
LIFE
IL3

Regional Funding

The RIS3CAT 2030 promotes a sustainable, competitive industrial system.

RIS3CAT 2030

The **ProACCIÓ Green** program includes ACCIÓ's services, grants, and activities to position sustainability as one of your company's strategic axes through responsible innovation and using technology as a lever for green transformation

Circular Economy Nuclis d'R+D: grants for circular economy projects, specifically in the field of waste.

Collaboration between the Catalan Waste Agency (ARC) and ACCIÓ.

Agència de Residus de Catalunya

ACCIÓ Catalonia Trade & Investment

Generalitat de Catalunya

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Grants map

BUSINESS I+D+i CIRCULAR ECONOMY AND CLIMATE CHANGE SUSTAINABILITY

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Challenges & Opportunities

Opportunities

- Ecodesign, facilitating reuse, recycling and the use of materials and alternative solutions
- Articulation sustainable value chain
- Design of processes that help to close the Carbon cycle with zero net emissions
- Reindustrialization. New business based on chemical recycling and bioeconomy.
- Promoting new business aimed to moving towards a greener chemistry processes
- Research and innovation both in the improvement of processes and new ways of treatment at the end of the product's life, as well as more sustainable materials

Challenges

- Reduce dependence on fossil-based raw materials
- Eliminate the dumping of plastic materials to landfill
- Correct identification of the plastic type.
- Transforming value chains and the chemical industry
- Elimination of microplastics
- Legal and regulatory framework

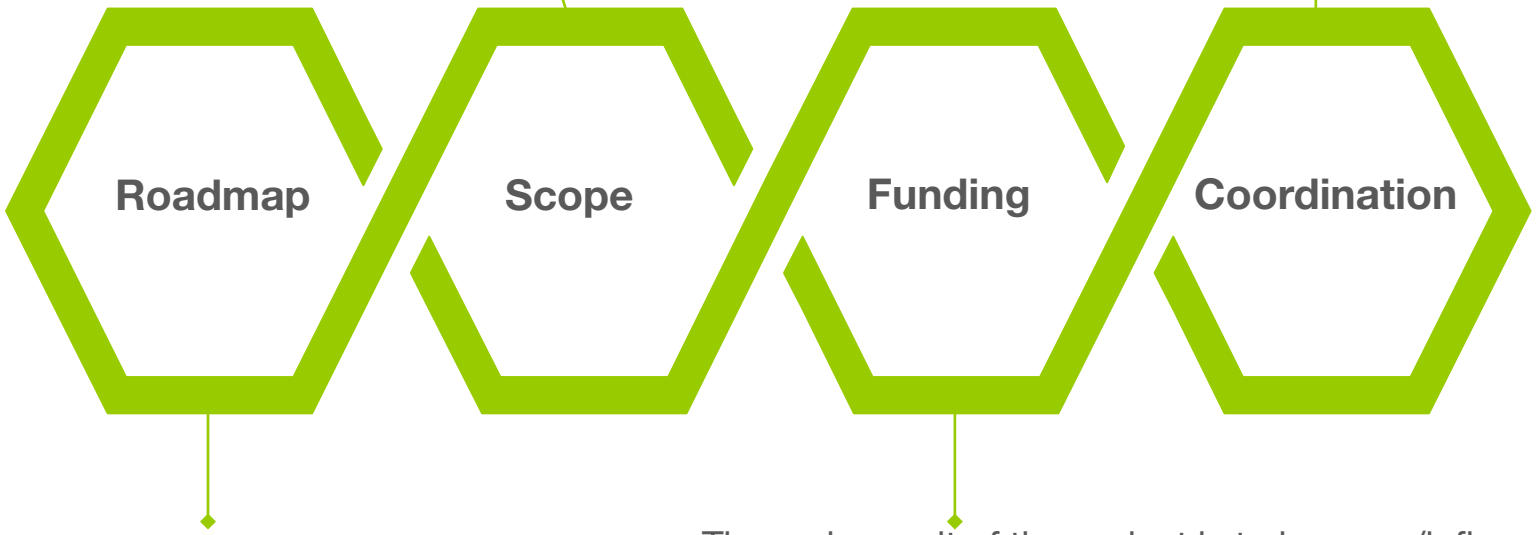
Social Dialogue

- During the development process of the new RIS3CAT 2030, meetings of the quadruple helix were held.
- The National Pact for the industry has been signed by the main business associations, unions and social agents.
- The association of chemical companies of Tarragona has established a social dialogue program with the different stakeholders and shareholders in the territory.
- Cluster activity
- Roadmap Circular economy

Changes expected in the instruments and policies to improve their impact and their contribution to the implementation of the European plastics strategy in Catalonia

Expand the scope of the nuclis R+D to incorporate not only waste, but also alternative raw materials.
Promotion of R&D in material design and production

Improve coordination



Analysis of the starting point, better knowledge, and establishing the necessary stages to achieve it.

The main result of the project is to improve/influence the regional policy instruments addressed (OP FEDER 2021-2027) through the proposal of new projects that can be financed by the OP FEDER and support the implementation of the 'strategy of the EU on plastics and to facilitate the change towards a society where the use of plastic is sustainable.

Success stories

The **Ecoplanta** project will contribute to the municipal solid waste management by using non-recyclable materials to produce circular chemicals and advanced biofuels.

Clariant has implemented high-performance polymers to cope with non-sustainable textile flooring disposal in the carpet manufacturing industry.

Elenplast is focused on plastic production and transformation. The company uses high- and low-density polyethylene in its production process.

PICVISA has developed a robot that separates plastic from other waste in recycling plants.

Zicla transforms waste into innovative products that address city needs. The VECTORIAL System allows multiple configurations for the construction of bus platforms.

DAN*NA develops and produces high value-added new biomaterials and bioplastics.

Cafès Novell introduces the first Nespresso-compatible compostable coffee capsule on the market.

ENGAGE.REN products can help the footwear industry become more sustainable through the use of bioplastics.

IFLEX has developed a new pioneering reprinting service for Tetrbricks.

The objective of project **Foodwaste for foodpack** is to valorize waste from the fruit and vegetable processing industry as a resource to obtain a fiber-based packaging material for the agri-food industry.

Marina Textil is involved in a project for the chemical recycling of laminated textile waste.

ArcessoDynamics implements the circular economy in polyurethane (PU) foams by chemical recycling through catalytic glycolysis.

GCR Group employs green energy sources for the production processes and develops efficient plastic solutions. They use recovered plastic as a raw material, which originates from post-industrial waste.

Sadako designs, develops and applies computer vision technology for the recycling industry.

Sea2see designs and produces optical frames and sunglasses using exclusively recycled marine plastic waste.

VEnvirotech specializes in the transformation of organic waste into Polyhydroxyalkanoate (PHA) bioplastics.

TATAY recovers and reintroduces into the production process 100% of the waste generated and prioritizes the use of raw materials.

LyondellBasell is one of the largest producers of polymer compounds and licensor of polyolefin technologies. Produces advanced solutions in food safety and access, clean water, fuel efficiency, etc.

Delafruit has developed a study to implement single-material solutions with the aim of promoting the circular economy in the packaging industry.

The **SOFLEX** project is a commitment to the development of thermoformable flexible mono-material.

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Success stories and best practices (I): Waste valorisation

The **Ecoplanta** project is the only Spanish candidate pre-selected among the seven projects chosen for support by the European Commission Innovation Fund. Repsol, in collaboration with technology leader Enerkem, has joined forces to establish Ecoplanta Molecular Recycling Solution joint venture located in El Morell, near the port of Tarragona.

The main focus of the Ecoplanta will be the valorisation of non-recyclable municipal solid waste into circular methanol, which can be utilized in the production of advanced biofuels and new materials. The initiative will thus become a benchmark for material recovery, obtaining new materials and reducing the use of virgin raw materials.

This project will mark the first waste recovery plant in Spain and it will contribute to the growth of the circular economy, decarbonization, and a more sustainable future.

www.ecoplanta.net

Marina Textil, a company based in Barberà del Vallès, specializes in developing technical fabrics for personal protection. The company is focused on industrial resilience and processes, as well as chemical recycling to contribute to the industrial transition towards the circular economy.

The upcycling project aims to develop an innovative process for recycling chemicals from the laminated textile waste generated during the company's production process, in order to recover and recycle fibre material from yarn raw material. They also offer solutions by chemically degrading Polyutherane layers (PU), and by recovering textile layers.

The estimated potential for recovered fibres to be reintroduced is more than 5.4 tonnes per year. Additionally, implementing this process could lead to an 88% reduction in textile waste.

marinatextil.com

Success stories and best practices (II): Chemical recycling

CLARIANT

Clariant is an international chemical specialist that contributes to the research and development of innovative and sustainable solutions. Their focus areas include energy efficiency, renewable raw materials, emission-free mobility, and conserving finite resources.

In the carpet manufacturing industry, disposal of textile flooring poses a significant problem, commonly ending up in landfills or incineration. This is largely due to the traditional use of water-based latex backing that cannot be removed from the pile fibres and creates a mix of materials that are difficult to recycle. Addressing this challenge, Clariant has developed a solution with its Licocene high-performance polymers.

www.clariant.com

ARCESSODYNAMICS

ArcessoDynamics is specialized in innovation and manufacturing of polyurethane matrix products. Their main facilities are located in the Parc Tecnològic de Cerdanyola del Vallès (Barcelona).

The company actively engages in several research projects. The FOAM2FOAM initiative aims to implement the principles of circular economy in polyurethane (PU) foams by chemical recycling. The process results in PU waste recycling through catalytic glycolysis, thus obtaining green polyols.

New materials obtained from the recycling process work for buildings, especially bathrooms. Moreover, the developed technology can be applied to biological analysis, bank tellers, ticketing machines and lightning.

arcesso-dynamics.es

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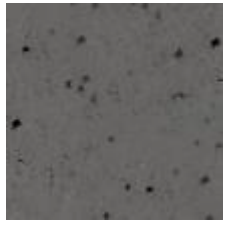
Success stories and best practices (III): Post-production recycling

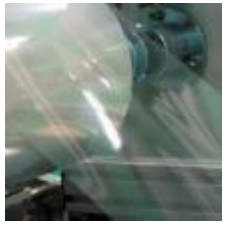
Elenplast is focused on the production and transformation of plastics employing a modern treatment system. The main facilities are located in Rubí, Barcelona.

Their efforts contribute to sustainability and environmental well-being of its areas of influence by purchasing and selling plastic materials, such as: Industrial Film, Shrink Film, Agricultural Film, Automatic Packaging Film, Garbage Bags and Polyethylene; as a way of post production recycling.

In its production processes, Elenplast uses high and low density polyethylene, offering multiple applications such as food or pharmaceutical. Additionally, the company has a section for recycling leftovers for their own consumption, in which first quality post-industrial materials are processed.

www.elenplast.com





GCR Group offers high quality and environmentally efficient plastic solutions developed specifically for the industrial packaging market with international presence.
The company's headquarters are located in La Bisbal del Penedès (Tarragona) and the facilities of the group are positioned just 30 kilometers away from 90% of its mineral and polymer suppliers, ensuring efficient supply chain management.

During its production processes, the company employs green energy sources and has a unique patented technology called Irtion, which requires low energy consumption.

In addition, the emissions associated with the extraction of most of the raw materials are very low. These raw materials primarily consist of minerals, from natural sources that are difficult to deplete, as well as recovered plastic, which originates from post-industrial waste.

gcrplasticsolutions.com

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Success stories and best practices (IV): Artificial Intelligence and computing in waste management

PICVISA is an innovative technology-based company provides robotics, AI and machine vision solutions in order to accelerate the global transition to the circular economy. The company has been part of the CALAF group since 2018 and its test center is located in Barcelona.

Picvisa, Ferrovial Services and its affiliate CESPA, specialized in environmental services and waste management, have collaborated to pioneer robotic technology for waste separation. By using AI and machine learning algorithms, the system identifies plastic containers among other waste and separates them for recycling, leading to improved waste recovery and sorting efficiency. This breakthrough automation contributes to the promotion of the circular economy.

picvisa.com

SADAKO TECHNOLOGIES is a Catalan company based on innovation created in 2012. They are specialists in the development of AI and robotics technology.

The company designs, develops and applies computer vision technology for the recycling industry. By implementing this technology into recycling lines and chains, their computer vision machinery can effectively detect, recognize and selectively differentiate various types of waste. For instance, it has the ability to distinguish PET trays from PET bottles.

sadako.es

Co-funded by the European Union

Success stories and best practices (V): Post-industrial plastic recycling

Zicla, an innovative company based in Barcelona, focuses on transforming recoverable waste generated by cities and their associated activities into new materials.

Their goal is to close the waste cycle by transforming waste into innovative products that address urban needs. They have successfully developed a family of new materials using PVC waste from different sources, especially from the recovery process of copper from end-of-life cables. These new PVC materials are used in the production of various city products.

The VECTORIAL System is a product made up of modules that fit together, allowing a wide variety of configurations for the construction of bus platforms. These platforms are designed to provide public road safety, better accessibility and comfort for citizens at bus stops.

www.zicla.com

Sea2see designs and produces optical frames and sunglasses using exclusively recycled marine plastic waste. They collaborate with thousands of fishermen in Spanish and Ghanaian ports to collect the plastic waste.

Since 2015, Sea2see has pioneered a *seastainable* change in the eyewear industry proving that marine plastic waste is a valuable raw material. The company faces ocean plastic contamination and not only contributes to emission reduction and sustainable change, but also raises environmental awareness.

www.sea2see.org

Success stories and best practices (VI): Bioplastics

DAN*NA is a bioengineering company located in the Barcelona Science Park, dedicated to developing and producing high value-added new biomaterials and bioplastics that address the challenges of the cutting-edge technology industry.

Their solutions are built upon using biological residues of plant or animal origin to develop bioplastics such as PHA, PLA, BPS and PEF. Additionally, they employ molecular technology, green chemistry processes, and AI to transform raw material into bioplastics. Moreover, DAN*NA focuses on improving the physical properties of bioplastics to adapt them to the production process and the needs of the final product.

According to the results, electronic waste was reduced by 80%, 70% of organic waste was recovered in a bioproduct, and energy usage was reduced by 82% in substitution of metal processing.

artificialnature.com

VEnvirotech is a biotech start up based in Santa Perpètua de Mogoda, Barcelona.

The company specializes in the transformation of organic waste into Polyhydroxyalkanoate (PHA) bioplastics, a type of high-quality biodegradable polyesters produced by bacteria and compatible with the human body.

The process involves feeding bacteria with organic waste modifying their environment to stimulate the production of PHA bioplastics. PHAs possess properties such as rapid biodegradability within six and twelve months, sustainability with no toxic effects, and compatibility for mixtures with petroleum-based plastics.

venvirotech.com

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Success stories and best practices (VII): Advanced plastics

ENGAGE.REN products can help the footwear industry become more sustainable through the use of bioplastics.

ENGAGE™ REN, which has ECOLIBRIUM™ technology, is an advanced bioplastic that is produced in Tarragona from renewable raw materials. This material presents several key advantages to the footwear industry, including:

1. Reduction of the carbon footprint: Using renewable raw materials in the production of ENGAGE™ REN, contributes to reducing greenhouse gas emissions.
2. Recyclability: A commitment to sustainability includes designing products that are recyclable and that enable the circular economy in the industry.

Specifically, ENGAGE™ REN has been used to manufacture CROCS brand sandals. The use of this bioplastic has allowed CROCS to reduce carbon emissions in the manufacturing of its sandals by 30%. Incorporating ENGAGE™ REN into footwear manufacturing can help brands meet their sustainability goals and meet growing consumer demand for environmentally friendly products.

https://plasticseurope.org/es/case-studies/dow-engage-ren/

LyondellBasell is focused on comprehensively addressing the problem of plastic waste and its circularity: Improving recyclability through product and packaging design; growing their mechanical recycling capacity; accelerating scalable advanced recycling technologies. LyondellBasell initiatives in several fields:

Moretec: Molecular Recycling Technology (MoReTec) addresses traditional plastic waste pyrolysis limitations. It uses catalyst technology for polymers and chemicals to improve energy efficiency, reduce residence time and improve scalability and higher plastic-to-plastic yield.
CirculenRecover brand: The product line is based on transforming plastic waste into high-quality materials for various industrial, household and consumer product applications.
Diverse applications: The new product grades can be tailored to suit various applications across different industries – packaging, automotive components, etc.
Reduced Carbon Footprint: The production of virgin plastics is energy-intensive and contributes to greenhouse gas emissions.
Circular economy: CirculenRecover aligns with LYB circular economy principles, where products and materials are designed to be reused, remanufactured and recycled.

https://www.lyondellbasell.com/

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Success stories and best practices (VIII): Bio-based production

Cafès Novell introduces the first Nespresso-compatible compostable coffee capsule on the market, manufactured and marketed in Spain. It addresses the environmental impact caused by the growing number of coffee capsules that become waste as they are made from non-biodegradable plastic or aluminum.

On average, conventional capsules generate 1.5 to 2 g of waste per unit and cannot be processed as packaging due to their size and legal classification. In contrast, The Novell capsule is made from a polymer called **Ecovio®,** biopolymer developed by **BASF** obtained from corn, taking between 4 and 12 weeks to biodegrade.

The capsule holds certifications with the following seals: OK Compost, ensuring that the packaging is biodegradable and compostable, and OK Biobased, certifying the use of renewable raw materials in the manufacture of the product.

Recognized for its environmental excellence, this project received the "Catalunya Ecodesign 2017" award in the product category.

cafesnovell.com

TATAY leads the way in using eco materials and ensures that its products have a long and easily recyclability, contributing to the circular economy. The majority of its products are manufactured and distributed in Catalonia.

TATAY prioritizes the origin of raw material, making local purchases, supporting the local economy and minimising the impact of transport. They have recently launched TATAY ECOHOME, their first range of products made with 100% recycled materials. In 2021, the company significantly increased the use of raw materials by 200%. Furthermore, they have eliminated PVC packaging, limiting its use only for essential products.

To minimize the environmental impact, TATAY adheres to a ‘0 waste’ policy, which consists of recovering and reintroducing into the production process 100% of the waste generated. Moreover, they avoid non-essential packaging from the products to minimize unnecessary use of plastics.

www.tatay.com

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Success stories and best practices (IX): Packaging

IFLEX, which specializes in flexible packaging printing, has developed a new pioneering reprinting service with the collaboration of the Packaging Cluster, the organization representing the packaging sector in Catalonia, and the financing of the Waste Agency of Catalonia, with the support program for circular economy promotion projects.

The initiative consists of the reprinting of Tetrabrik packaging reels that can be found obsolete. IFLEX, which has had to adapt its machinery to be able to reprint this material, manages to overwrite the obsolete coils, to cover the obsolete texts or anagrams and add the new desired information. With this reprinting, the industrial waste that would have been generated as a result of having to throw away all the defective products and manufacture them again is reduced.

The new tetrabrik coil reprinting service will directly save waste currently not recyclable that ends up in landfills and save costs for customers who use this new service, since they will be able to avoid having to stock up on new material to package their products.

https://www.iflex.es/

Delafruit, a children's and healthy food company specialized in the development and co-manufacturing of purees, smoothies, juices and compotes, has developed a study to implement single-material solutions with the aim of promoting the circular economy in the packaging industry. The initiative has the involvement of Leitat, a technological research center, as well as the collaboration of the Packaging Cluster.

The MM Pouch (Mono – material pouch for food products) project consists of carrying out research to carry out monomaterial pouch solutions in the food industry, specifically in the sector of pasteurized fruit juices and purees. The initiative also seeks to carry out a life cycle analysis of this structure to demonstrate the environmental benefit derived from its use compared to other less sustainable solutions.

MM POUCH is a project for the implementation of new products or services in the market financed by the Waste Agency of Catalonia in the call for subsidies for projects to promote the circular economy 2020.

https://www.delafruit.co

Co-funded by the European Union

Success stories and best practices (X): Packaging

FOOD FOR FOODPACK

The general objective of the innovative pilot project Foodwaste for foodpack is to materially valorize waste from the fruit and vegetable processing industry as a resource to obtain a fiber-based packaging material for the agri-food industry.

The pilot project aims to contribute to the use of waste generated by fruit and vegetable processing companies, turning it into a local resource for the packaging sector that offers an alternative to the use of virgin raw materials such as plastic and cellulose.

https://www.packagingcluster.com/news/foodwaste-for-foodpack/

SOFLEX

The **SOFLEX** project is a commitment to the development of thermoformable flexible mono-material.

The main objective of the initiative is to improve the recyclability of the flexible packaging it uses, through eco-designed packaging. This sustainable design should enable high-quality recycling by starting from mono-material waste while preserving the product to avoid food waste and guarantee safety for the consumer.

The development of the project is divided into five main phases: 1) Eco-design and manufacturing of the new flexible materials 2) Characterization and analysis of the materials and pilot tests 3) Industrial tests with the new materials 4) Comparative useful life studies 5) Analysis of the technical, economic and environmental feasibility of the new materials

https://packagingcluster.com/noticias/el-proyecto-soflex-pretende-desarrollar-envases-monomateriales-flexibles-para-el-sector-carnico/

Plastic sector in Fryslân / The Netherlands

Plastic Sector in Fryslân

58 manufacturing companies
79 collecting/recycling companies

€ 108 M + € 154 M added value

5,852 + 3,877 jobs

89% exports to Europe

+ 58%
+ 50% grow added value (2012-2021)

45% of plastics waste were sent to recycling in 2021

25% of plastics waste were used to produce new plastics

Total companies:
6,458 (including users, also packaging)
Collecting/recycling: **79**
Producing: **58** (also construction)

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The plastic value chain Fryslân

Production of raw materials that include even production of polymers

Manufacturing: Plastic conversion and product manufacturing

End of life treatment, collection, classification, mechanical recycling, chemical recycling, energy recovery

OOSTERWOLDE PLASTIC INDUSTRIE

Trioworld

BASF
We create chemistry

FLEXOPLAST

PRIMO

Sidijk
sport, fun and industry

EUROPROVYL
KUNSTSTOF KOZIJNEN

nedcam
shaping technology

LANKHORST

OMRIN

Heerenueen

renewi

BLUE CYCLE

NTCP nationaal testcentrum circulaire plastics

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Ecosystem agents in Fryslân

Universities

R&D Tech centers

Clusters & Associations

Comercial fair & Congress

Public Administration

Policies in Fryslân

Regional

Economy Policy letter of the province: comprehensive well being.

This policy focuses on future-proof SME's and labour market, attractive live and business climate and connected and cooperative ecosystems.

We also apply this for the circular plastic sector: creating ecosystems around business, education and governance (chemport, greenwise, VCF) to boost the knowledge and innovation around circular plastics.

National

Raw materials agreement with construction, plastics, manufacturing and food industry on the agenda.

2030: 44% less waste incineration. From 1,313 kton (2016) to 740 kton (2030

2050: fully circular: plastics should have a minimum of CO_2 footprint and consist of recycled or renewable plastics.

Instruments in Fryslân

European funds that focus on the RIS strategy including working towards a more circular economy. Examples:

- ERDF: reducing economic, social and territorial disparities
- Just Transition Funds: provide support to territories facing serious socio-economic challenges arising from the transition towards climate neutrality

National groeifonds – national governments investing in economic growth, which includes a part for circular plastics. Hubs4Circularity (applying atm) – ecosystems for full scale industrial symbiosis, industrial-urban symbiosis and circular economy closing energy, resource and data loops at regional scale. They are an important building block for achieving the climate neutrality targets by 2050.

Regional vouchers. Examples:
- National Test Centre Circular Plastics. Subsidised by Province of Fryslan, Central governant and the waste fund foundation
- Subsidy for establishment. 100.000 subsidy for a new circular business idea or diversification.
- Subsidy valorisation and knowledge development. Nedcam used this subsidy to further develop 3D printing.

Challenges & Opportunities

Opportunities

- Connecting education and the ecosystem of circular plastics (companies and governance).
- Getting the right lectureships and attracting the right students and workers so the technology innovation on circular economy can accelerate.
- More connection environmental services: control and laws/regulations.
- Monitoring
- Closer cooperation with the ministries of the State.
- Knowledge hub (NHL, Greenwise, NTCP)
- Bringing research and innovation together (Wetsus example)
- Profiling of most circular region in Europe 2025

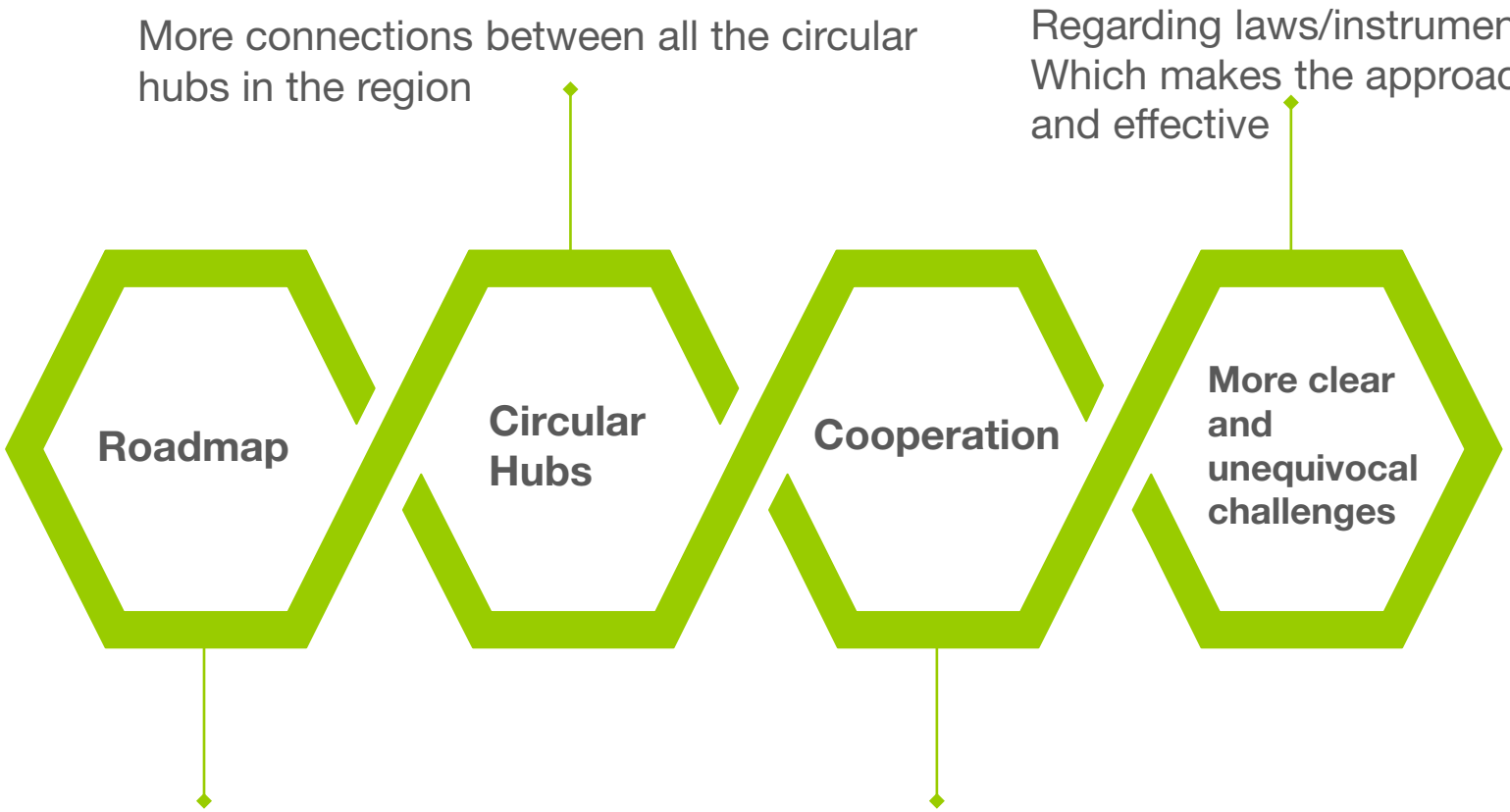
Challenges

- Bottlenecks laws and regulations
- Struggles in finding and receiving the right funds for companies
- Labour market (higher educated, technic educated, vocational studies complementary on work field
- Fragmentation of the parties
- Co development with the entire chain (suppliers, consumers)

Social Dialogue

- Citizen participations through the local authorities and the associations like VCF and business (more focused on companies).
- Challenge of province: less control of the citizens, whereas behavioral change is an important topic within this sector.
- De uitkijkers – facilitating dialogue about circularity, well-being and water.
- Springtij – dialogues about circularity and the systems behind.

Changes expected in the instruments and policies to improve their impact and their contribution to the implementation of the European plastics strategy in Fryslân

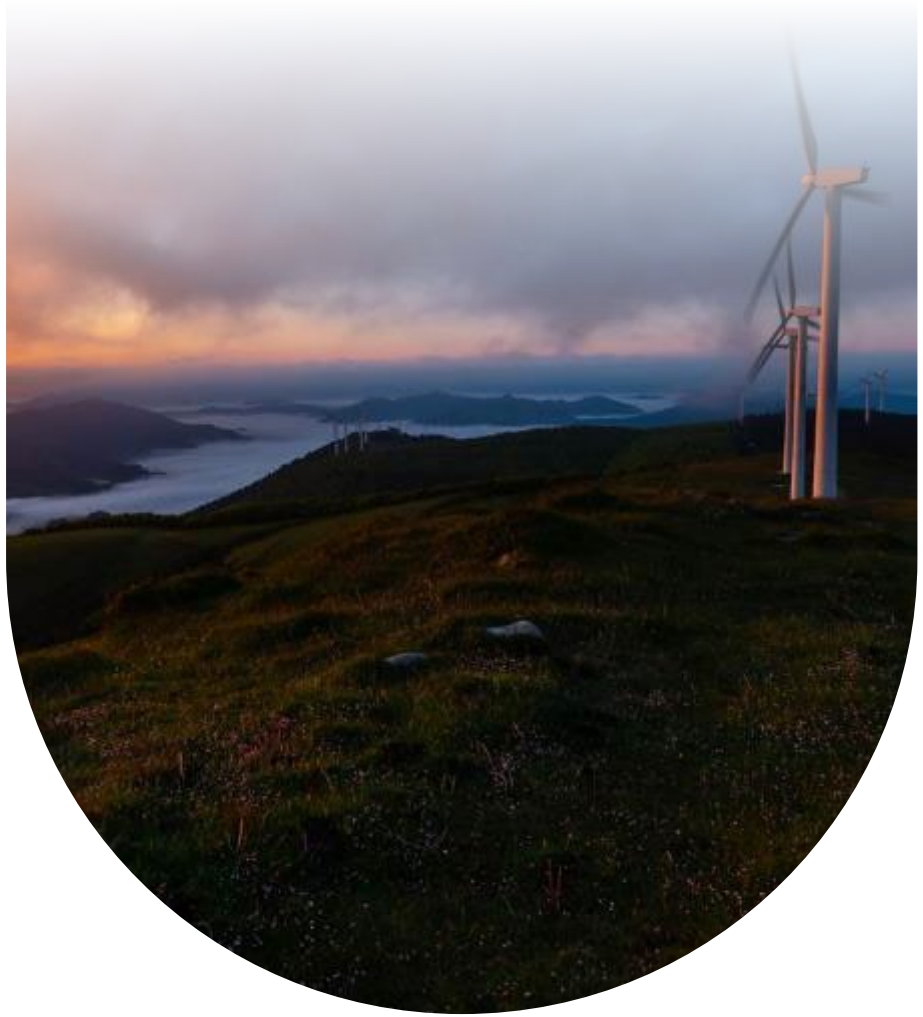


Success stories and best practices (I):

The Clean North is an initiative to develop the region into the top circular plastics cluster of Europe. The three northern provinces are especially suited to making this objective a success due to the presence of the required businesses and knowledge institutions.

The objective of the Clean North is clean technology for a clean environment. The basis is an intensive, structural collaboration in which provincial and municipal governments, knowledge institutions, and businesses jointly invest and grow. The basis is formed by a portfolio that currently holds sixty projects, on which dozens of companies and all knowledge institutions will get to work on straight away. This will increase the competitive economic position of the Northern Netherlands as a whole.

The potential in the region is huge, as is also shown from the ambitions for the coming ten years: an annual growth of 5 percent for the businesses, attracting 150 small and 5 large businesses in circular projects, a billion euros in corporate investments, and a total of 6 thousand new jobs.



https://universiteitvanhetnoorden.nl/en/programmes/the-clean-north/

Success stories and best practices (II):

- Association Circular Friesland – Association of companies business, governments and knowledge institutions. Linking pin between government policy and the organizations working on sustainability.

- Het Schone Noorden – The Clean North. Initiative to develop our region to the most circular plastic cluster of Europe. Coming 10 years:
  - Yearly business grow of 5 percent
  - Attracting of 150 small and 5 big companies with circular subjects
  - Creating 6000 jobs

- NTCP – National test centre Circular Plastics

- Greenwise campus – knowledge cluster including focus on circular plastics

- Valorization circular 3DXL thermoplastic. Cooperation between different northern initiatives (SMES, university, company Nedcam)

Plastic sector in Lombardy / Italy

Plastic Sector in Lombardy

3,744 companies

€ 16,323 M turnover

60,744 jobs

Export
36,6% of national exports is from Lombardy
€ 7,600 M in exports
66,5% of exports is to EU countries

Industrial Gross value added: **4.4%**

55% of the plastics is recycled in Lombardy

79% of the packaging is recycled in Lombardy

99,9% of the plastics that are treated in the plants in Lombardy are sent to recovery operations.

In 2019, **21 kg** of plastic per capita was recovered, up from the previous year when 18 kg of plastic per capita was recovered, and more than 10 times more than in 2008.

Sources: Assolombarda e Federazione Gomma Plastica, 2023; SACE (Italian Export Credit Agency), 2022; Lombardy Region, 2020; ISTAT (Italian National Institute of Statistics), 2020.

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The plastic value chain in Lombardy

non-exhaustive list

Production of raw materials that include even production of polymers

Manufacturing: Plastic conversion and product manufacturing

End of life treatment, collection, classification, mechanical recycling, chemical recycling, energy recovery

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Ecosystem agents in Lombardy

Universities

POLITECNICO MILANO 1863

UNIVERSITÀ DEGLI STUDI DI BERGAMO

UNIVERSITÀ DEGLI STUDI DI BRESCIA

UNIVERSITÀ DI PAVIA

R&D Tech centers

STIIMA

IIP ISTITUTO ITALIANO DEI PLASTICI

INSTM

CENTROCOT

PPR

Clusters & Associations

AFIL

UNIONCAMERE LOMBARDIA

ASSORIMAP confimindustria

CORPET BOTTLE TO BOTTLE

CERISIE

ASSOGOMMA

FEDERAZIONE GOMMA PLASTICA

Unionplast

COREPLA

Comercial fair & Congress

plast PLASTONLINE.ORG

Green plast greenplast.org

ipack ima

Public Administration

Regione Lombardia

ARPA LOMBARDIA Agenzia Regionale per la Protezione dell'Ambiente

FLA

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Policies in Lombardy (I)

Nacional initiatives

Entry into force of Plastic Tax (2023)

National Intelligent Factory Cluster Roadmap for Research and Innovation (2023)

National Strategy for Circular Economy (2022)

Membership of European Plastics Pact (2020)

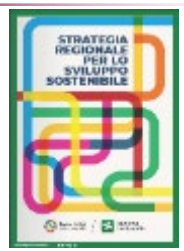
EUROPEAN PLASTICS PACT

Policies in Lombardy (II)

Regional initiatives

Regional Programme for Sustainable Development of Lombardy Region (2023), with a specific chapter on «Green Lombardy»

Regional Strategy for Sustainable Development of Lombardy Region (published in 2021 and updated in 2023)



Lombardy Roadmap for Research and Innovation on Circular Economy (2020)

PLASTECO - Interreg Europe Project (2019-2023), addressing ERDF ROP 2021-2027

CircE - Interreg Europe project (2017-2021), addressing ERDF ROPs 2014-2020 and 2021-2027

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Interreg Europe Co-funded by the European Union PLASTIX

Instruments in Lombardy

EU funding (national level)

NRRP (National Recovery and Resilience Plan) targeting the creation of new infrastructures for mechanical / chemical recycling and plastic hubs

managed by the Italian Ministry of Environment

EU funding (regional level)

ERDF (European Regional Development Fund) ROP 2021-2027 targeting circular economy projects in the field of plastics and textiles (prevention, ecodesign, recycling)

managed by Lombardy Region

Regional funding

Call for Expressions of Interest for the development of production supply chains and industrial ecosystems

managed by Unioncamere Lombardia

(in coordination with Lombardy Region)

Regional funding

Call for proposals targeting Circular Economy-related value chains and energy efficiency in Lombardy

managed by Lombardy Chambers of Commerce

(in coordination with Lombardy Region)

Challenges & Opportunities

Challenges

- The plastics industry is faced with the challenge of **combining innovation, market evolution and employment** with the objective of **minimising the ecological footprint of processes** and that resulting from the dispersion of products at the end of their life cycle caused by bad behaviours.
- The issue of **sustainability** is becoming increasingly central to companies' development strategies and market positioning, but it is not the only one. The ecological transition must be combined with the **digital transition** that enables the production of efficient and functional materials. Innovation is strongly driven by the development of high value-added products that integrate new functionalities (interactivity, communication, etc.) and the optimisation of production processes through the acquisition, sharing, management and processing of data generated at all stages of the product life cycle.

Opportunities

- The **European Union's Plastic Strategy** moves in this direction and gives priority to the recycling of plastic products at the end of their life cycle to maximise the useful life of the material through the circular economy, thus reducing the consumption of oil and energy deriving from the use of virgin material, containing CO2 emissions and reducing the amount of waste dispersed in the environment or disposed of in landfills. From this point of view, **Lombardy** has already significant rates of use of recycled plastic materials, thanks to the research and innovation work that the converting sector has been carrying out for several years, but there is room for improvement.
- The challenges of sustainability and digital transitions could lead in **Lombardy** to the adoption of digital technologies developed ad hoc according to the specific needs of the supply chain, in order to promote traceability, strengthen the entire ecosystem and accelerate the ecological transition itself.

Social Dialogue

- The opinion of consumers, in addition to the business perspective, is taken into account.

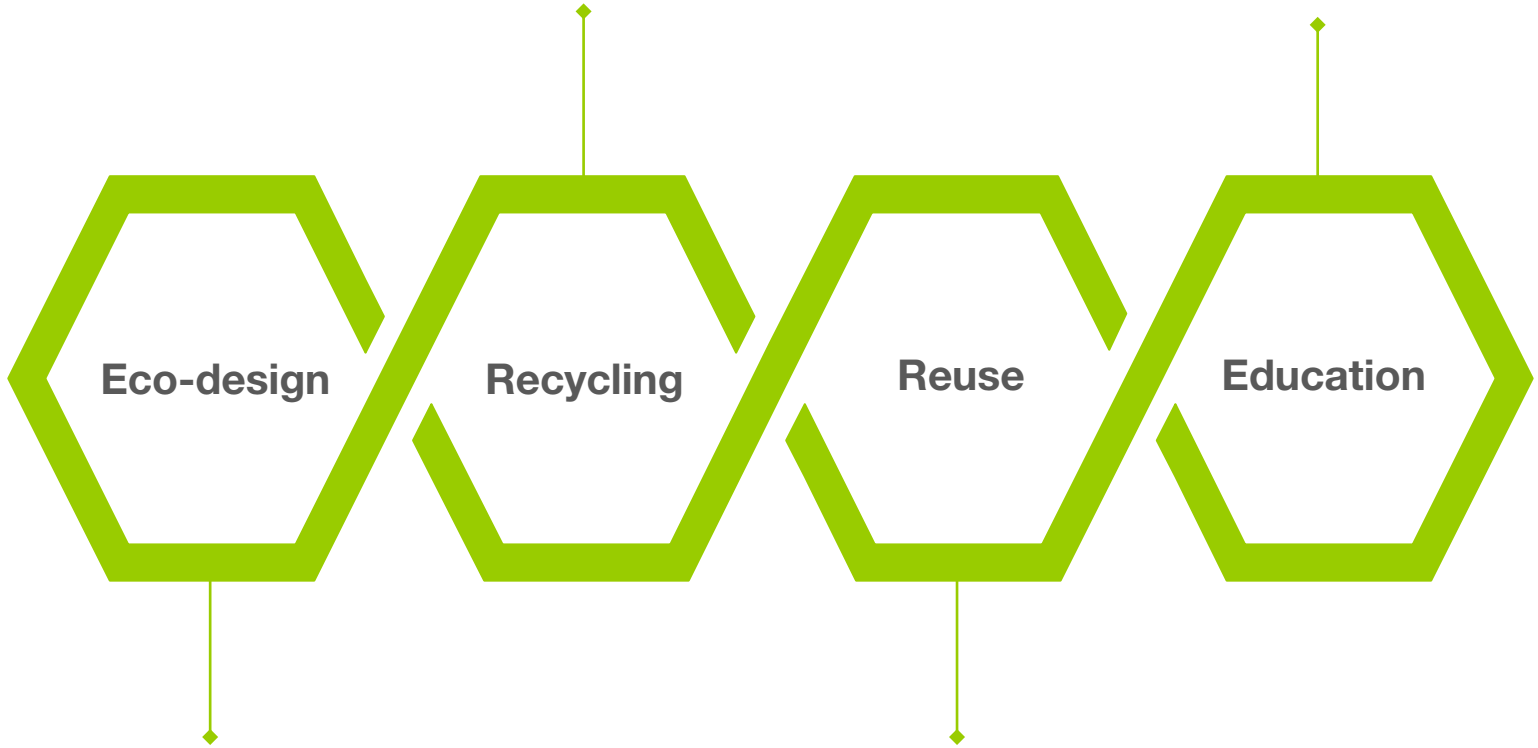
- A **survey among Italian citizens** run by IPSOS and COREPLA in **May 2023** showed that their attention towards recycling has signficantly increased.
  - 66% of interviewees has understood the concept of Circular Economy;
  - 88% understands its related-advantages for the environment;
  - 38% is aware that is Circular Economy is a lever of economic growth;
  - 91% believes that the government, institutions and municipalities should run a major campaign to raise citizens awareness on plastics recycling and should invest more resources in 100% recyclable plastics and waste management infrastructures.

https://www.corepla.it/indagine-ipsos-corepla

Changes expected in the instruments and policies to improve their impact and their contribution to the implementation of the European plastics strategy in Lombardy

Improving the quality of polymers derived from recycling
This would allow a full substitution of virgin materials, in economic terms for competitiveness in the market (lower supply chain cost) and in qualitative terms for the actual value of the material

***Educating consumers**, whether businesses or private citizens, to manage plastic waste correctly*



Applying eco-design principles
This would allow to extend the useful life of products and simplify recycling at the end of their life, e.g. by favouring the production of single-polymer products

Expanding the range and quantity of reused recycled polymers
Applying Circular Economy principles based on industrial symbiosis could unlock new business models based on sustainability awareness and culture

AFIL Strategic Community on Advanced Polymers

AFIL Lombardia

AFIL Strategic Communities are working groups that members choose to join based on their interests and commitment to strategic topics for the manufacturing sector. In particular, the **Strategic Community on Advanced Polymers** aims to increase regional competitiveness in the field of advanced polymers and smart plastics through cross-sectoral and interregional networking actions. Additionally, it supports Research and Innovation initiatives, promoting the establishment of consortia to participate in public funding calls at regional, national and European levels.

https://www.afil.it/

Lombardy Region Open Innovation Platform

Regione Lombardia Open Innovation

The Lombardy Region's Smart Specialisation Strategy vision represents a cultural leap regarding involvement of citizens in policy decision-making process through innovative tools, both financial and enabling. Thus, a regional **Open Innovation Platform** has been built around the key principles of the Quadruple Helix Open Innovation model, where "Government, industry, academia and civil participants work together to co-create the future and drive structural changes far beyond the scope of what any one organisation or person could do alone".

https://www.openinnovation.regione.lombardia.it/en/

Lombardy Roadmap for Research and Innovation on Circular Economy

The Roadmap, developed by **Lombardy Region together with AFIL Cluster** in 2020, intends to provide a framework for the development of a sustainable, low carbon, resource efficient and competitive strategy for the transition to a more circular economy in the region, under a smart specialization perspective.

This document also contributes to the definition of the **Smart Specialization Strategy of the Lombardy Region 2021-2027**, within which the achieved results in terms of Circular Economy are also valued. The Roadmap represents a versatile cultural and technical reference that can stimulate the cooperation between public and private stakeholders, with the aim to build strategic initiatives on circular economy.

https://www.openinnovation.regione.lombardia.it/it/b/633/regioneunaroadmapsulleconomiacircolare

Plastica Consapevole (Plastic Aware) is an initiative for the reduction of plastic water bottles at Palazzo Lombardia (headquarters of **Lombardy Region**) thanks to the installation of purified water dispensers in 30 break areas. In parallel, a #plasticconscious communication campaign was conducted to promote more conscious forms of behaviour for both internal staff and the general public, and a photo exhibition was set up with images by artist Mandy Barker that artistically document the path of plastic waste.

https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioRedazionale/istituzione/attivita-istituzionali/red-contaminazioni-plastica-consapevole

RiVending is a campaign (run by **CONFIDA, COREPLA and UNIONPLAST**) for the collection of polystyrene coffee cups and stirrers dispensed by vending machines in refreshment areas. The initiative, which was also sponsored by the **Lombardy Region**, through a dedicated collection, made it possible to simplify the sorting process by initiating a homogeneous material to the production of second raw material.

https://rivending.eu/

Rold Academy

Rold Academy is the **training initiative by Elettrotecnica Rold**, a Lombardy manufacturing company specializing in innovative components for household appliances. It offers a dynamic physical and virtual space promoting continuous learning, knowledge exchange, and innovation. The Academy fosters collaboration among individuals, universities and other companies, creating a shared value base. Its goal is to empower people and businesses by providing high-quality educational programs and the right skills for future talents in the industry.

https://www.rold.com/it/rold-academy-cultura-apprendimento-continuo/

Polymers Competence Centre

The activities of Istituto Italiano dei Plastici (IIP) focus on certification services about system and product of plastics supply chain, as well as on testing of mechanical performance and chemical characterization of plastic and rubber products. Over the last decade, IIP has launched the **Polymers Competence Centre,** a national and European reference body active in the plastics and elastomeric materials sector. Particular attention in recent years has been paid to the trending topics of the circularity of the supply chain, the sustainability and the value of plastics.

https://www.iip.it/news/centro-competenza-sulle-materie-plastiche/

Plastic sector in Värmland /Sweden

Plastic Sector in Värmland

62 companies

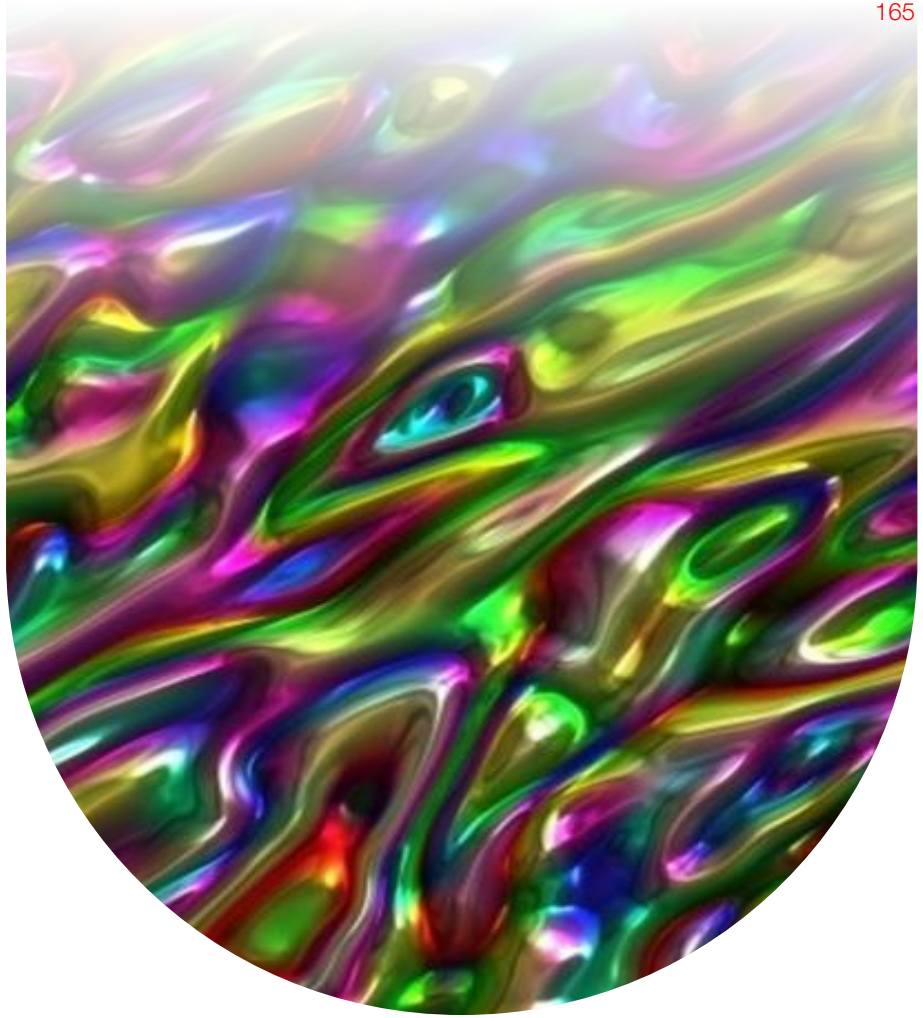
turnover
€ 261.17 M
3,033 million SEK

731 jobs

Industrial Gross value added:
0.24%
0.67% including collecting/energy recovery

Plastic recycling rate in Sweden is **10%** and for packaging (households) is **18%**

7% Bio-based plastic



Förpackningsinsamlingen (fti) is a nationwide collection scheme that collect packaging waste from households so it can be recycled into new raw material. **18%** of the collected plastics was recovered to new raw material.

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The plastic value chain in Värmland

non-exhaustive list

Production of raw materials that include even production of polymers

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FINNFOAM
INSULATION YOU CAN TRUST

ANVA POLYTECH

CELLCOMB

fti

Karlstads Energi

STENA RECYCLING

Kretsloppa & Recycling i Sverige
krsab.nu

RAGN-SELLS

VEOLIA

Svensk Plaståtervinning

van werven

Ecosystem agents in Värmland

- Universities
- R&D Tech centers
- Clusters & Associations
- Comercial fair & Congress
- Public Administration

Policies in Värmland

Nacional initiatives

National strategy and action plan for circular economy.

National action plan for plastics.

There are also six prioritized material streams in the strategy:

- Plastic
- Textiles
- Food
- Renewable and bio-based raw materials
- Construction and real estate sector
- Innovation critical metals and minerals.

Targets for the sustainable use of plastics

- Resource-smart usage
- Raw materials and production with minimal environmental impact
- Significantly increased and high-quality material recycling
- Reduce plastic leakage in nature

Instruments in Värmland

Nacional Funding

BIO INNOVATION

BioInnovation

SME support

BioInnovation

Support for a transition to a circular and biobased society

Småföretagscheck - Region Värmland (regionvarmland.se)

Nacional Funding

RE: SOURCE

Re:Source

Managed by RISE.

Financed by Energimyndigheten, Vinnova & Formas

Focus on sustainability and circular economy.

Project fundings

Regional instruments

Region Värmland

SME checks 0-49 employees

Region Värmland

Focus on green transition (among other topics)

Småföretagscheck - Region Värmland (regionvarmland.se)

Challenges & Opportunities

Opportunities

- Replacement of fossil-based plastics to a biobased material

Paper Province is supporting different testbeds moving from a fossil-based material to a biobased.

One is CircLab that is looking at 3D-printing using saw dust and other biobased material; another is a testbed focusing on lamination of paper using biobased material and the third is focusing on lignin (LignoCity) that also can be used to make biobased plastics.

Challenges

- Collecting and sorting is still a challenge, 53% of all plastics from households are collected but only 18% are recovered to new plastics. The sorting has been a very big challenge in Sweden but now a new factory is built in Sweden called "Site Zero" that will be the world's largest and most modern facility for plastic recycling. This challenge will not be so big if the factory works well.
- The contamination and mix of different types of materials in the plastics that is recovered that will lead to a low-grade product that maybe only can be used for single used package.
- Low demand for recycled plastics.

Social Dialogue

- A significant role but if we today look at household collection of plastics then we see that 53% is already collected but only 18% recovered.
- Awareness plays a crucial role in ensuring that citizens sort their plastic waste and doing it correctly, separating it from non-recyclable materials so it is not contaminated.
- But also encouraging individuals/companies to reduce their plastic consumption, reuse plastics when possible, and recycle effectively.
- When citizens demonstrate their commitment policymakers are more likely to prioritize and allocate resources for recycling infrastructure and waste management systems.

Changes expected in the instruments and policies to improve their impact and their contribution to the implementation of the European plastics strategy in Värmland

More support to replace fossil-based plastics to other biobased materials.

Success stories and best practices in Värmland: Plastic recycling (I)

Swedish Plastic Recycling

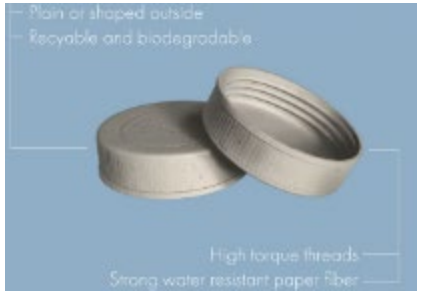
Site Zero. The world's largest and most modern facility for plastic recycling

The facility will be able to recycle all plastic packaging from Swedish households and make plastics circular – completely without any CO_2 emissions. With Site Zero we're doubling our capacity and will be able to handle 200,000 tonnes of plastic packaging per year. Thanks to cutting-edge technology it will be possible to recycle practically all types of plastic. Today the facility can manage four types of plastic – in the future Site Zero will make it possible to sort and recycle twelve different types.

https://www.svenskplastatervinning.se/en/site-zero/

BLUE OCEAN CLOSURES

Blue Ocean Closures is a start-up company in the packaging industry. They develop high quality fiberbased closures, such as screw caps and lids, with the overall vision to reduce the use of plastics and reduce environmental impact.



https://www.blueoceanclosures.com/

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Success stories and best practices in Värmland: Plastic recycling (II)

Circlab
3D printing for a biobased future

Circlab design, and test new materias for 3D printing based on fossil-free materials such as biocomposites made from wood raw material and bioplastic.

https://torsby.se/circlab

LignoCity

LignoCity is an open test and development environment in Värmland, Sweden.
A testbed focusing on lamination of paper using biobased material and the third is focusing on lignin that also can be used to make biobased plastics.

https://lignocity.se/sv/

Plastic sector in Savinja-Šalek Region /Slovenia

Plastic Sector in Savinja-Šalek Region

65 companies

€ 3,101.7 M

7,533 jobs

96.8% (foreign sales net income at the market)

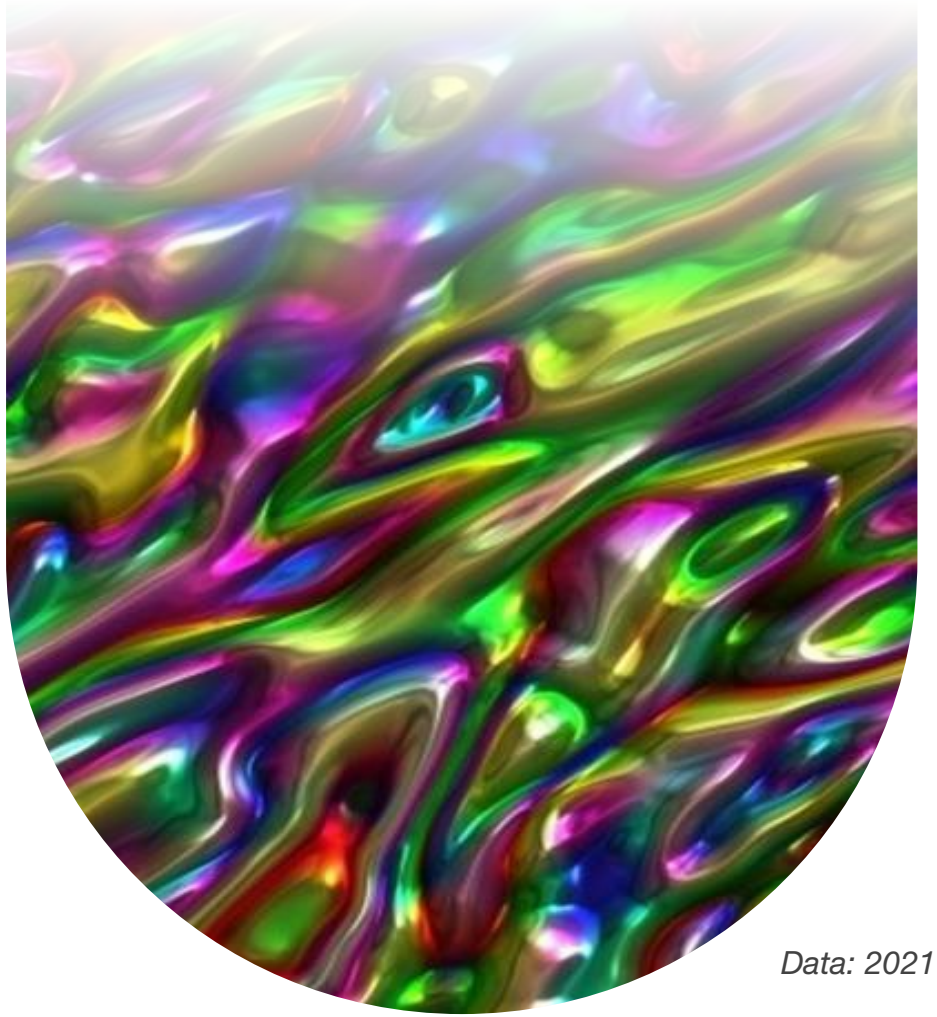
23.8 % turnover

50.5% Recycling rate of waste plastic packaging (2018)

25% of plastics waste were used to produce new plastics

In Slovenia, the contribution of plastic to the GDP increase on the state`s global scale, in the year 2020; recovery after Covid situation

GDP: **5.4%** **increase from 2021** for whole Slovenia



Source: Agency of the Republic of Slovenia for Public Legal Records and Related Services.(*AJPES), Annual report of 2021*

Data: 2021

The plastic value chain in Savinja-Šalek Region

Production of raw materials that include even production of polymers

Manufacturing: Plastic conversion and product manufacturing

End of life treatment, collection, classification, mechanical recycling, chemical recycling, energy recovery

VEPLAS advanced technologies

Evegreen

skaza Exceeding Expectations.

gorenje Life Simplified

PUP Saubermacher

KARBON

B/S/H/

ŠTRUCLJ

TehnoplastPOVŠE

Tumna Nadaljujemo tradicijo. Ustvarjamo prihodnost.

PREMOGOVNIK VELENJE

KOVINOPLASTIKA LOŽ BENDA d.o.o.

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Ecosystem agents in Savinja-Šalek Region

Universities

FAKULTETA ZA VARSTVO OKOLJA

ŠOLSKI CENTER VELENJE mavrica znanja od 1958

MEDPODJETNIŠKI IZOBRAŽEVALNI CENTER

R&D Tech centers

eurofins

skaza Exceeding Expectations.

B/S/H/

PREMOGOVNIK VELENJE Skupina hse

gorenje Life Simplified

VEPLAS advanced technologies

KOVINOPLASTIKA bf BENDA d.o.o.

TehnoplastPOVŠE

Clusters & Associations

GP GROZD PLASTIČNIH PODJETIJ SLOVENIJA

Comercial fair & Congress

Public Administration

SŠGZ SAVINJSKO-ŠALEŠKA GOSPODARSKA ZBORNICA

MESTNA OBČINA VELENJE

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Policies in Savinja-Šalek Region

Document/draft of Territorial Plan for Just Transition of the Savinja-Šalek Region

In this document, the guidelines for the restructuring of the region are written down. As part of the 2020 Semester Report, the European Commission has identified around 100 regions or areas that are entitled to "Just transition". The reason is the dependence of the area and the expected adjustment workers or job losses in the production and use of fossil fuels or production with the largest intensity of greenhouse gases. Among these regions, two Slovenian coal plants regions were identified, Zasavska and Savinja-Šalek (SAŠA). Both areas have been strongly influenced by tradition in the past that is mining of coal and the production of electricity from this fossil fuel.

Regulation on reducing the impact of certain plastic products on the environment

Regulation on packaging and waste packaging

A European Strategy for Plastics in a Circular Economy

National Energy and Climate Authority plan

Milestones for the transition to a climate-neutral economy are set by the National Energy and Climate Authority plan (NEPN) and the National Strategy for Exiting Coal and Restructuring coal regions (hereinafter: NSPP). NEPN specifies,

- by 2030 at the latest by shutting down Unit 5 in the Šoštanj Thermal Power Plant (hereinafter TEŠ) reduce the mining of lignite, and to abandon the use of imported coal in Thermoelectric heating plant Ljubljana;

- in the proportion of primary sources to produce electricity, the use of fossil fuels is reduced (35% in in 2017 to 25% in 2030), considering improved energy efficiency (35% by 2030), followed by greater use of renewable energy sources (13% in 2017 to 23% in 2030), while the share of nuclear energy stays the same.

- until 2030, the production of electricity using domestic coal - lignite will still be maintained.

NSPP, which was prepared based on the Comprehensive National Energy and Climate Plan (NEPN), was adopted in January 2022. The document specifies the year of exit from the use of coal (2033) and it defines a common vision of a just transition. The strategy supports the goals of NEPN and is also consistent with the EU's more ambitious goals: to reduce domestic greenhouse gas emissions by 55% by 2030; by 2033 the use of coal also in block 6 TEŠ should be completely abandoned.

Instruments in Savinja-Šalek Region

European Instruments

European cohesion funds (**European Cohesion Policy 2021-2027**) to support “Just transition” the improvement of the management of plastics, recycling and reduction of waste and circular economy overall.
Horizon 2020

National Instruments

Slovenian Regional Development Fund (SRDF) acts as one of the key institutions of regional development policy in Slovenia since 1995. It aims for a more sustainable achievement of long-term public goals in the development of regions, rural areas and protected areas. Beneficiaries are SME’s, farmers, holdings, co-operatives, municipalities and non- profit organisations. As a primary form of incentive, the Fund grants loans with a favourable interest rate and a long maturity. Other forms are guarantees, subsidies, soft loans, capital investments and pre-financing.

Regional Instruments

Vouchers
Regional public Tenders
Different non-financial incentives

Challenges & Opportunities

Opportunities

- Strenghtening the competitivness of the economy
- Strengthening international cooperation
- Development and production of cleaner sources of energy and alternative fuels
- Preventing the negative impacts of climate change
- Measures and support for self-sufficiency in the field of waste management
- Upgrading the waste collection and management system, reuse
- Changes in business processes adapted to the circular economy
- Circular economy awareness measures
- Measures for green infrastructure in urban and rural environments
- Adaptation of infrastructure to space and time using modern technologies
- The start-up ecosystem, including the creative industry
- Zero waste valley
- Promotion of environmental development projects

Challenges

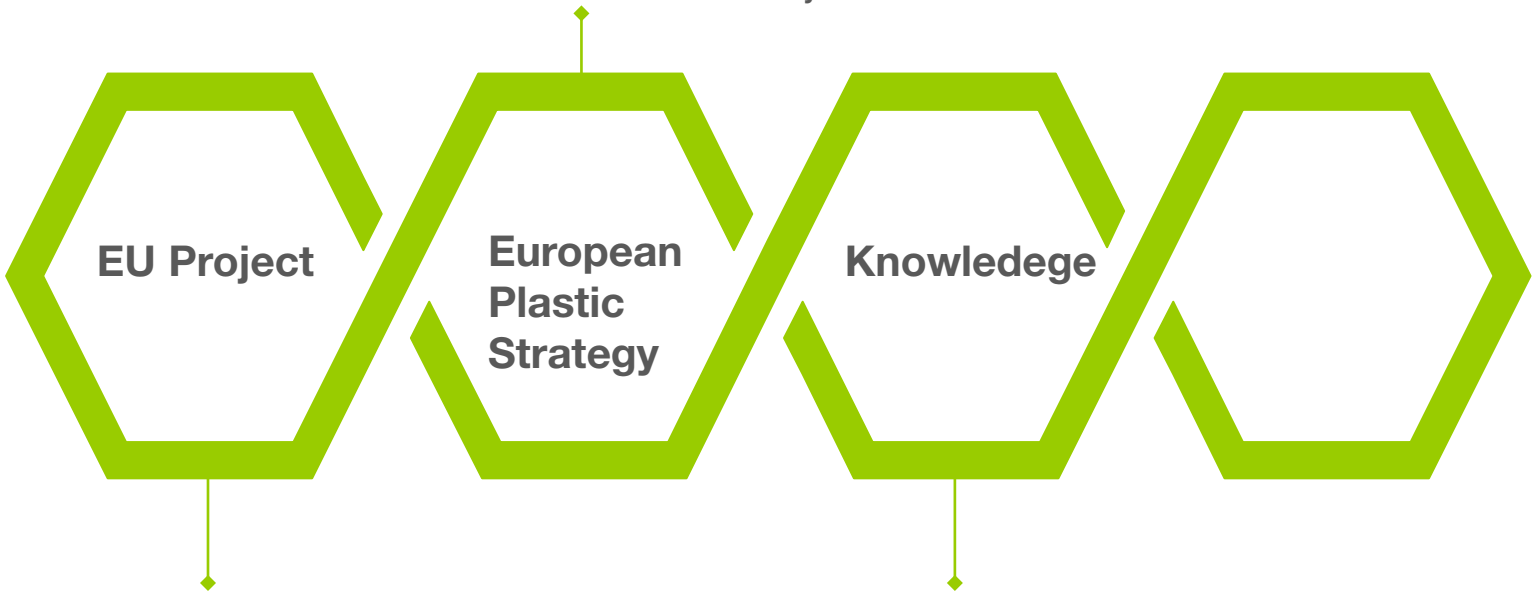
- Plastic packaging is still the only type of plastic waste subject to a binding target regarding recycling. Other sectors that generate plastic waste have yet to develop dedicated strategies or set specific targets for plastic waste management, even if they may already be subject to broader waste management targets.
- A significant increase in the average recycling rate of plastic packaging over the next ten years at the same time as the need to improve the use of recycled materials is certainly a challenge. The challenge of scaling up recycling capacity in Europe will be even greater due to the start of the new Basel Convention in 2021. It will make it more difficult to export plastic packaging waste to third countries, which amounted to a third of the reported recycling rate of EU plastic packaging waste in 2017 and increase the pressure on capacity of EU recycling.
- The expected increase in pressure on the EU's plastic recycling capacity will coincide with the likely by reducing shipments of waste from the EU, which is an important outlet for excess plastic waste. These risks lead to an increase in the number of criminal acts related to waste and illegal shipments and are exacerbated by the weaknesses of the current EU legal framework for the protection of the environment in criminal law.
- The EU's ambitions to improve its recycling of plastic packaging reflect just how big an environmental challenge plastic pose. The new legislation and targets on plastic packaging waste are an indication of the commitment of the EU and Member States to allocate resources, sometimes considerable, to address the challenge of plastic waste. Solving these challenges requires the coordinated action of all actors along the value chain.

Social Dialogue

- Before implementation of policies, proactive role of stakeholders and social dialogue should be a key, that also leads to a just transition of our region, as they ensure that no one and nobody is overlooked at all stages of the transition.
- The involvement of stakeholders in the "bottom-up" direction also ensures ownership and the motivation to implement coal exit strategies and related plans.
- This kind of approach of active involvement of key stakeholders of both coal regions was also used in the preparation of the National Strategy for Coal Exit and Restructuring of Coal Regions in accordance with principles of just transition.
- Through interviews, field visits, focus groups, operational working groups of the Ministry of Infrastructure and individual consultations, their own views, data and opinions were shared by representatives of the energy company - the HSE group (including Coal workers Velenje, TEŠ, and HSE - Energy Company Trbovlje - HSE-EDT), trade unions, municipalities, economy, regional and area development agencies, formal and informal education, non-governmental organizations, ministries, state agencies, institutes and EU institutions.

Changes expected in the instruments and policies to improve their impact and their contribution to the implementation of the European plastics strategy in Savinja-Šalek Region

Improve the impact and contribution to the implementation of the European plastics strategy, through instruments and policies, such as: Territorial Development Program of The Savinja-Šalek Region 2021-2027 (TDP), Territorial Plan for Just Transition of the Savinja-Šalek Region



Increase the participation of the Savinja-Šalek in European projects.

The knowledge gained during the implementation of the Plastix project will help to amend the TDP and facilitate a Just transition and restructuring of Savinja-Šalek region.

Success stories in Savinja-Šalek Region (I):

Plastika Skaza d.o.o., is involved in the processing of plastics, has been awarded the prestigious Red Dot Award for the innovation and superior design of its products.
They received the award for the product of their own brand, Organko Daily, which for the second time proves Skaza's leading position among the trendsetters in the plastic industry and their commitment to sustainable business.
In cooperation with design studio SITO, Skaza developed the innovative 3.3-liter container Organko Daily. The container is intended for the collection of biological waste and is made of recycled plastic, which makes it a sustainable choice for everyone, who want to live environmentally friendly. Organko Daily is a practical accessory that you can easily place on the kitchen counter, and once a day you simply empty the biological waste into a container or Bokashi Organko composter. The combination of the Organko Daily and the Bokashi Organko composter enables an efficient process of composting biological waste. This reduces the amount of waste and provides high-quality fertilizer for plants and vegetables. In addition, composting with Bokashi Organka is currently trendy and sustainable, so users of both products contribute to nature conservation and environmental protection. Organko Daily and Bokashi Essential were also selected as finalists of the prestigious European Plastic Awards 2023, which proves that we have successfully combined sustainability and design, which is our core mission.
Plans in the future, Bio-waste circular economy, Factory EMS (Electronic Manufacturing Services).

https://www.skaza.com/our-products/organko-daily

According to research by scientists, each of us should throw away at least 140 kg of plastic waste annually, but only a third of this is actually recycled. Plastic slowly breaks down into microparticles that seep into the soil. From the soil to groundwater, to rivers, etc.
The **Evegreen** team has a solution.
Together with a partner company from Germany, Evergreen developed a new, affordable and fully biodegradable material that leaves no trace in the soil. They developed a new process for processing these materials on classic plastic injection molding machines.
Their ECO solution - a flower pot, which is also suitable for spring planting. Just plant the Evegreen flower pot together with the young plant in the garden, where it immediately becomes an effective natural protection against garden pests. After 3 months, the pot finally decomposes and becomes fertilizer.

https://www.startup.si/sl-si/startup-mapa/startupi-scaleupi/evegreen

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Success stories in Savinja-Šalek Region (II):

Gorenje d.o.o.: The development of a new generation household appliances, increase in production capacity of factories household appliances, increase in production factory capacity televisions

http://www.gorenje.com/

PLP d.o.o.: Wood processing center Velenje

https://plp.si/

HTZ Velenje I.P. d.o.o. (disability company): Establishing a center for photovoltaic recycling modules at the location of the industrial areas of the Velenje Coal Mine group.

http://www.htz.si/

Velenje Coal Mine Group: Circular Economy SPV – plastic processing and production alternative fuels.

https://www.rlv.si/

City Municipality of Velenje, has in 2022 started a project LESS PLASTIC, MORE DURABILITY

The municipality of Velenje has joined the commitment Less plastic, more sustainability to eliminate single-use plastic. They have committed to eliminating single-use plastics from our operations by the end of 2022. As part of the project, they have removed 25,680 plastic glasses from circulation and prevented their creation in the coming years.

PROJECT MILESTONES

1. Eliminate all problematic and unnecessary plastic packaging and items.
2. Move from disposable to reusable models
3. Use plastic packaging that can be reused, recycled or composted, and encourage suppliers to do so
4. Increase the amount of recycled content in plastic products
5. Invest in increasing the rate of plastic recycling and composting
6. Report on the progress in achieving the goals regarding the four key items for the elimination of single-use plastics from Slovenian tourism.

https://www.velenje.si/en/

12. Analysis

- Regional Dimension
- Biobased materials
- Technologies related to plastic recycling
- Policies & Strategies
- Instruments
- Opportunities & Challenges
- Changes
- Force field
- Problem tree analysis
- Solution tree
- PESTEL

Regions

Region	Companies	Value chain	%recycling	%recycling to new plastics
Tampere	500	Manufacturing End of life		
Catalonia	860	Production Manufacturing End of life	60%	25%
Fryslân	137	Manufacturing End of life	45%	25%
Lombardy	3,744	Production Manufacturing End of life	55%	
Värmland	62	Manufacturing End of life	18%	18%
Savinja-Šalek Region	65	Manufacturing End of life	50.5%	25%

Regional dimension

- Due to the versatility of plastic, and its multiple applications in various fields, the transformation and manufacture of plastic products is widespread.
- The same does not happen with the manufacture of polymeric material or primary plastic, where the chemical industry is the one that dominates the processes.
- The 6 regions that are part of the project all have a plastic transformation industry, but only 2 of them, Lombardy and Catalonia, also have a basic chemical industry in their territory.
- The regional ecosystems are completed with universities, technology centers and research institutes, as well as professional associations and clusters.
- The problem of plastic waste affects all countries and regions. All the regions participating in the project have companies in their territory that are dedicated to the collection of waste and its subsequent treatment.
- Recycling rates vary between different regions. The regions with the highest recycling rates are Catalonia, Lombardy and Savinja-Šalek Region.
- This may also be related to the different legal frameworks, which depending on the country and region, may give more or less importance to energy recovery.
- Regarding the incorporation of recycled material in new plastic products, Catalonia and Fryslân report that 25% of recycled plastic is incorporated again in the manufacture of products, and Värmland,18%.

Biobased materials

- Along with recycling, materials based on alternative raw materials from municipal solid waste or biological residues from crops, forest clearing, or farms can be a good substitute for petroleum-based plastics.
- However, its development has not yet reached a large market. Only 2.6% of the plastics on the market come from this source, although projections point to significant growth in the coming years.
- Only Värlamd has data on bioplastics, with 7%, much higher than average.
- The rest of the regions cannot provide data in this section.

Technologies related to plastic recycling

	Mechanical recycling	Chemical recycling	Bioeconomy	Others	
Tampere	✓	✓	✗		
Catalonia	✓	✓	✓		
Fryslân	✓	✓	✓		
Lombardy	✓	✓	✓		
Värmland	✓	✗	✓		
Savinja-Šalek Region	✓	✓	✗	✓	

Policies & Strategies

- Due to belonging to the European Union, all the countries participating in the project have elaborated strategies and policies aligned with the EU directives on issues of plastics and circular economy.

- In the case of Finland, its plastics roadmap can be highlighted; for Spain, the circular economy strategy and the law limiting the use of plastics; in the case of the Netherlands, different lines of action related to the circular economy; Italy, has its roadmap for smart industrial clustering as well as national circular economy strategy; and Sweden a strategy and action plan for a circular economy, and an action plan for plastics; the region Savinja-Šalek, a national energy and climate plan, to reduce reliance on coal and restructure the region.

- As regards the regions, some of them have included aspects related to the circular economy and sustainable transformation within their RIS3 regional strategy. Some regions have developed specific policies or strategies.

- Thus, Tampere Region presents a Vision for the Circular Economy; in the case of Catalonia, a circular economy strategy and different initiatives related to the circular economy; in Fryslân, different policies to create ecosystems around the circular economy and especially plastics; Lombardy has different plans and roadmaps for circular economy and sustainable development; the region Värmland focuses on green transition (among other topics); Savinja-Šalek region is part of the so-called “Just Transition regions”, and they have a specific plan.

Instruments

- Most regions recognize the importance of EU instruments to support their strategies and policy. These include ERDF, cohesion funds, international cooperation programs, and others linked to research projects.
- National Instruments are more closely linked to national strategies and EU recovery funds
- In the regional instruments, vouchers stand out as a tool to be able to reach SMEs
- Likewise, other types of non-financial instruments can be highlighted, such as support for SMEs, the existence of clusters that help to stimulate the sector

Opportunities & Challenges

Opportunities

- Improving collecting scheme (by application sectors, type of material,...)
- Reindustrialization. New companies in chemical recycling & bioeconomy
- Sustainable value chain
- Research & Development
- Circular Economy Talent
- Replacement of fossil-based plastic to a biobased material
- Mitigate /prevent negative impact of climate change

Challenges

- Contamination and mix of different types of materials
- Fragmentation of material flows
- Collecting and sorting
- Transforming value chain
- Microplastic elimination
- Expanding plastic waste regulation across sectors
- Legal framework and regulation
- Funding

Changes expected in the instruments and policies to improve their impact and their contribution to the implementation of the European plastics strategy

Structural Analysis

Plastics sector analysis

Political

- Agenda 2030
- Green Deal & other EU policies
- National & Regional policies

Economics

- Waste taxes
- CO_2 emissions taxes
- Fossil-based raw materials procis vs recycled or bio-based materials

Social

- Climate emergency awareness
- Consumer confidence
- Training and Education

Technological

- Opportunities in scientific and technological advances
- Expensive high technology solutions
- Pace of change and new products adoptation

Environment

- Growing environmental agenda
- Circular and bioeconomy
- Identify ecoopportunities to market

Legal

- Regulatory controls becoming tougher
- International harmonization
- Secondary raw material

Force field

Driving forces

Economic incentive

Legislative impulse

Decarbonisation

Technological advances

Climate emergency

Citizenship

Reduce plastic waste

Restraining forces

Lack of substitute materials in some applications

Higher cost of alternatives

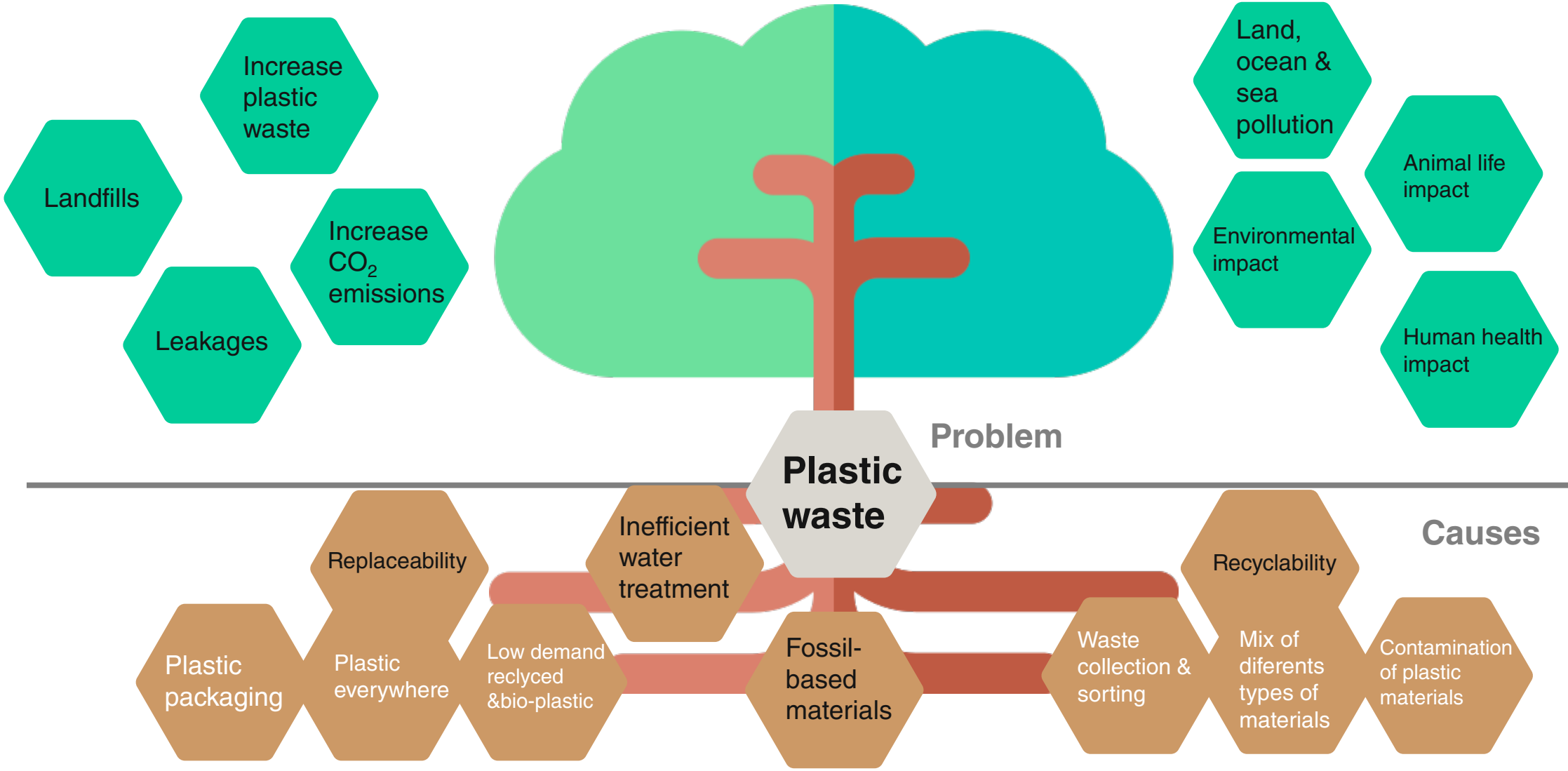
Unclear regulatory framework

Lack of industrial facilities

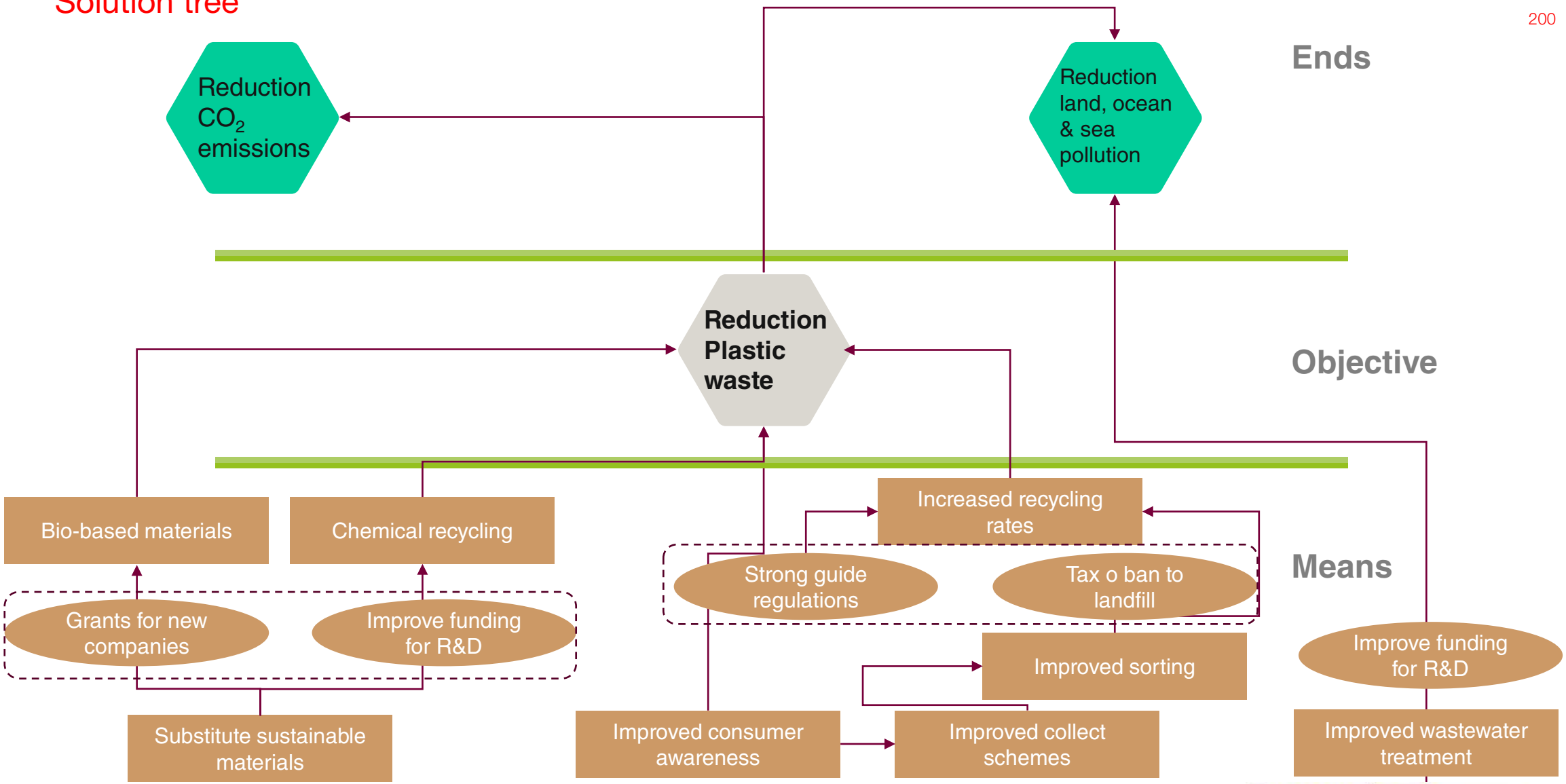
Denialism

Consumption habits

Problem tree analysis



Solution tree



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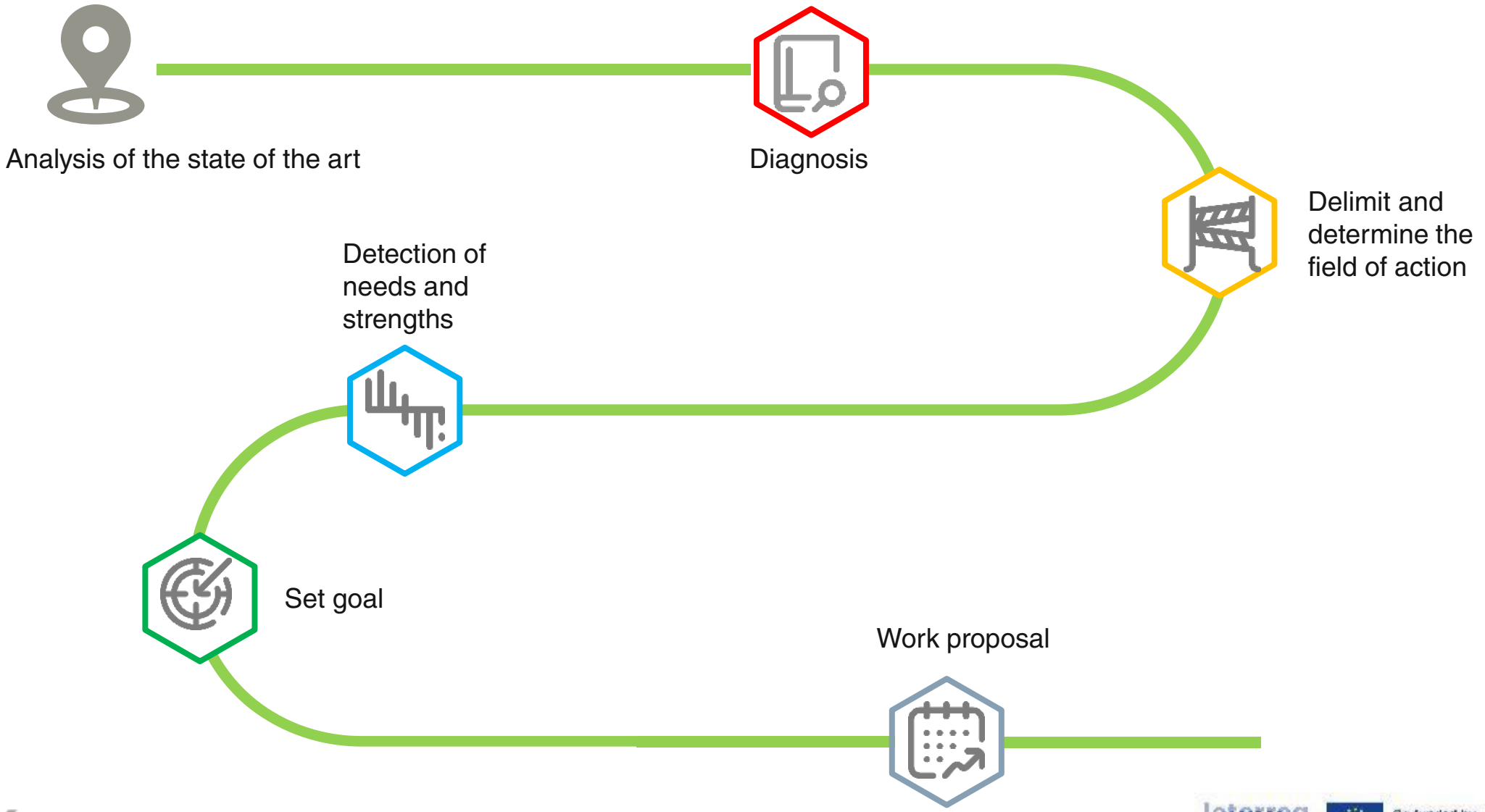
Roadmap


Analysis of the state of the art
Diagnosis
Delimit and determine the field of action
Detection of needs and strengths
Set goal
Work proposal

Recommendations

For Businesses

- Design of products thinking about their recyclability and reuse (eco-design)
- Choice of materials that allow recycling
- Avoid material losses in all processes of the value chain that could harm the environment.
- Chemical recycling research
- Incorporate recycled materials in product formulation
- Use bio - based materials

For Policy makers

- Improved selective collect schemes and sorting
- Increased recycling rates
- Strong guide regulations
- Tax o ban to landfill
- Improve funding for R&D and new companies
- Improved wastewater treatment
- Improved consumer awareness

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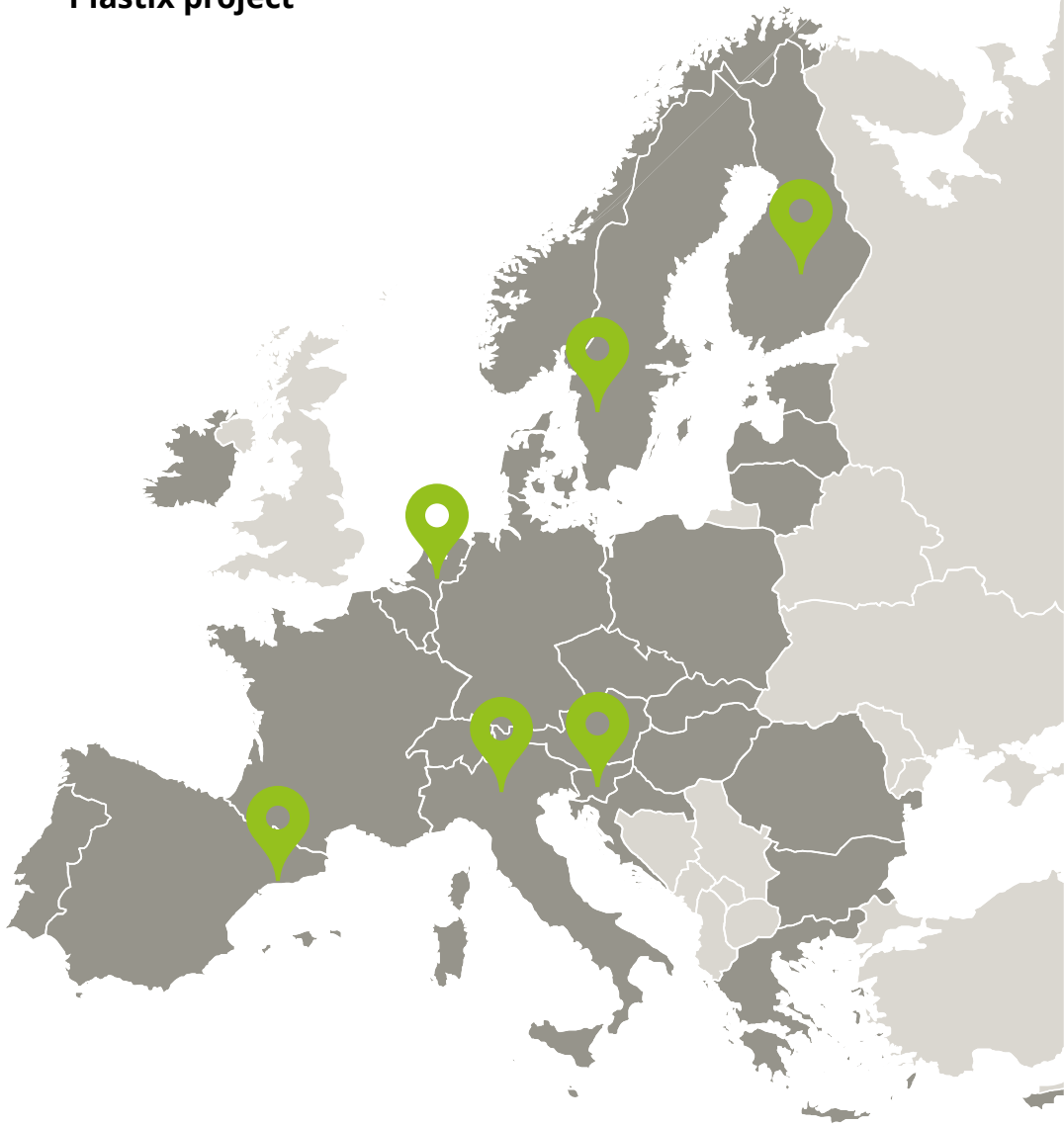
The project PLASTIX is implemented in the framework of the Interreg Europe programme and co-financed by the European Union.

www.interregeurope.eu/plastix

Plastix project



We would like to thank all those companies and institutions that have contributed to this study for their time and share knowledge.

aeqt Associació Empresarial Química de Tarragona
ChemMed Tarragona Mediterranean Chemical Cluster
fedeQuim Federación Empresarial Catalana del Sector Químico
Cluster Mav
PACKAGING CLUSTER
CLÚSTER RESIDUS
Agència de Residus de Catalunya
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More information about the sector, news and opportunities
https://catalonia.com/key-industries-technologies/chemical-plastics-green-business

Check the project's website here

https://www.interregeurope.eu/plastix

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