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REGIONE AUTÒNOMA DE SARDIGNA
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MYSEA - Mediterranean Youth, NEETs and women advancing Skills, Employment and Awareness in the blue and green economy

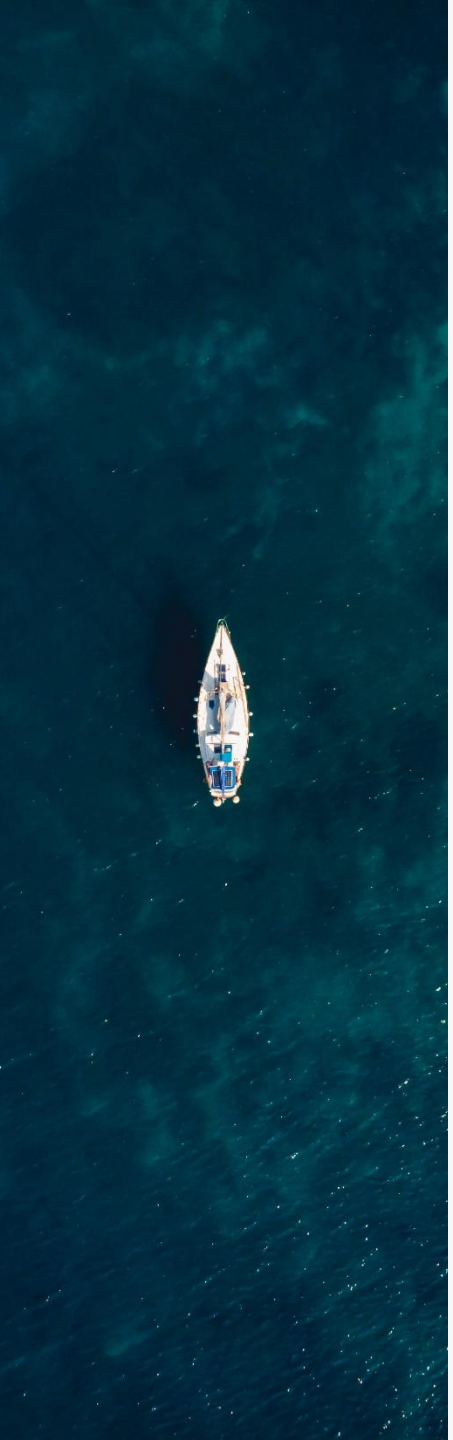
MYSEA

Introduction

This course provides fundamental information on the Blue and Green Economy, an overview of the trends in the agri-food and waste management sectors, information on the supply chain and elements of innovation, sustainability and environmental conservation.

Waste Management

(Module 3)



Circular Economy

The Circular Economy is closely related to the Green Economy.

Research from 2017 explores and describes Circular Economy *as*

"a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling."

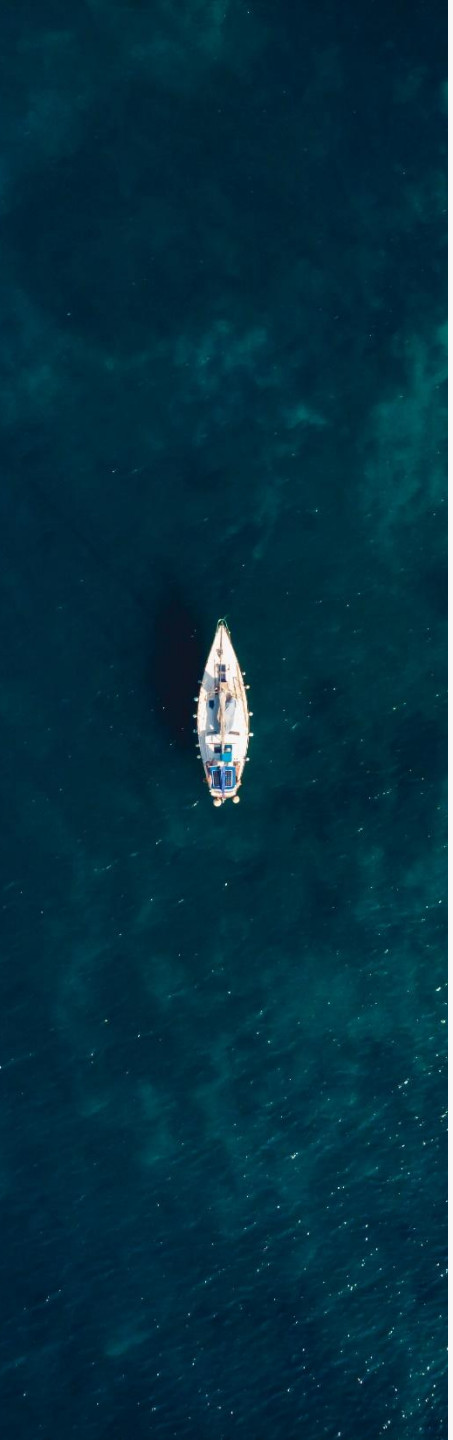
The 3R Concept

Following this definition, it is easy to understand how and why circular economy is used interchangeably with the ***"3R Concept"*** in waste management ***– Reduce, Reuse, Recycle.***

1. Reduce

– this is related to simply creating less waste. In doing so you are stopping the problem at the source.

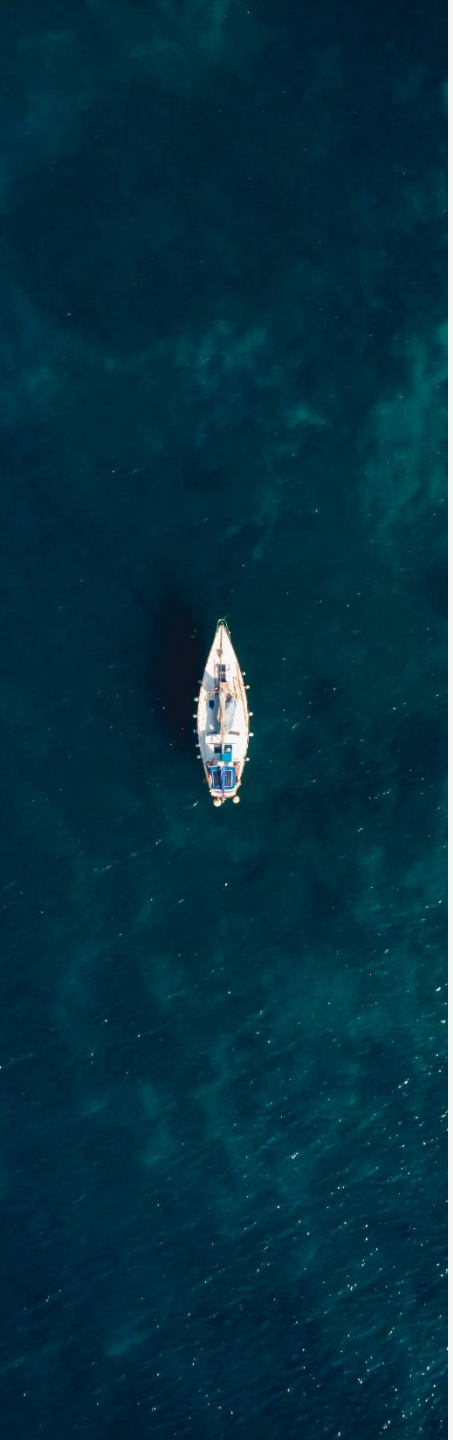
The easiest way to do so is to start looking around and identify items that you can substitute with such that you can use repeatedly, like reusable bags for your groceries, reusable bottles for water and beverages, and reusable boxes for lunch and other meals.



2. Reuse

– this is related to expanding the boundaries of what we described in the previous R. Here reusing may be related to giving away that which you are not using anymore or even repurposing an item for different use. In doing so you are expanding its usefulness and servitude.

Example activities include selling and sharing clothes, children's toys, and any other items that don't serve you anymore and have been gathering dust for the past year and even more.

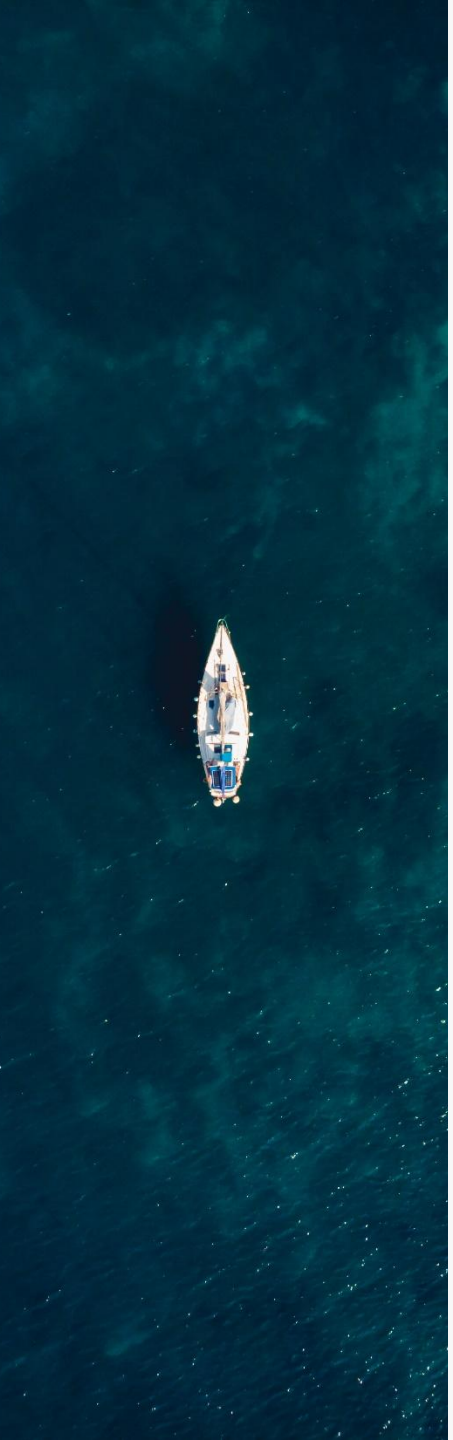


3. Recycle

– at this point, many people have an intuitive understanding of what recycling means. This is the transmutation of items discarded as waste into new materials and products, with the goal of furthering what we already have instead of more natural, virgin resources.

Of course, waste management and each mentioned concept go way beyond the basics we've just outlined.

For this reason, let us now explore some of these in greater depth.

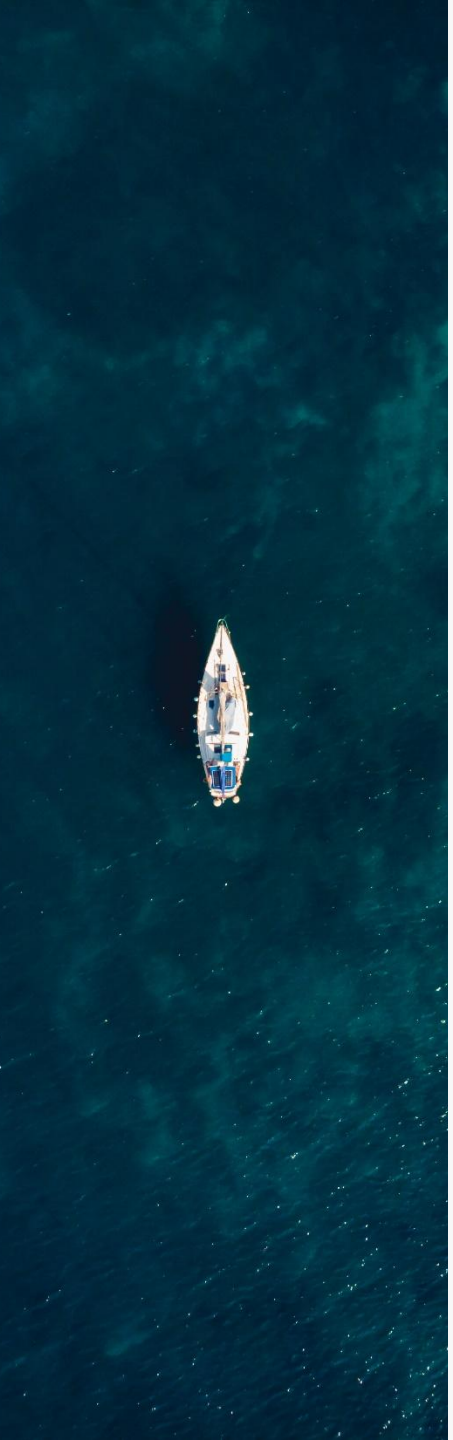


Definition & Classification of Waste

Definition of waste

Defining waste is more important than one may think. While from a personal point of view this may seem nonessential, it is crucial from the perspectives of government and legislation.

A clear understanding of what is and what is not waste, makes it easier to assess the environmental and health risks that may come from different products – this in turn, makes waste management possible.

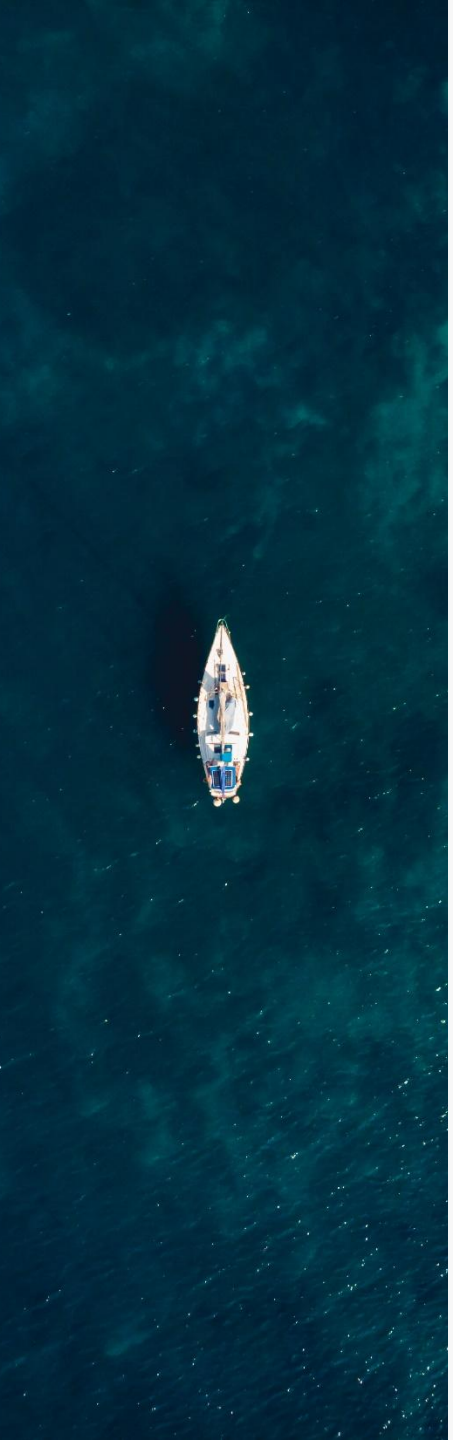


So, what is waste?

Gathered from various official definitions, waste is:

- A substance, object or material
- No longer suited for its intended use
- Directed for recycling or reuse
- Intended to be disposed of or

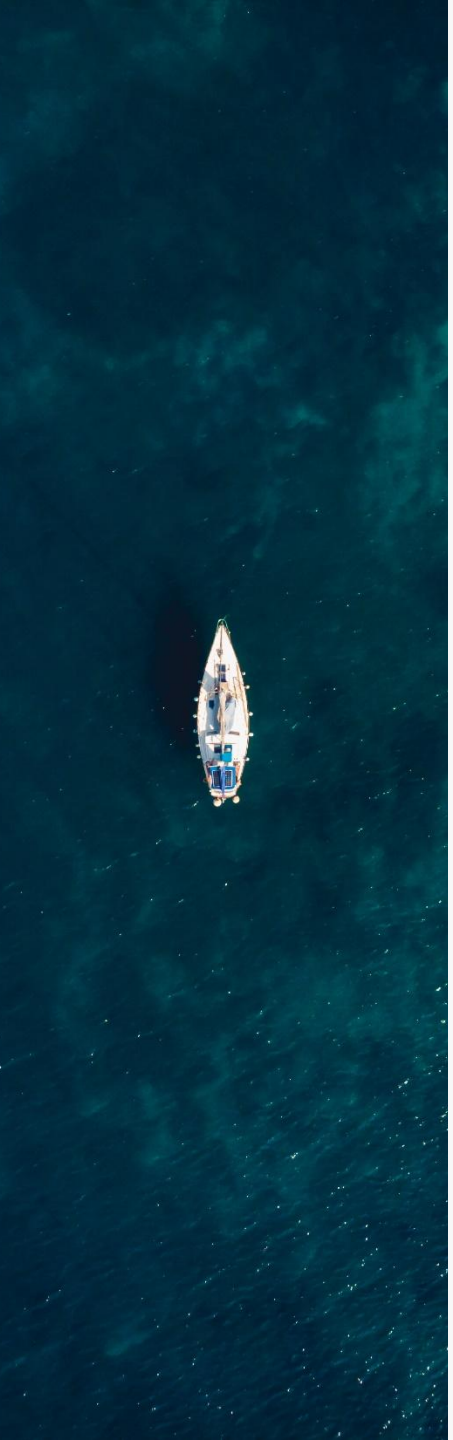
Required to be disposed of by law.



Classification of waste

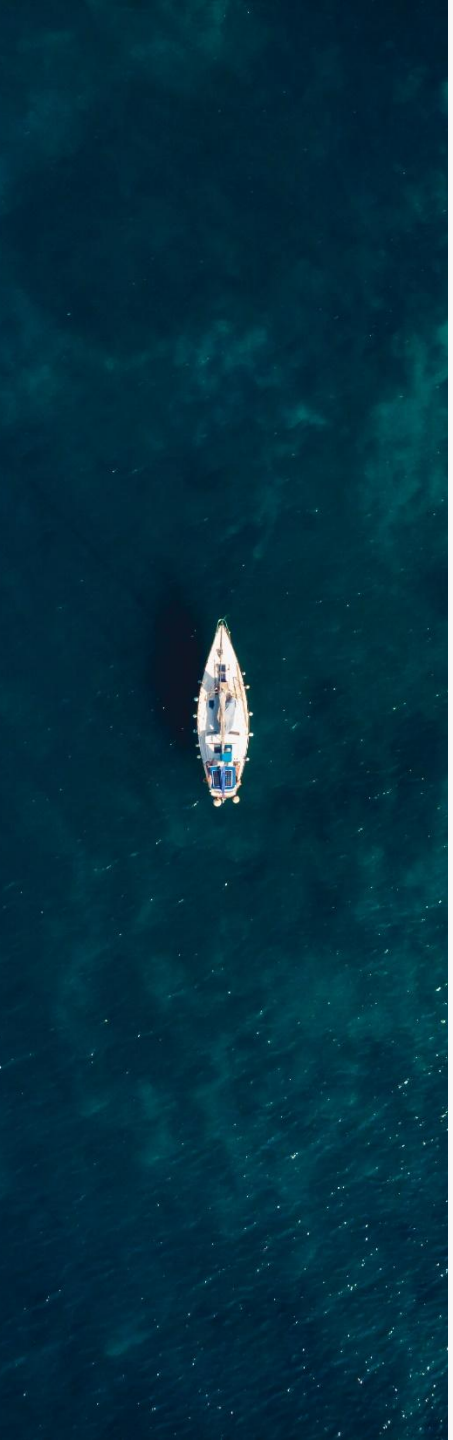
Classification of waste depends greatly on national regulations and legislation.

That said, most types of classification usually follow one (or a combination) of concepts that use specific questions as a starting point.



For example:

- “Who or what generated the waste”
- “What is it made of?”
- “Who handles this type of waste?”
- “How dangerous is it”



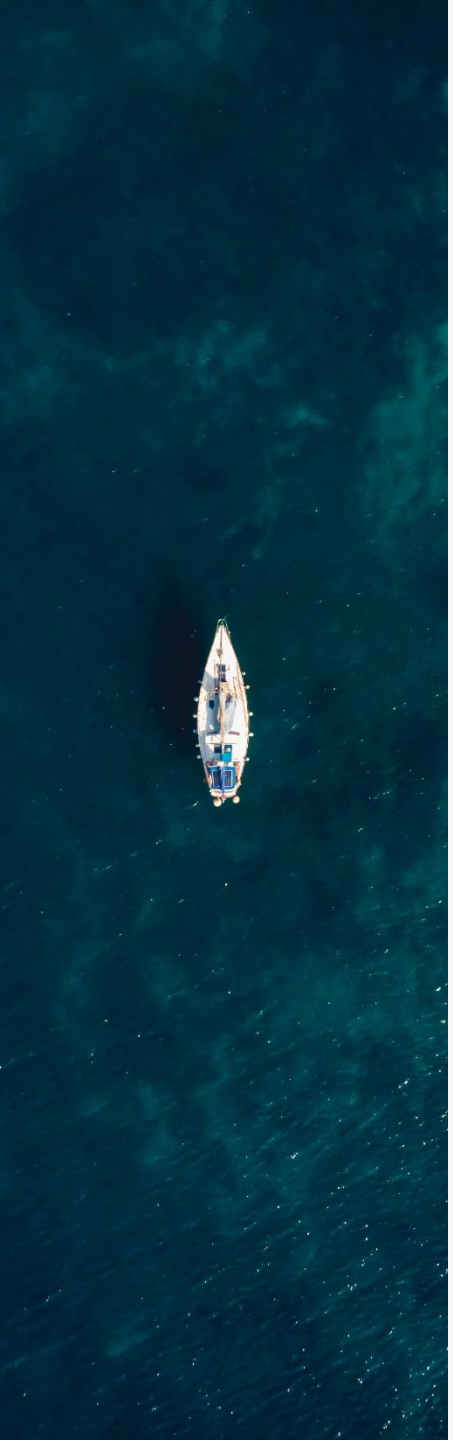
Examples of waste classification

Source of Origin

This concept classifies waste by answering **“Who or what generated the waste?”**

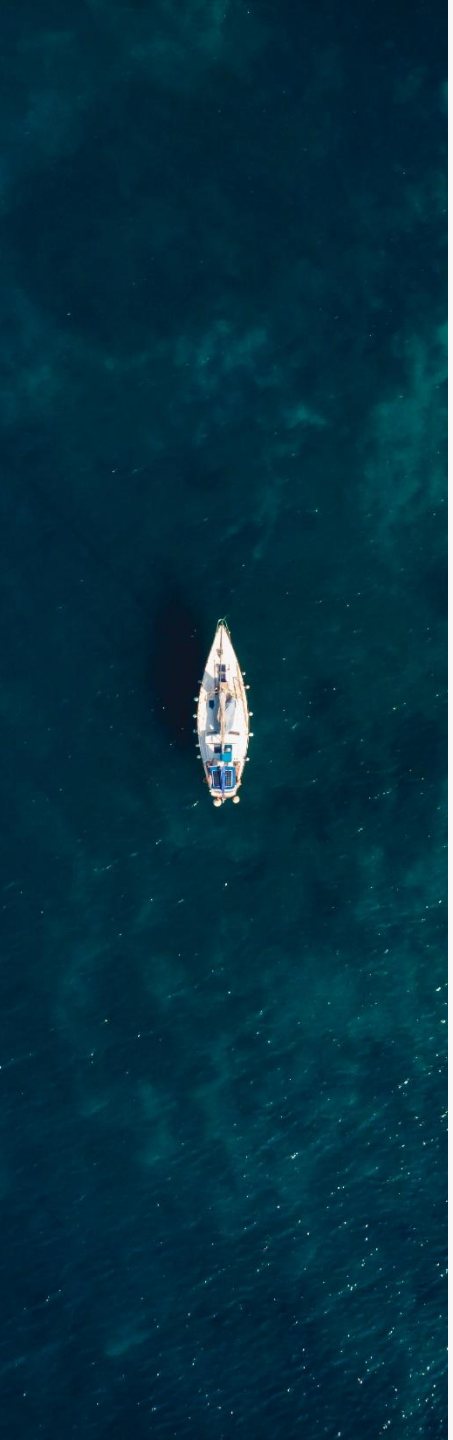
For example:

- Construction and demolition (concrete, wood, etc.)
- Household and commercial (municipal solid waste, medical, tires, etc.)
- Agriculture and forestry (organic, pesticides, fertilizers, etc.)
- Wastewater treatment (sewage sludge, chemicals, solid waste, etc.)
- Industry (textile, plastics, chemicals, nuclear, etc.)
- Mining (mine water, waste rock, chemicals, etc.)



Level of Risk

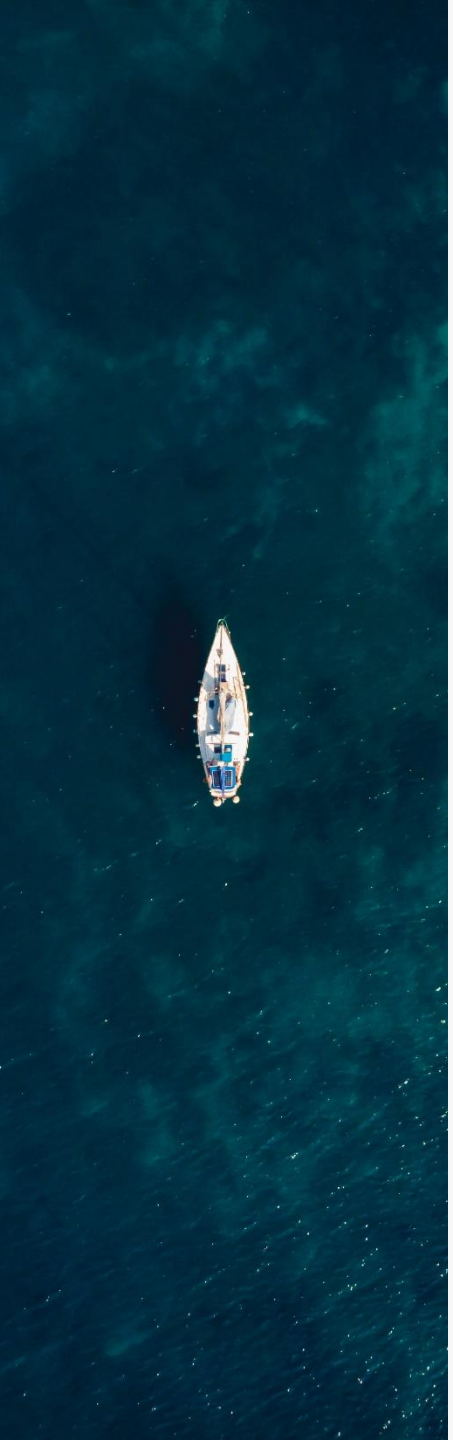
This concept classifies waste by answering “How dangerous is it?”



Non-hazardous waste

Also called “solid waste”, represents all types of waste that haven’t been classified as hazardous.

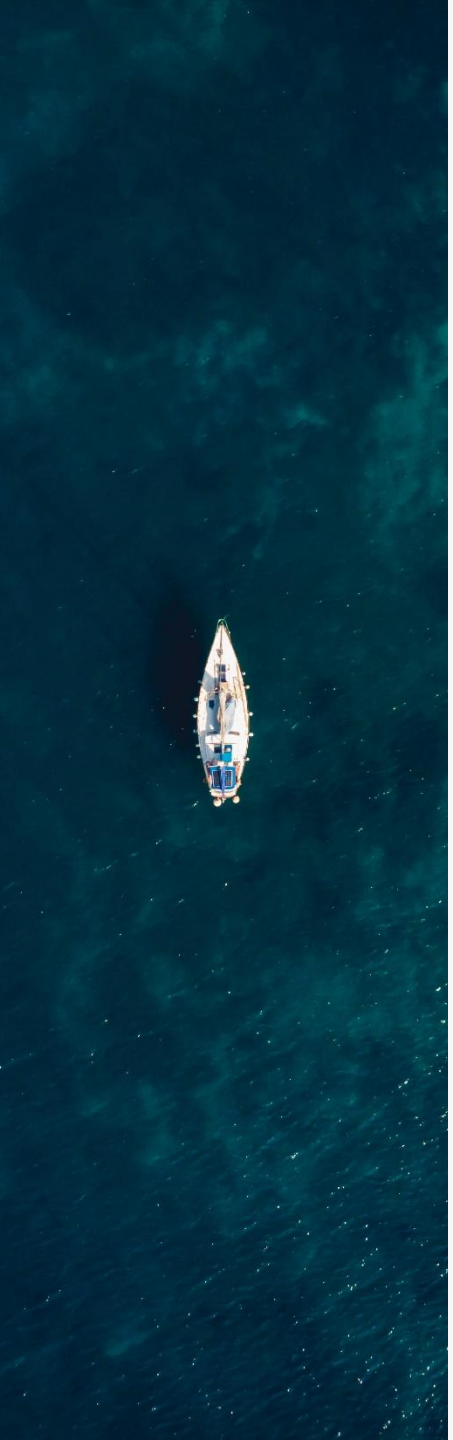
Solid wastes are products that we often associate with recycling and consider for repurposing: paper, plastic, glass, metal, organic, etc.



Hazardous Waste

- This type of waste has been generally classified as harmful (either to the environment or to human health). Hazardous waste can also be collected and recycled, but the processes related to that are very different from those associated with non-hazardous waste.

- The main characteristics of hazardous waste are **toxicity** (ingestion or absorption), **ignitability** (flammable), **corrosivity** and **reactivity** (explosiveness or toxic gas release).



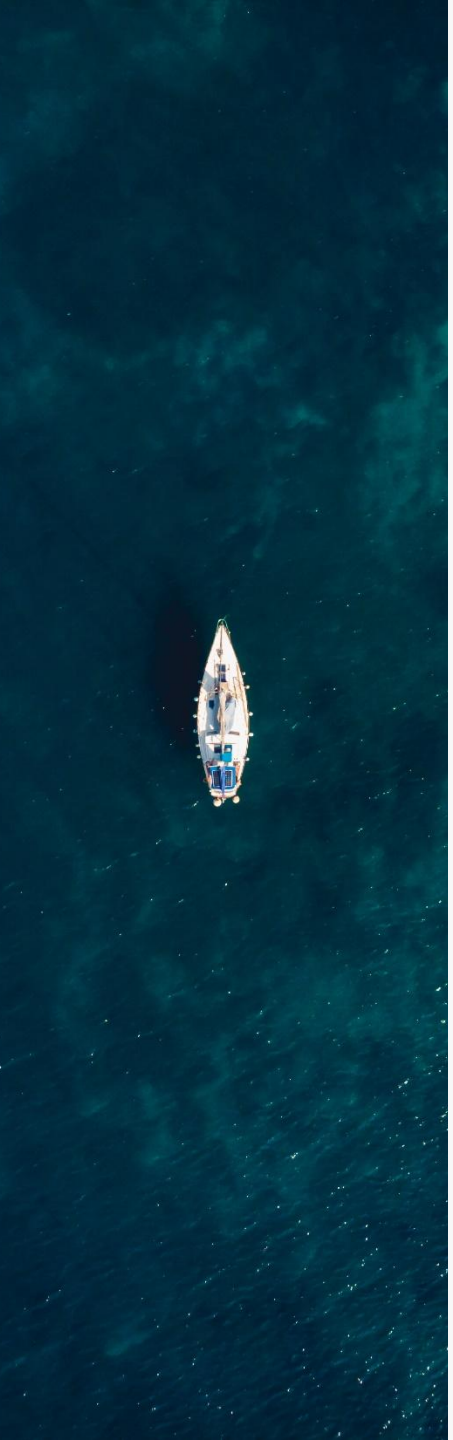
Example include:

E-Waste

– generally characterized as hazardous because of toxic components.

Includes:

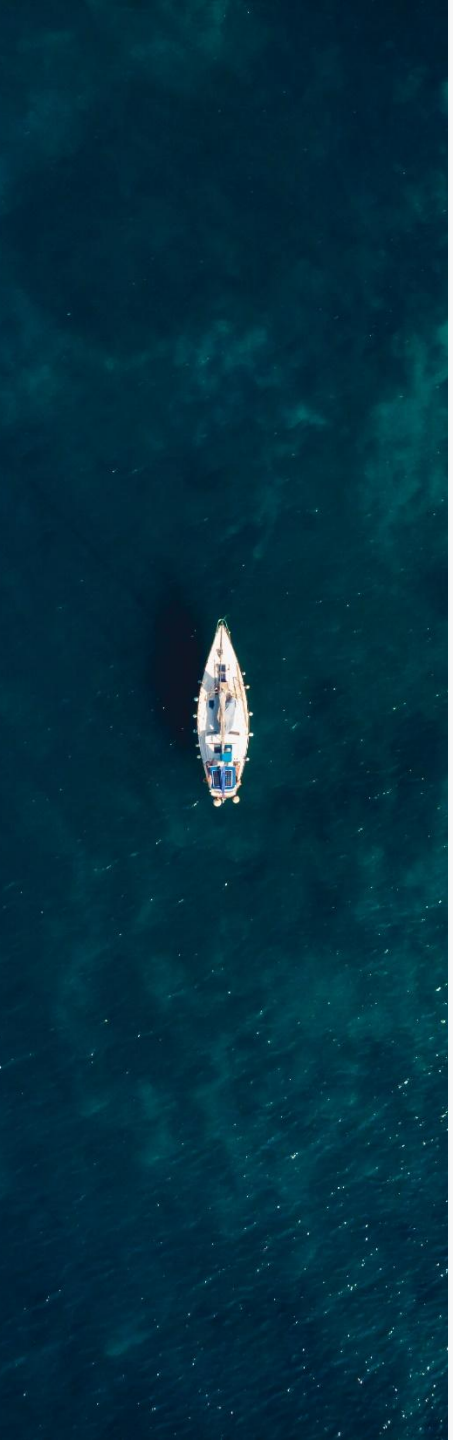
- Batteries
- Computers
- Phones



Medical waste

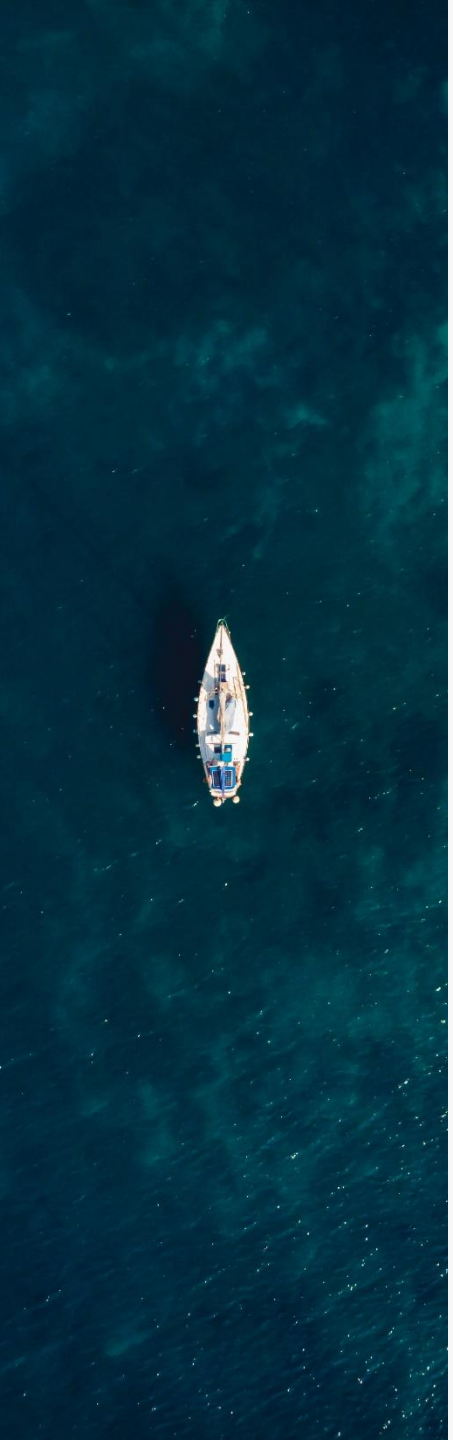
– hazardous because it can be toxic, and infectious, containing harmful microorganisms and bacteria. Includes:

- Pharmaceuticals
- Bodily fluids
- Body parts
- Bandages
- Chemicals

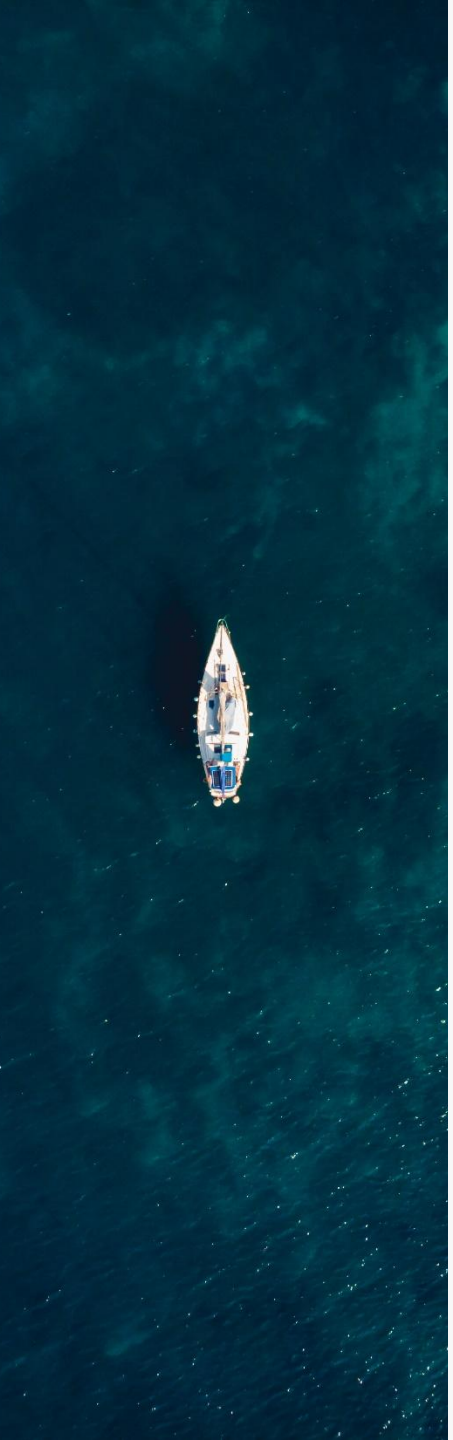


Radioactive waste

– hazardous because it includes radioactive materials. Handling and managing this type of waste is significantly different from others.



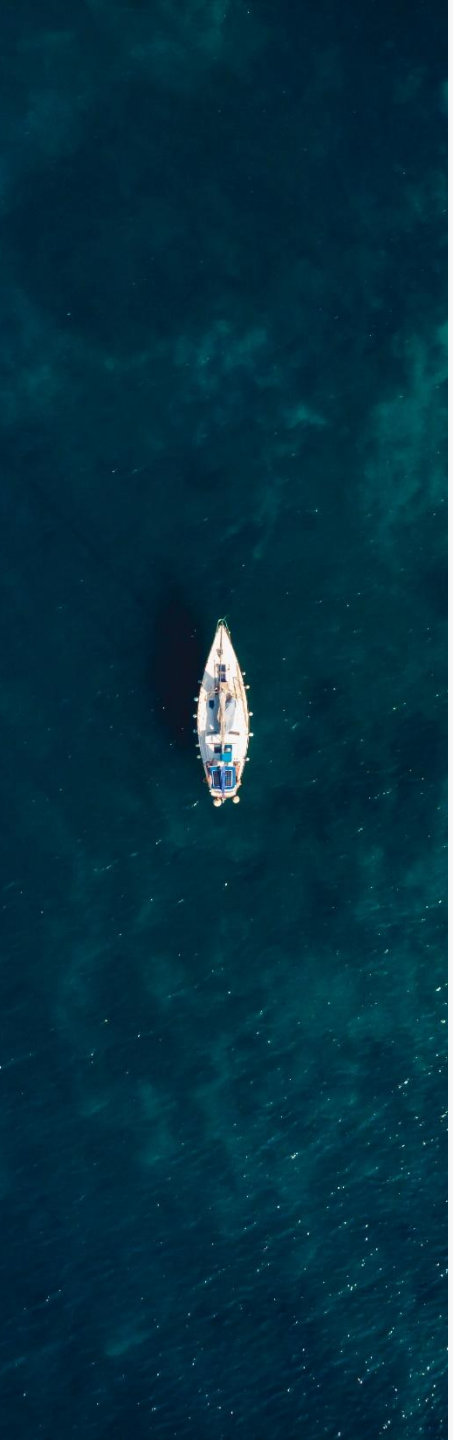
Recyclable, Biodegradable & Compostable Waste



Recyclable

Products that can be collected and re-processed to produce new items are called “recyclable” products.

Common recyclable materials are paper, cardboard, plastic, glass, aluminium, and electronic waste. Just like other eco-friendly practices, recycling aims at diverting waste from landfills.

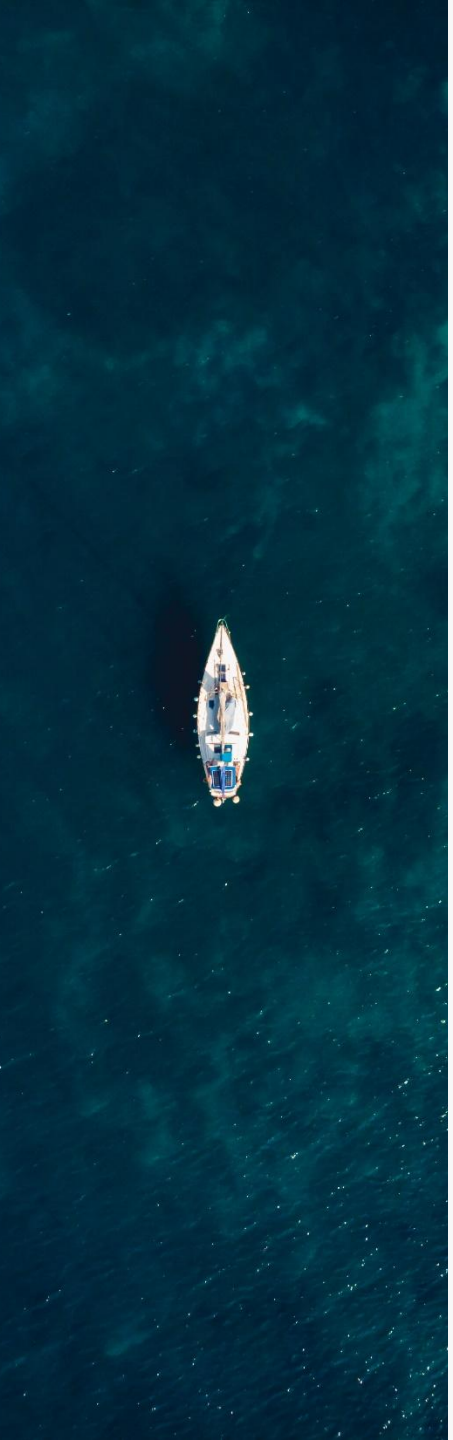


Identifying Recyclable Products

Most simple paper and plastic products are marked with the universal recycling symbol.

However, any complex electrical goods (mobile phones, computers, printers, etc.) can be recycled as well.

Some products can be disassembled, and their parts can be recycled, while products like batteries, paints and fertilizers can be further processed to reduce the environmental impact of their disposal.



Biodegradable

'*Biodegradable*' products are the ones that break down into carbon dioxide, water and biomass within a reasonable amount of time in the natural environment.

However, the term '*biodegradable*' has no legal enforcement or definition which leads to manufacturers using it very loosely.

Biodegradability is highly sought in cleaning agents. While conventional cleaning agents usually emit hazardous phosphates and volatile organic compounds (VOCs) when they degrade, biodegradable cleaning solutions do not.

Identifying Biodegradable Products

Biodegradable goods feature a leafy triangle shape on the back of their packaging.

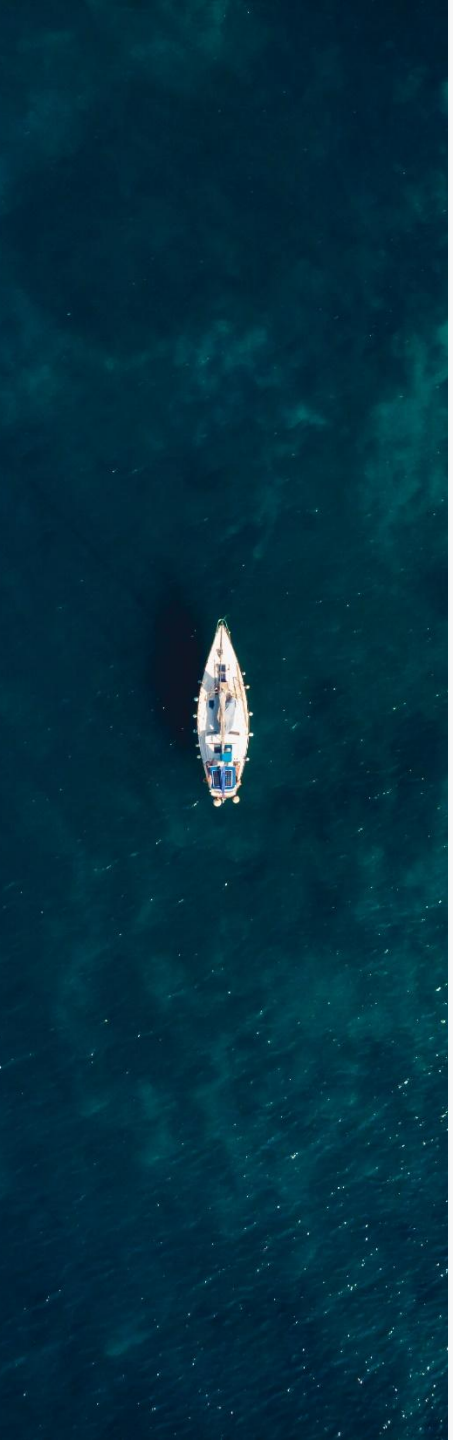
This sign is different from the conventional continuous arrow triangle found on recyclable objects. In addition, products have various levels of biodegradability.

Disposing of Biodegradable Products

Biodegradable can be disposed of in your garbage.

However, it is essential to highlight that landfills lack the microorganisms and oxygen required for waste to biodegrade in a timely manner.

For this reason, it is important to consider minimizing your use of biodegradable items and consider recyclable or compostable alternatives.

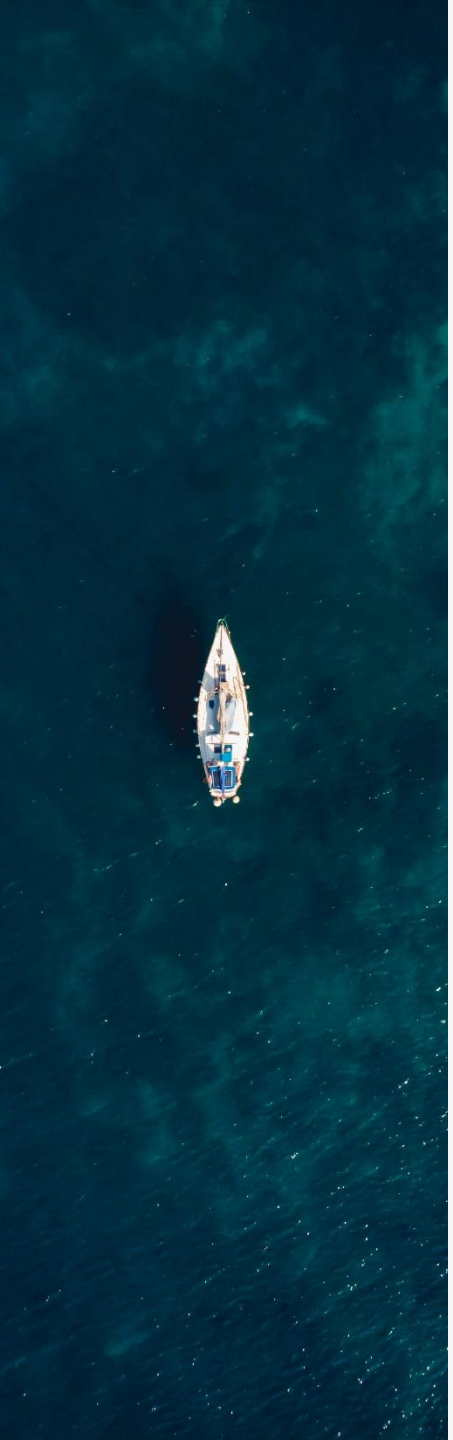


Compostable

"*Compostable*" products are biodegradable bodies that also release valuable nutrients into the soil, enhancing the growth of trees and plants. The most popular composters are industrial however, personal compostable containers are gaining popularity and finding a place in people's gardens.

Compostable products are commonly made out of PLA (Polylactic acid), vegetable starch or bagasse (sugarcane fibre). From an eco-friendly perspective, products labelled "*compostable*" are to be preferred over others that may be labelled "*biodegradable.*"

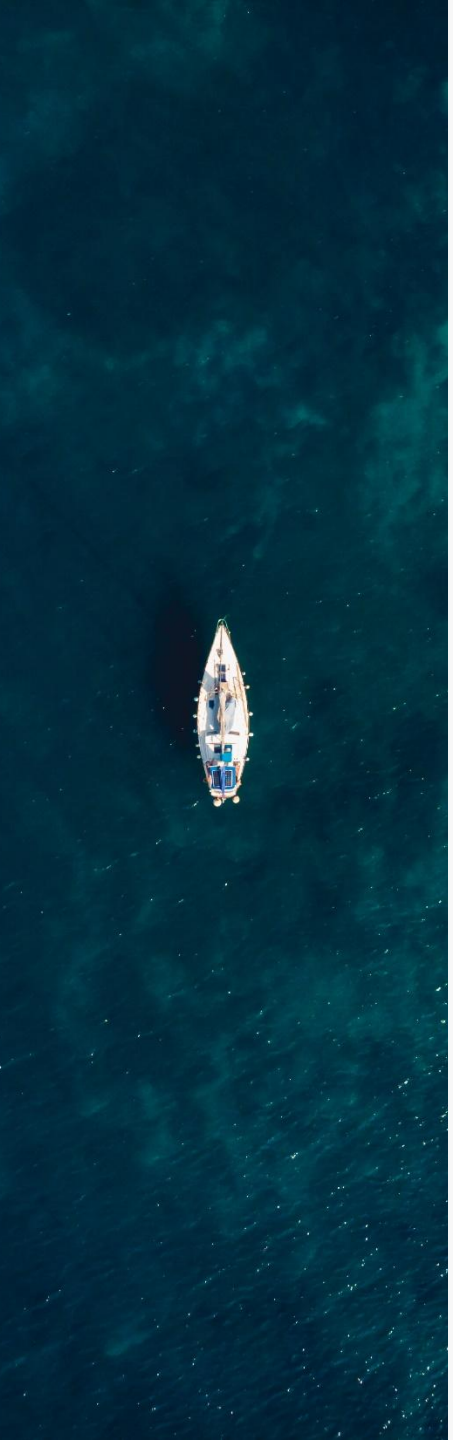
Compostable products degrade within several months and produce no toxic residues.



Identifying Compostable Products

Compostable products are indicated as “compostable” with a label. (usually found on the bottom or the handle of an item). A product can be labelled as “*compostable*” only if it is fully compostable – this requires the item to be certified as such and the evaluation is usually carried out by a third-party company.

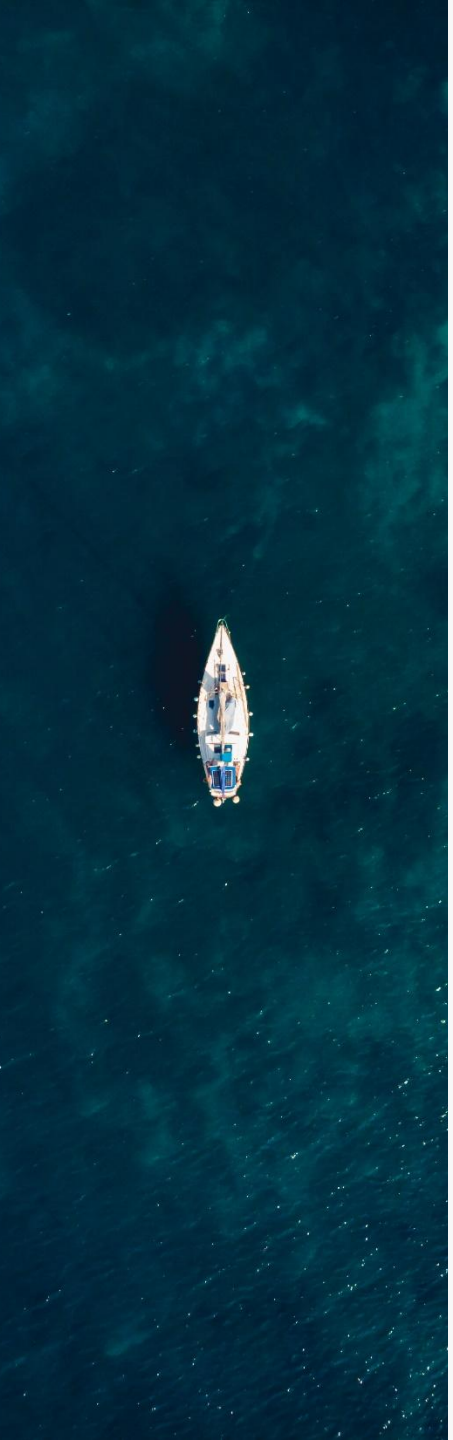
It is extremely important to pay attention to the actual text since there are numerous labels that may want you either to believe that the product is compostable or simply indicate that the product is of different nature. Such labels include “*biodegradable*”.



Disposing of Compostable Products

From a personal standpoint, the process of dealing with compostable products is pretty straightforward - you place the products in your compost collection containers, and they get picked up.

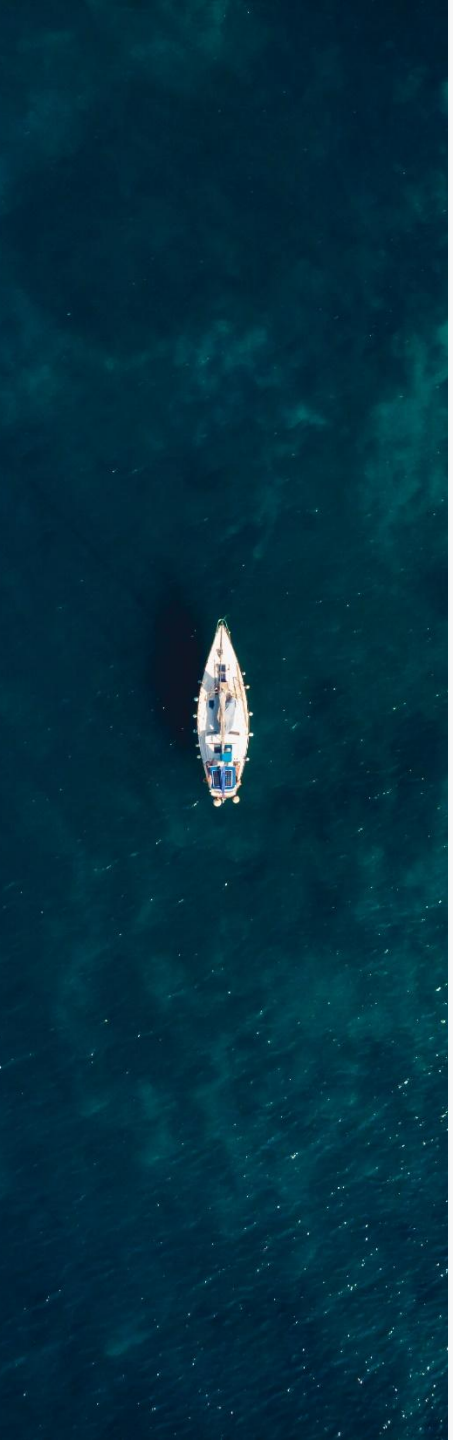
Items generally decay in 30-120 days, depending on the product size and material. This happens in an industrial composter – for this, a city must have a composting facility.



You can use a home composter in your backyard !!

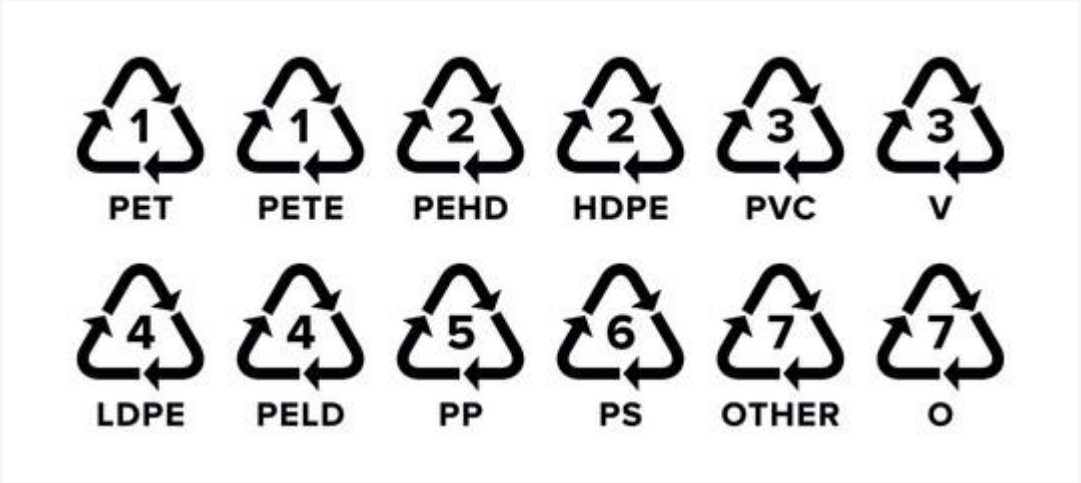
If you don't have access to a compost facility or a home composter, your last resort solution would be to dispose of your compostable products in the garbage.

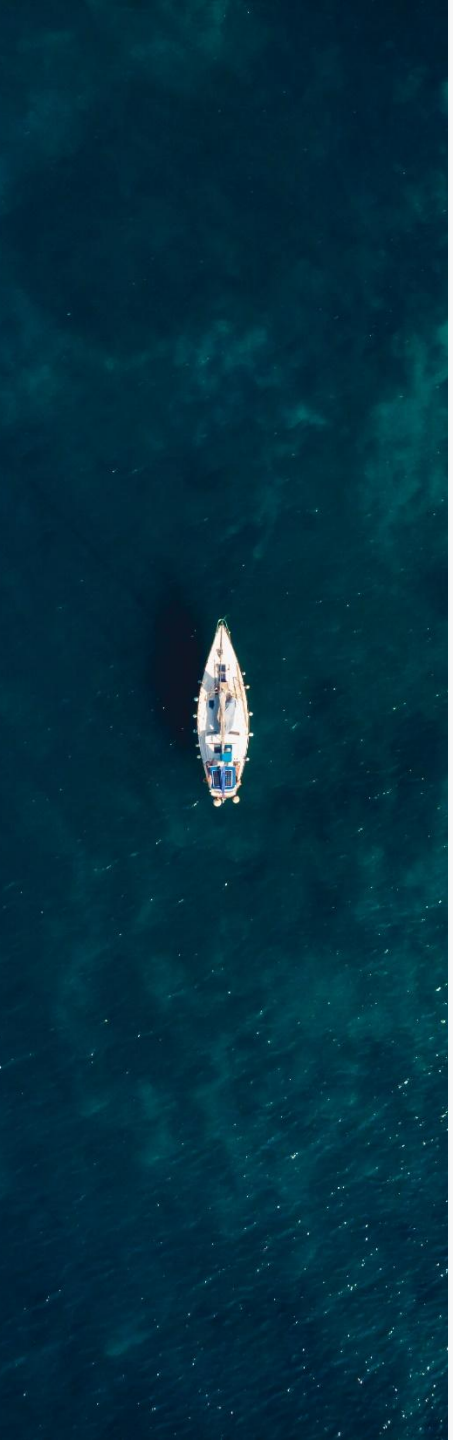
The reason being is that compostable items are NOT recyclable yet – if you put compostables into your recycling you will only contaminate the process.



Guide to Recycling and use of Biodegradable and Eco Sustainable Plastics and Products

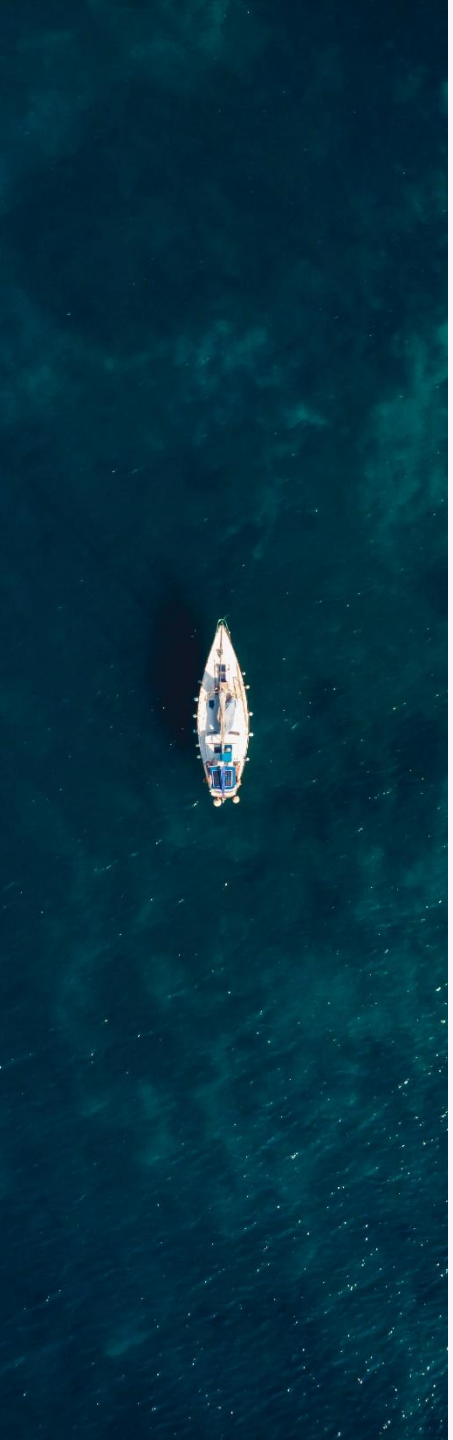
There are several types of plastic that are considered common.





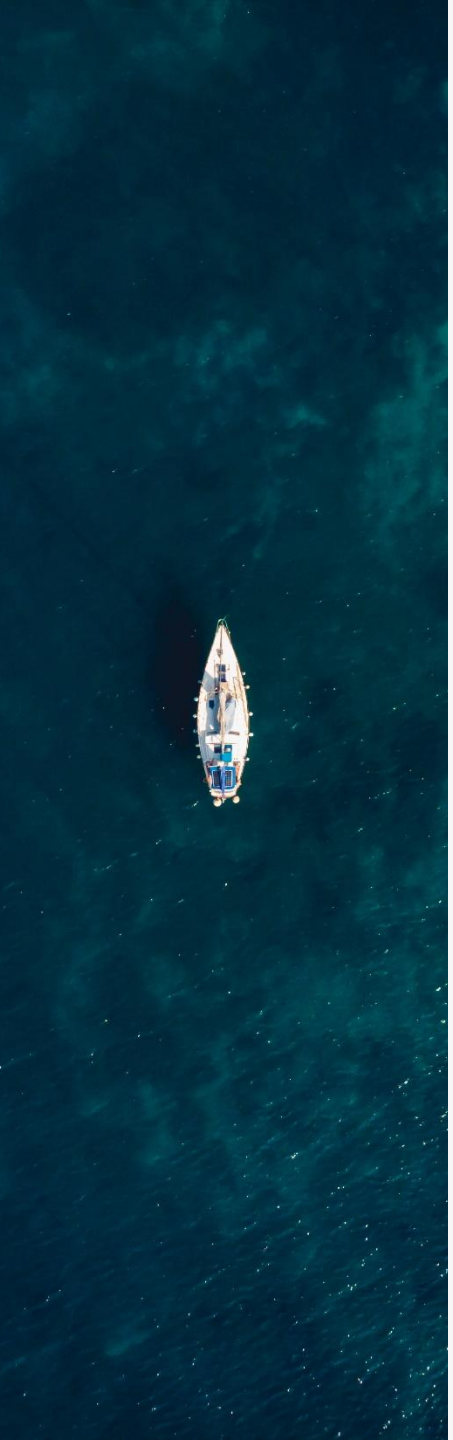
1. PE

Collectively, this is the most common type of plastic worldwide.



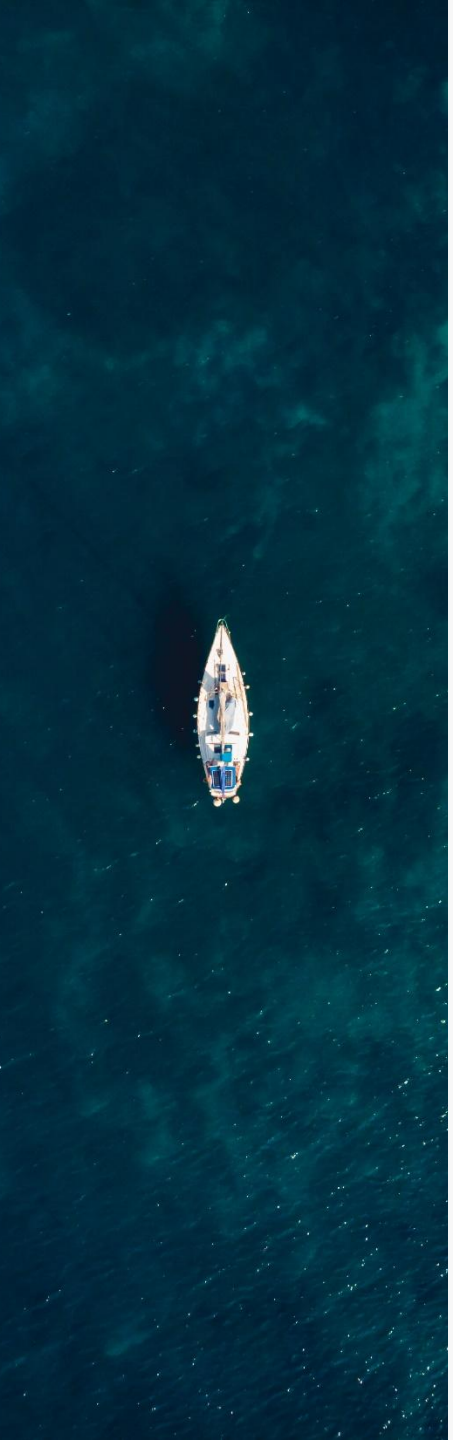
PE classified into three types:

- **HDPE (High-Density Polyethylene)**
  Considered NOT biodegradable as the process takes a very long time.
  It is recyclable. Also, it can be reused and repurposed utility are limited
  - Milk bottles
  - Shampoo bottles
  - Chemical containers
  - Toys
  - Buckets



- **LDPE (Low-Density Polyethylene)**
  Considered NOT biodegradable as the process takes a very long time.
  It is not always recyclable – this depends on the regional recycling institutions.
  Its reuse and repurposing utility are limited.

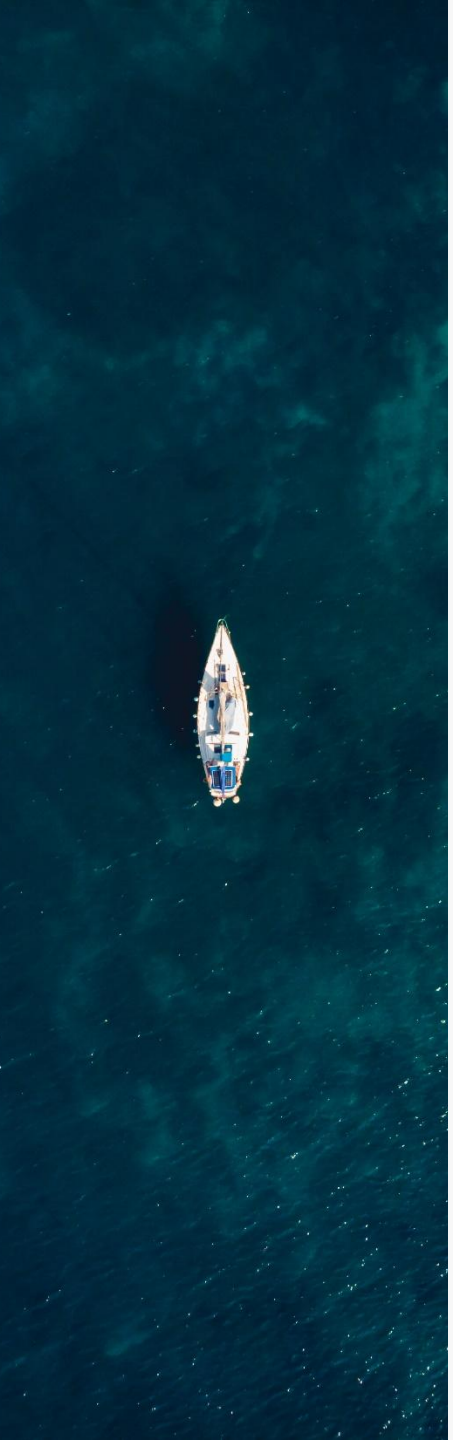
  - Garbage bin liners
  - Plastic bags
  - Films and sheets
  - Landscape timber
  - Bubble wraps
  - Beverage cups
  - Postal Envelopes



- **LLDPE (Linear Low-Density Polyethylene)**

Considered NOT biodegradable as the process takes a very long time.
It is not always recyclable – this depends on the regional recycling institutions.
Its reuse and repurposing utility are limited.

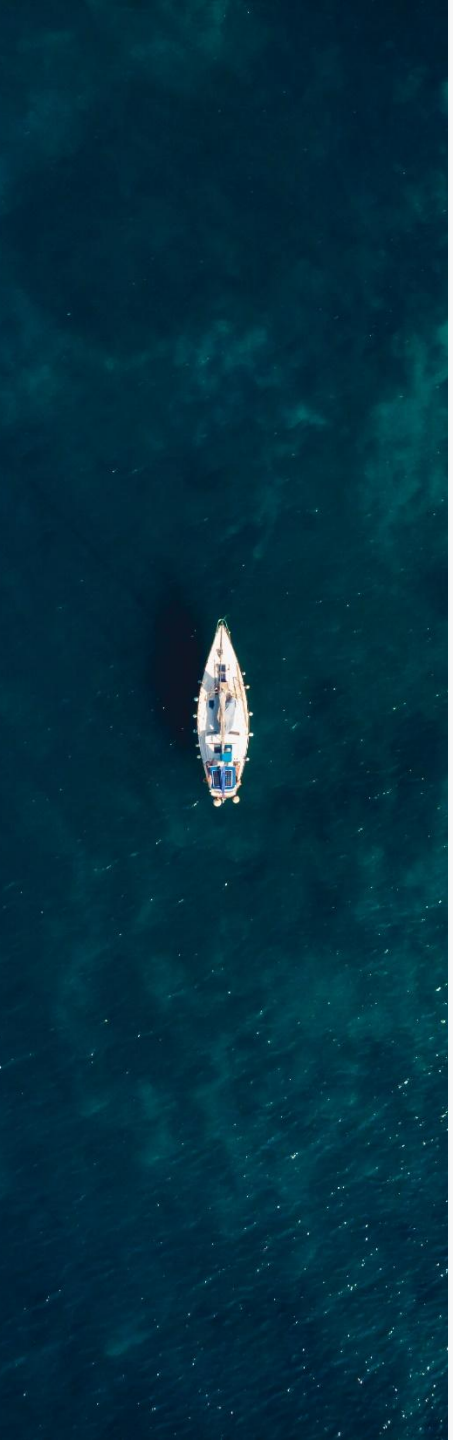
- Salad bags
- Cheese wraps
- Protective food films (bread, meat)



2. PET or PETE (Polyethylene Terephthalate)

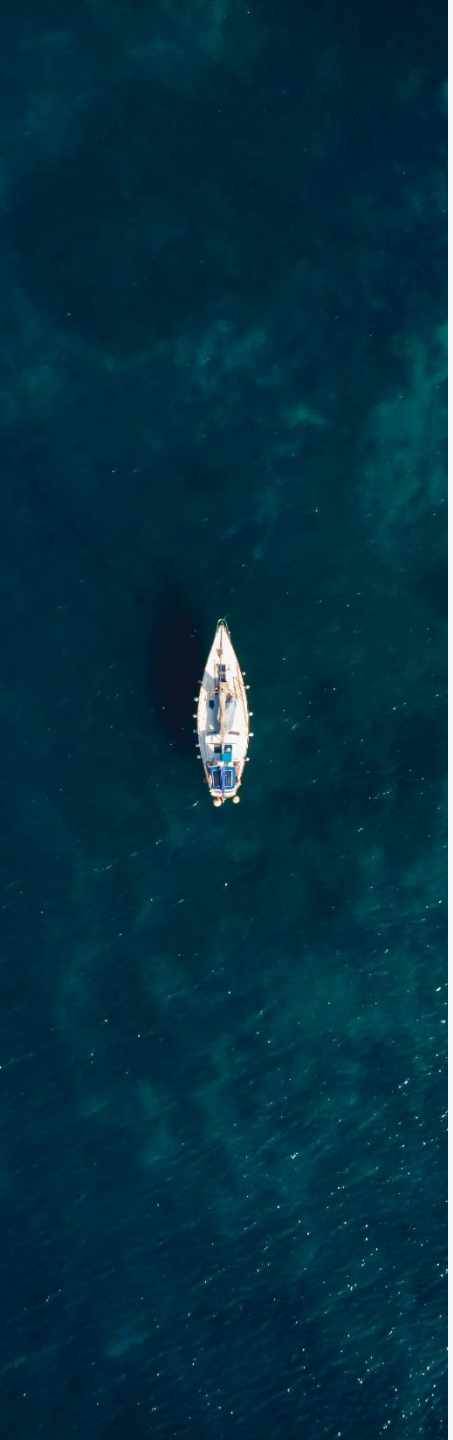
This kind of plastic is one of the most prevalent types. It is commonly used for food packaging, usually transparent, lightweight, and fabrics (e.g., polyester). It is usually transparent, lightweight and durable.

Clear PET is fully recyclable however, black packaging PET is not yet recyclable. Health advocates advise NOT to reuse PET products. In addition, it may have some repurposing utility.



Examples of PET or PETE:

- Beverage bottles
- Food jars (jelly, peanut butter, etc.)
- Food bottles (dressings like ketchup, mayonnaise, mustard)



3. PVC or Vinyl (Polyvinyl Chloride)

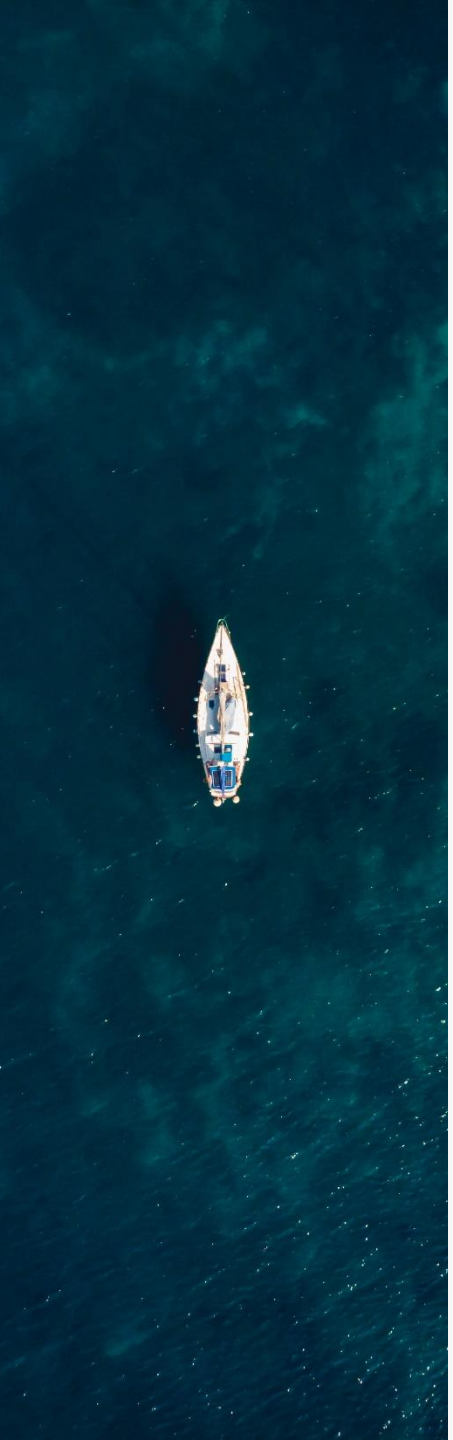
This plastic is harder and more resistant to weathering and chemicals, and it doesn't conduct electricity. These qualities make it a preferred material for building, construction and high-tech application.

It is also impermeable to germs and easily disinfected – because of that, it is often used in health-care equipment and single-use applications that reduce infections. The latter is important, because **PVC is also the most dangerous type of plastic** to our health, as it leaches toxins through the entirety of its lifecycle.

PVC isn't recyclable, neither is it biodegradable. However, it can be reused or repurposed to create other products.

Examples of PVC:

- Credit cards
- Plumbing pipes
- Medical bags
- Medical tubing
- Oxygen masks



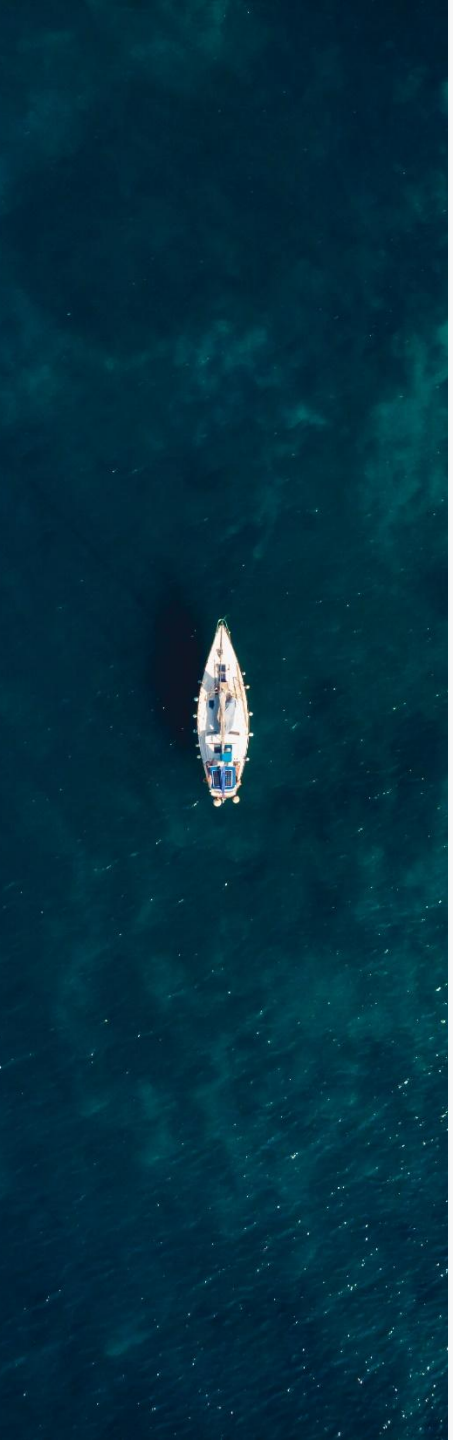
4. PP (Polypropylene)

This plastic is more durable, flexible enough and more heat resistant than some others. Because of that, it is usually found in food packaging and storing products, as well as items that are meant to be reheated.

Polypropylene is recyclable, but it is not biodegradable. However, it can be reused or repurposed to create other products.

Examples of PP:

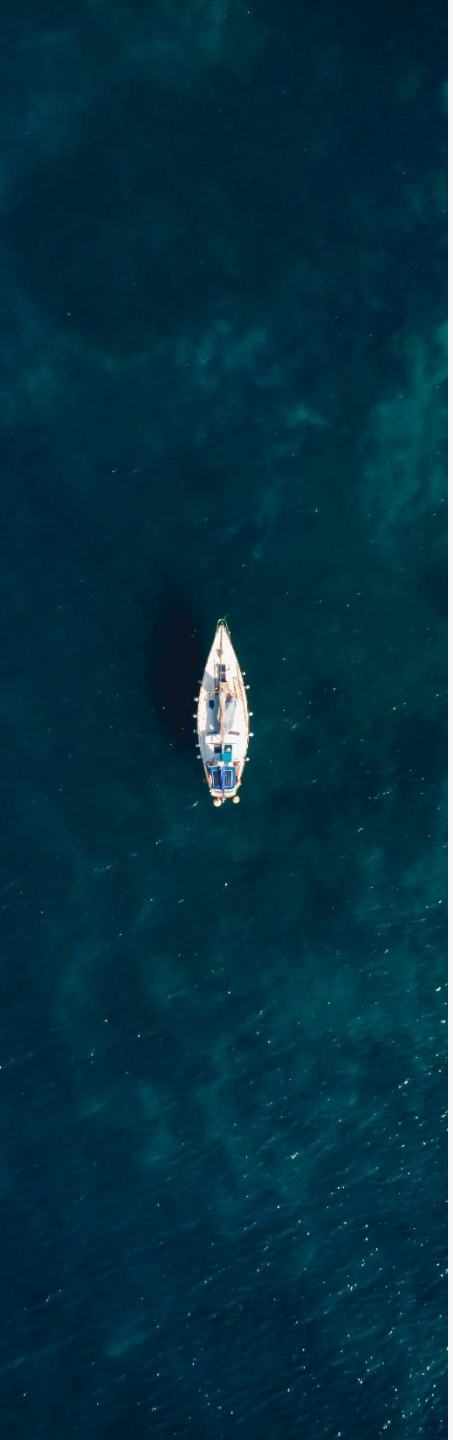
- Food containers
- Straws
- Bottle caps
- Prescription bottles



5. PS or Styrofoam (Polystyrene)

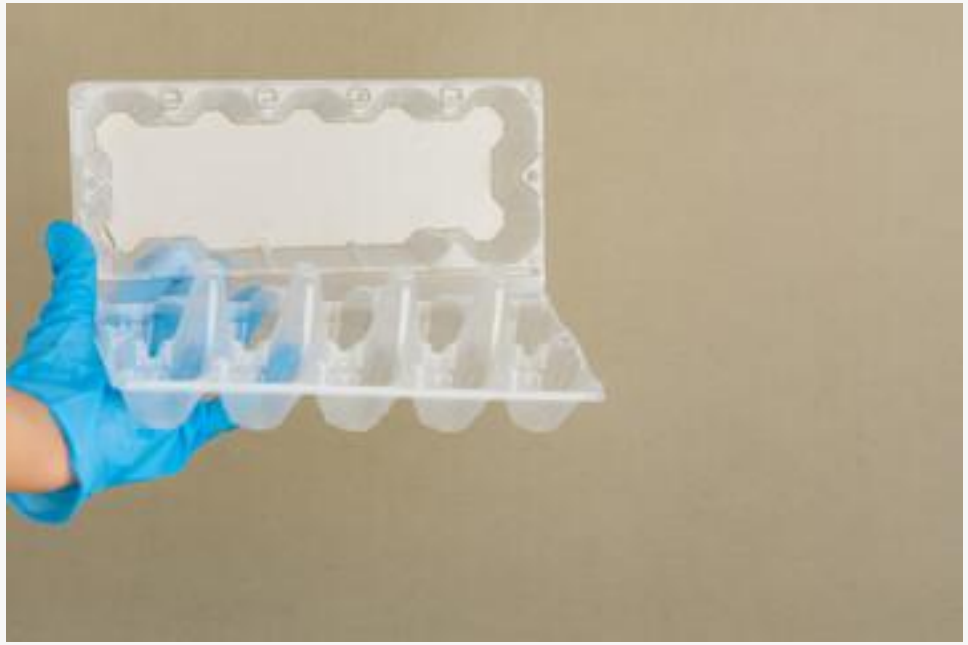
This plastic is rigid, offers very good insulation and is low-cost. For these reasons, it is one of the more preferred materials in the food and construction industries. It is, however, similar to PVC in a way that can be harmful to human health, as it can easily leach toxins that can be absorbed by food.

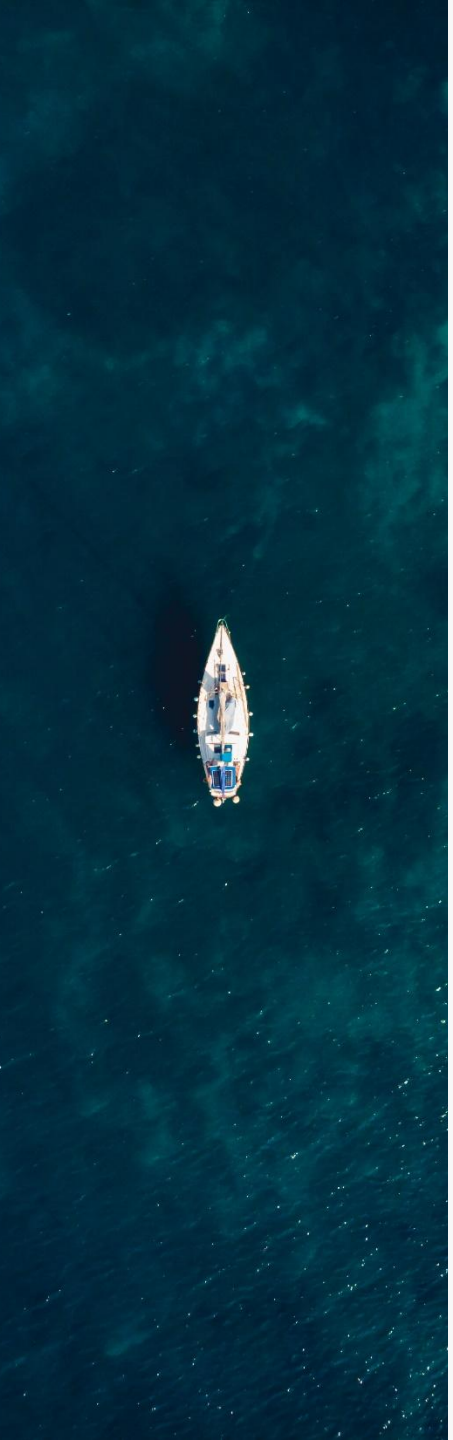
Polystyrene is recyclable, but it is considered non-biodegradable, as the process takes too. Health professionals advise against reusing it however, the material can be repurposed.



Examples of PS:

- Takeout food containers
- Egg cartons
- Cutlery
- Cups
- Shipping packaging
- Product packaging
- Building insulation





6. other

The purpose of this category is to encompass any other type of plastic, which doesn't belong to any of the aforementioned types. This is supposedly reflected in its code, and it usually means that this particular type of plastic is non-recyclable (yet).
Examples include:

- Eyeglasses
- Clear plastic cutlery
- Baby bottles
- Sport bottles
- Electronics

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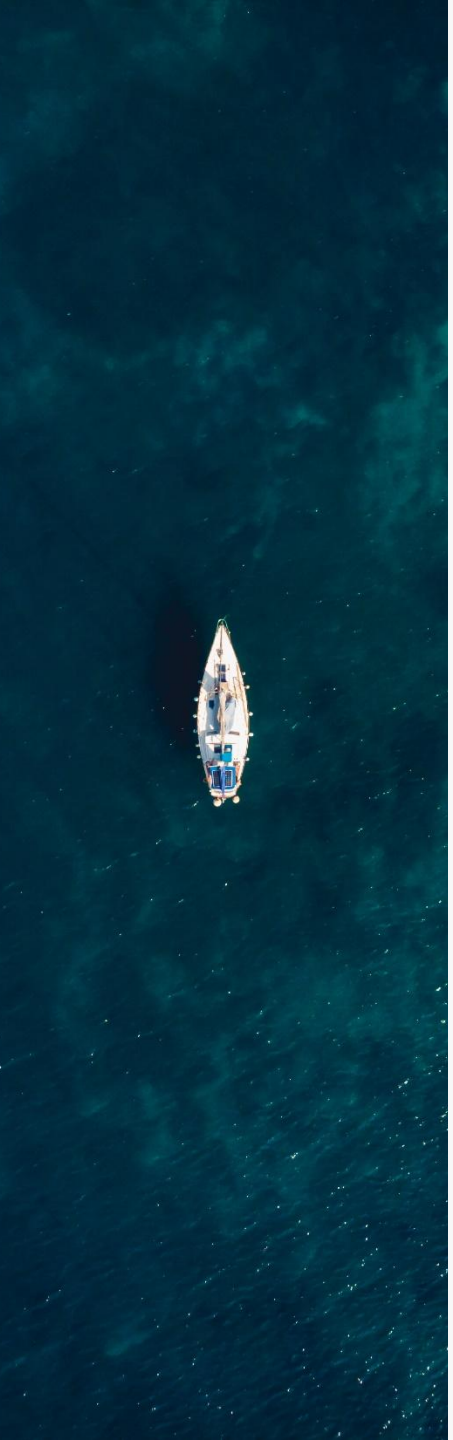
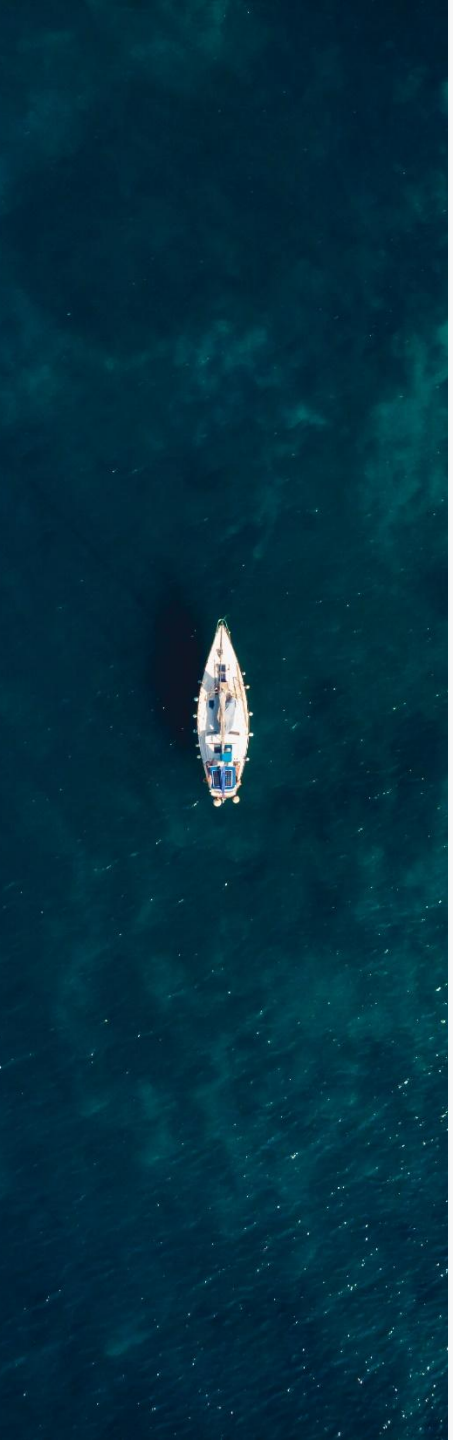


Landfills or (site for burying waste)

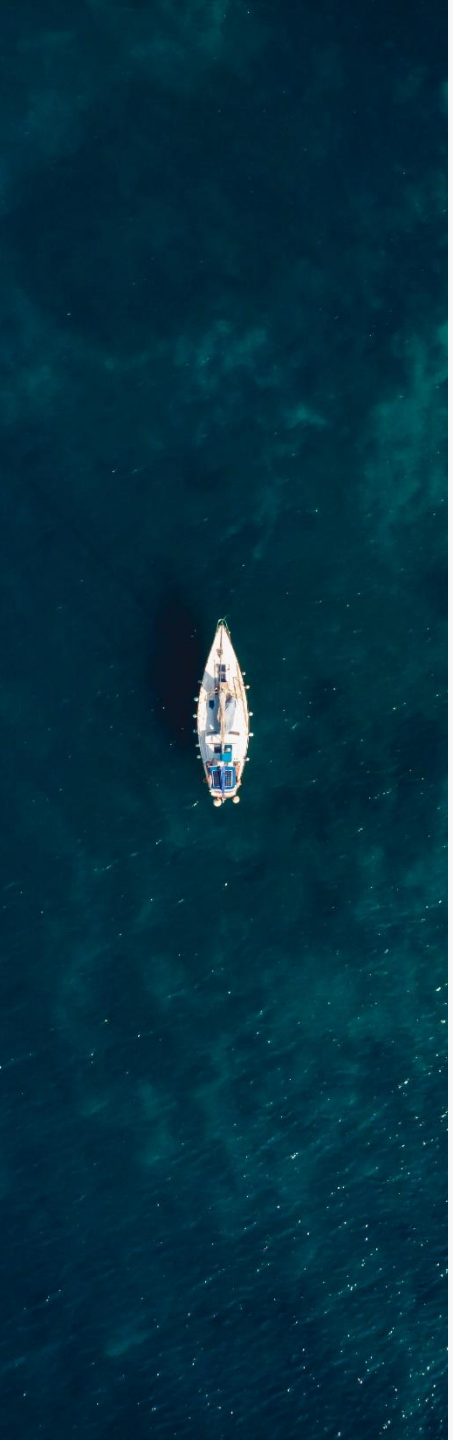
Green economy and sustainable development are continuous endeavors - the final destination for lots of waste is still **landfills.**

This doesn't mean that landfills aren't elaborate and something that is also under the umbrella of continuous improvement and worth understanding.



What Are the 4 Types of Landfills?

There are currently three standard landfill types – each designed to accept and handle specific types of waste. In addition, there is a fourth, currently emerging, type of landfill that allows for the controlled disposal of organic materials.



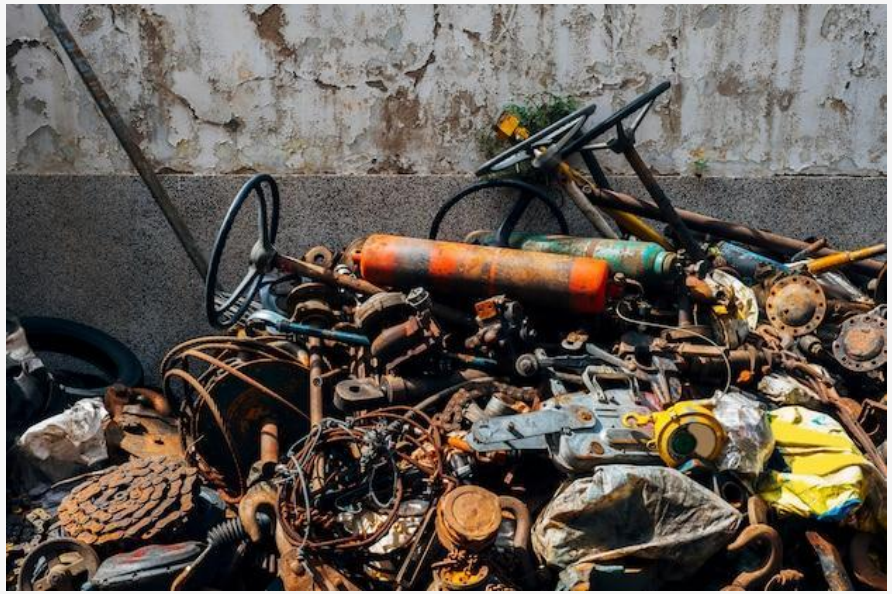
1. Municipal Solid Waste Landfills

If you throw it out in a garbage can, chances are that your trash ends up in a municipal solid waste (MSW) landfill. These sites are typically what come to mind when you think about a landfill.

2. Industrial Waste Landfills

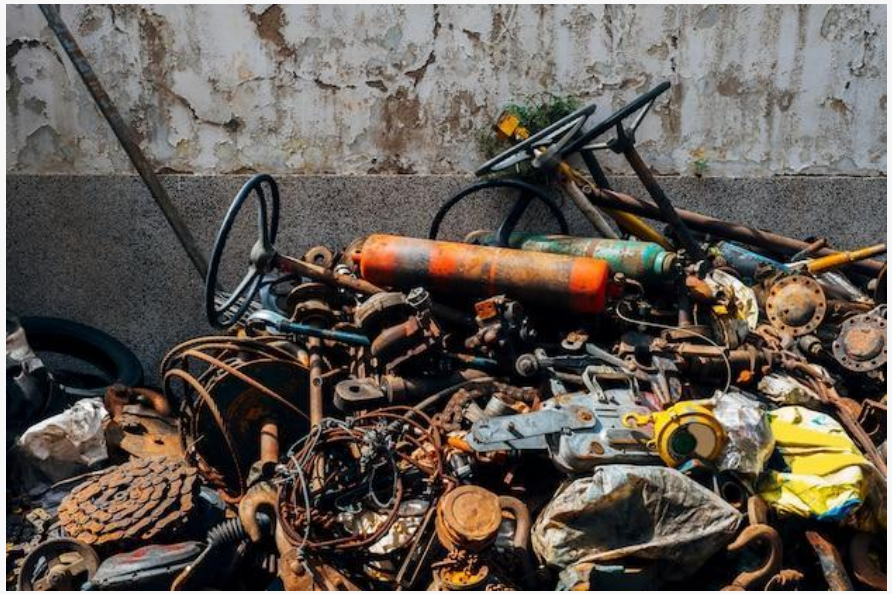
If it sounds like this landfill is self-explanatory, that's because it is.

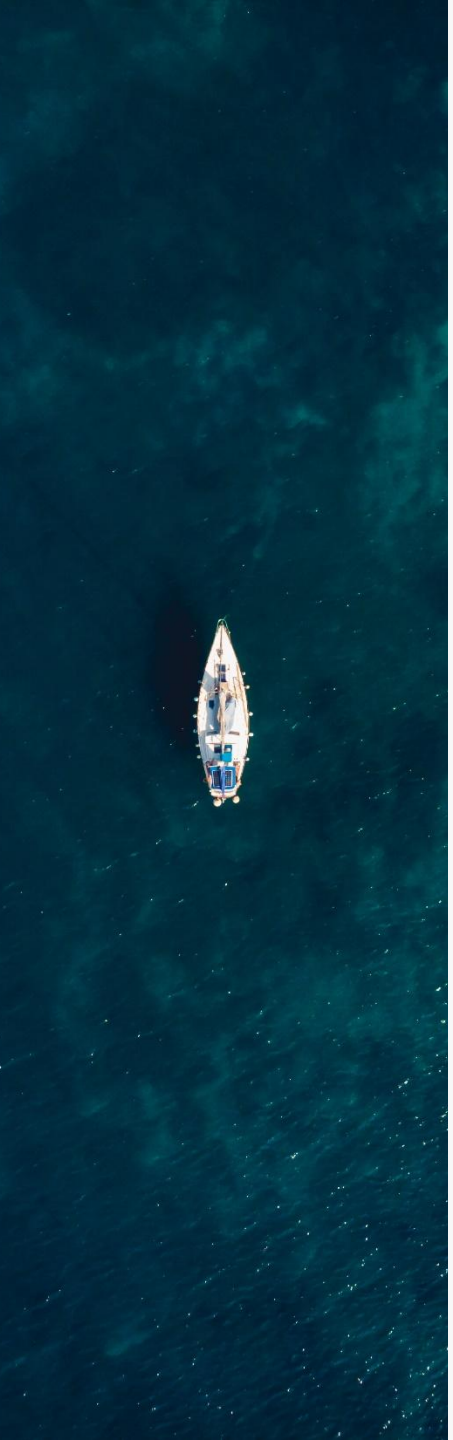
An industrial waste landfill is where industrial waste is disposed of.



Items often brought to industrial landfills include:

- Concrete
- Lumber
- Asphalt
- Gypsum
- Metal
- Bricks
- Building components (doors, countertops, cabinets, etc.)



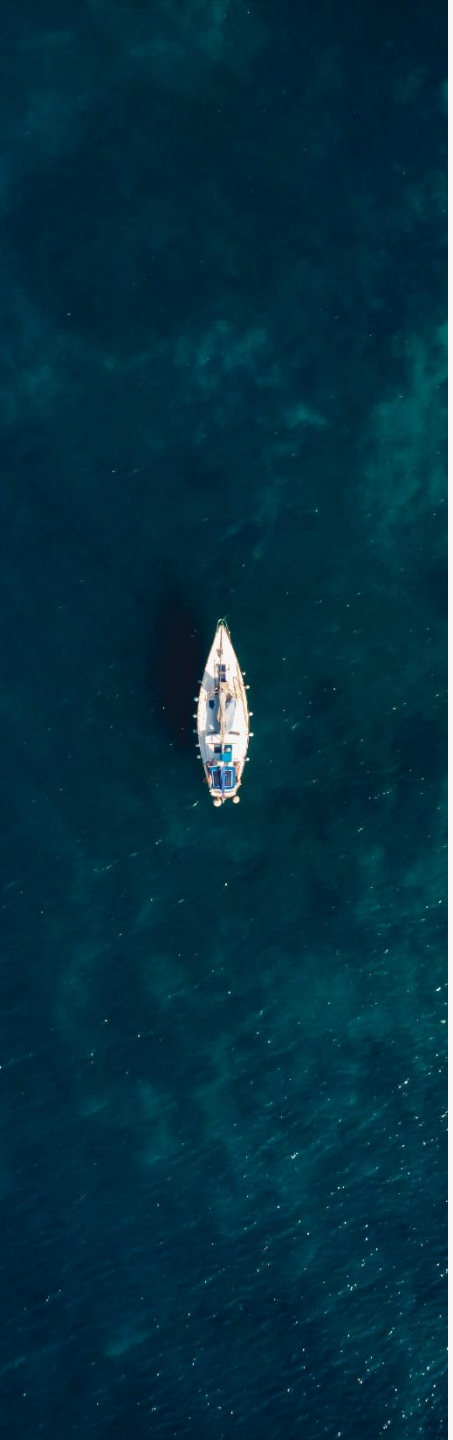


3. Hazardous Waste Landfills

For important reasons, hazardous waste landfills are the most closely regulated and structured landfills. They are specifically designed to hold hazardous wastes in a way that virtually eliminates the chance of them being released into the environment.

Some of the design requirements for hazardous waste landfills include:

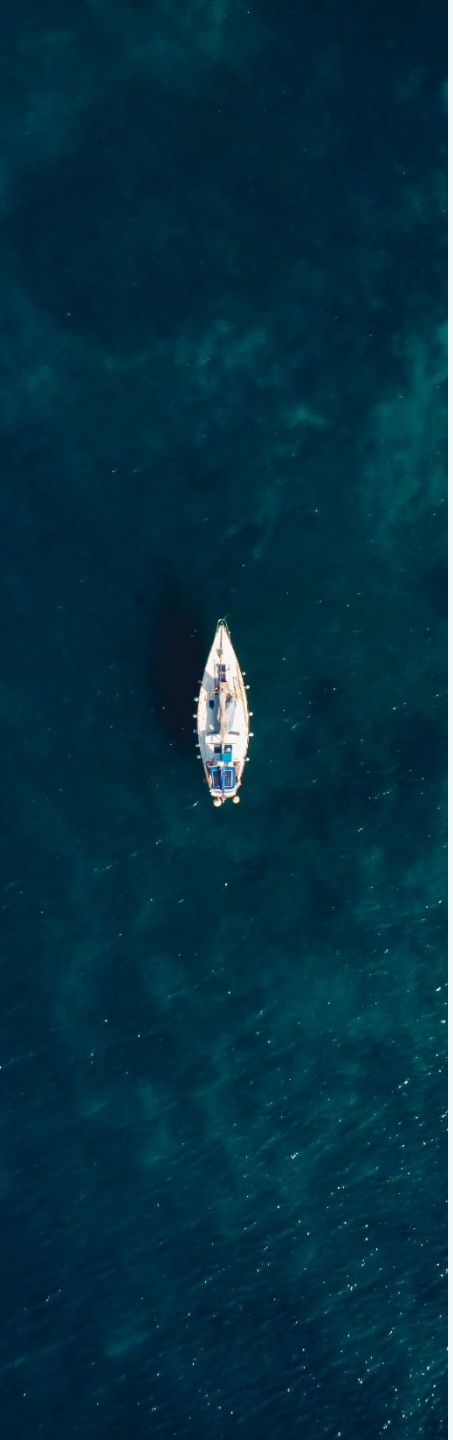
- Double liners
- Double leachate collection and removal systems
- Leak detection systems
- Run on, runoff and wind dispersal controls
- Construction quality assurance programs



4. Green Waste Landfills

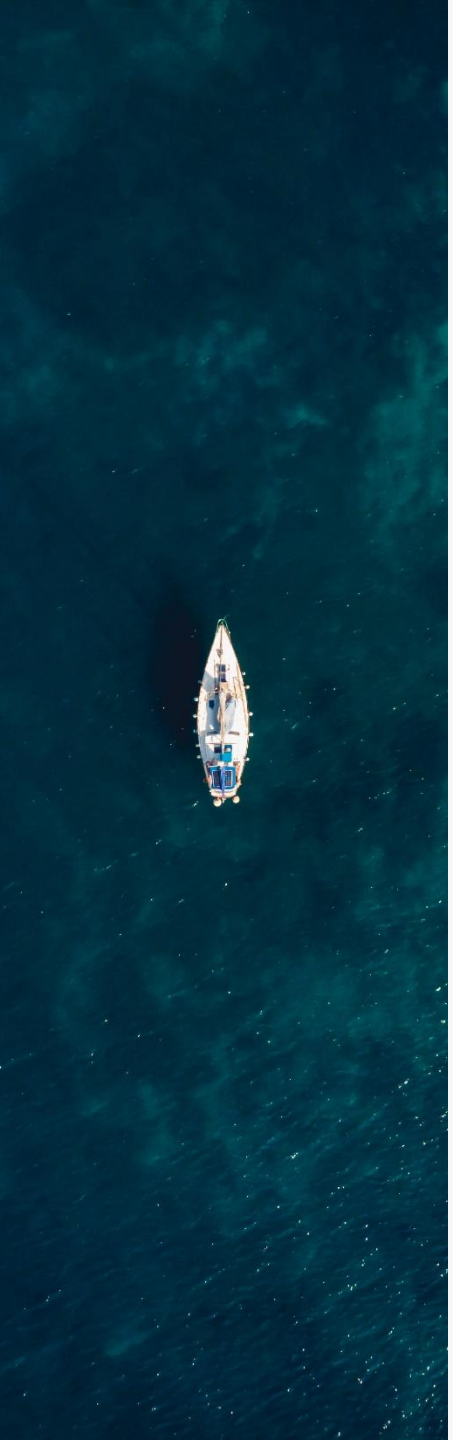
Many municipalities are starting to offer a place for organic materials to naturally decompose.

These composting sites are on the rise because most standard landfills and transfer stations are not as accepting of organic materials like fruits, vegetables, and, in particular, yard waste disposal.



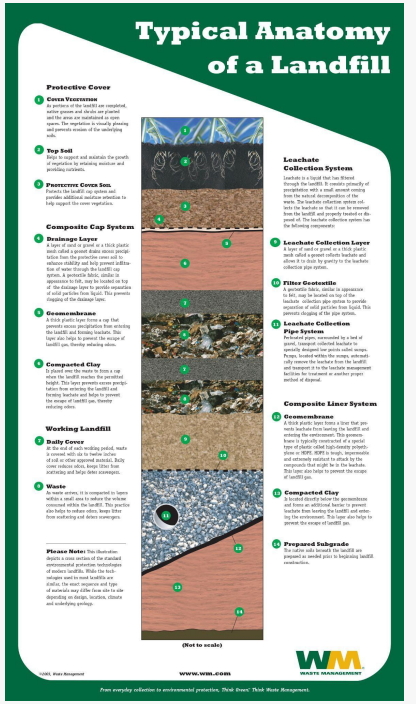
Since these landfills are still not officially sanctioned by the EPA, some transfer stations will accept it, others only partially or not at all – it all depends on your local municipality.

- Common types of green waste include:
- Mulch
- Weeds
- Leaves
- Tree branches
- Biodegradable food waste
- Flowers and grass trimmings

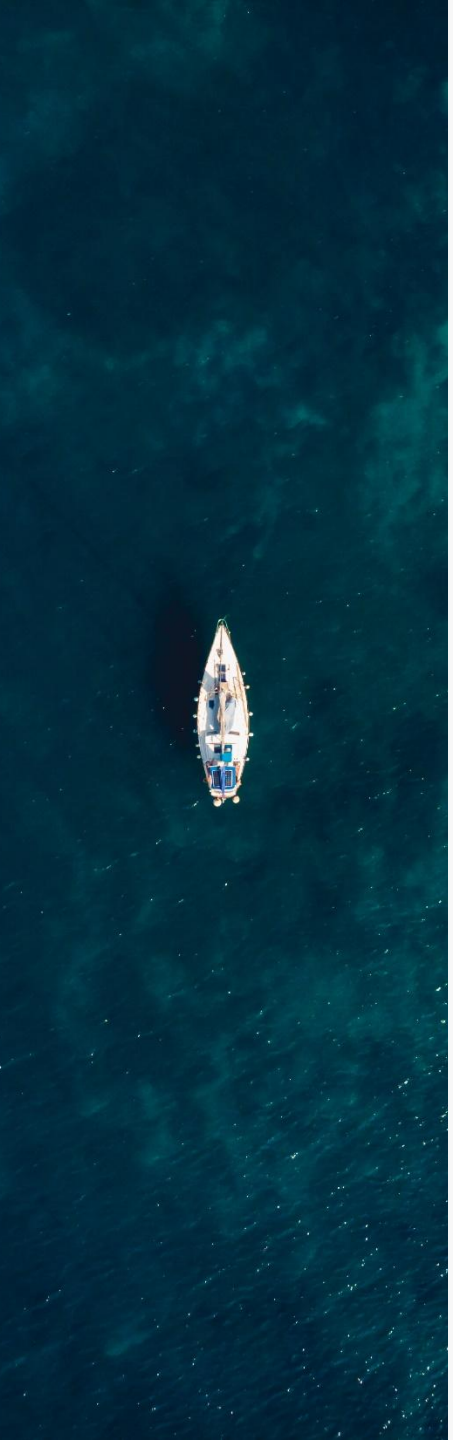


Typical Anatomy of a Landfill

Technologies used in most landfills are similar, however, the exact sequence and type of materials may differ from site to site depending on design, location, climate and underlying geology. That said, here are the most common elements of a landfill:



WM - Typical Anatomy of Landfill (2003)



Protective Cover

1. COVER VEGETATION

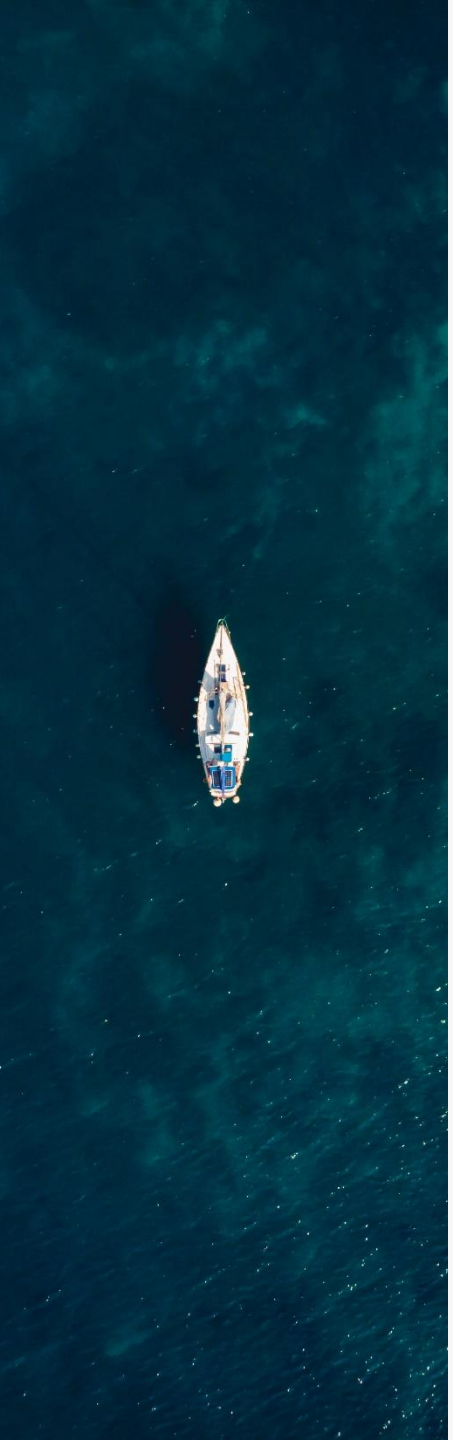
As sections of the landfill are finished, native grasses and shrubs are planted, and the grounds are kept open. The vegetation is visually appealing and helps to keep the underlying soils from eroding.

2. TOP SOIL

Top soil promotes and sustains plant growth by retaining moisture and supplying nutrients.

3. PROTECTIVE COVER SOIL

The protective cover soil shields the landfill cap system while also retaining moisture to maintain the covering vegetation.



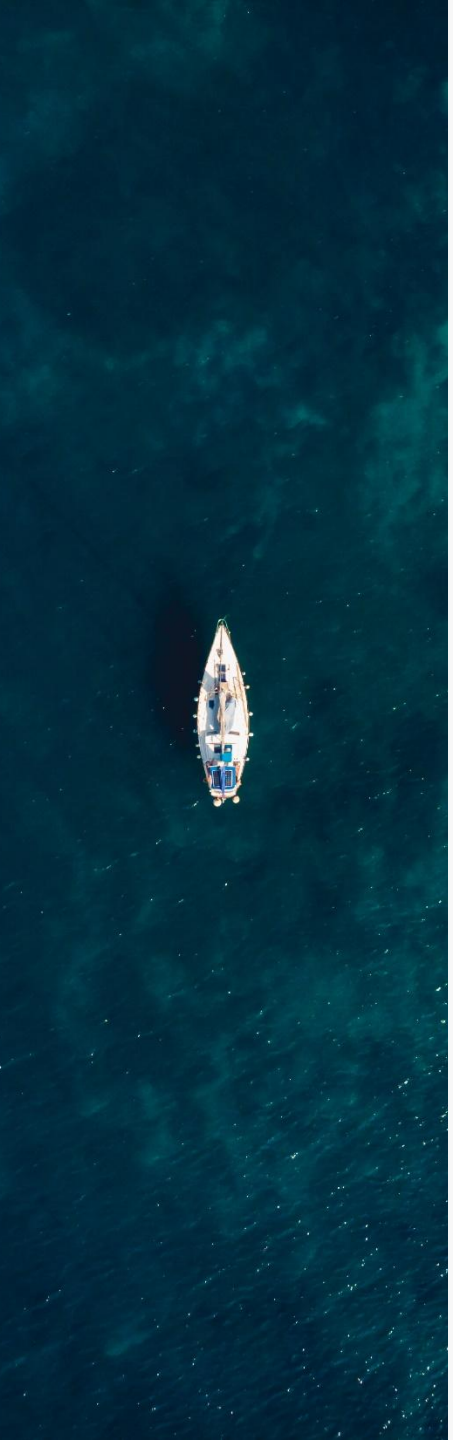
Composite Cap System

1. DRAINAGE LAYER

A geonet, which is a layer of sand or gravel or a thick plastic mesh, drains excess water from the protective cover soil to improve stability. It also helps with preventing water penetration through the landfill cap system. To separate solid particles from liquid, a geotextile fabric similar to felt may be placed on top of the drainage layer. This keeps the drainage layer from becoming clogged.

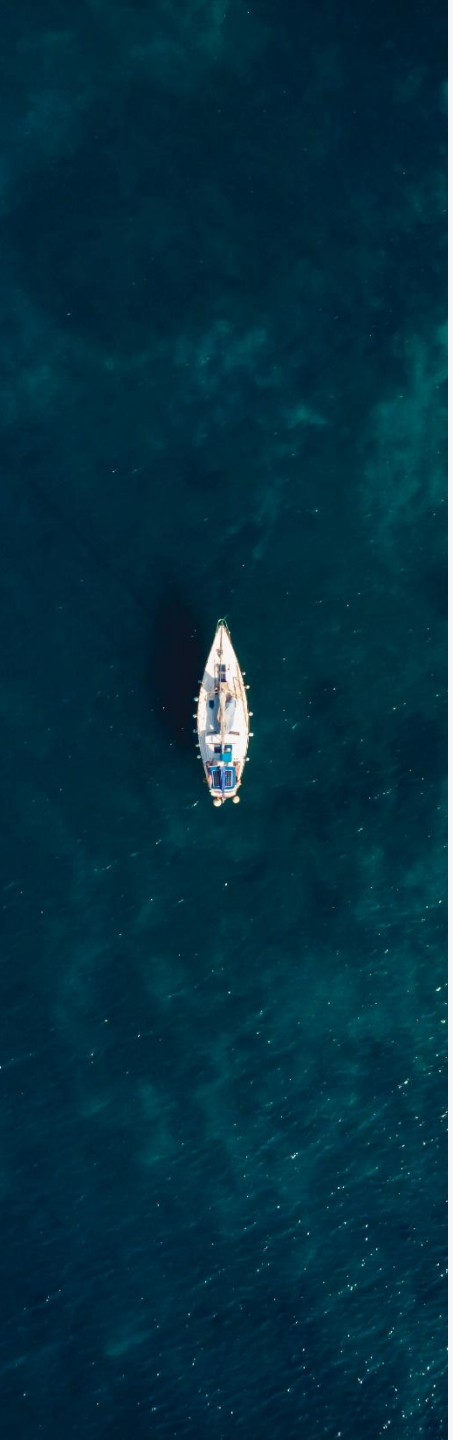
2. GEOMEMBRANE

A thick layer of plastic forms a cap, keeping excess precipitation out of the dump and preventing leachate. This layer also keeps landfill gas from escaping, reducing odours.



3. COMPACTED CLAY

When the landfill reaches the authorized height, compacted clay is laid over the rubbish to form a cap. This layer keeps excess precipitation from entering the landfill and creating leachate, as well as preventing landfill gas from escaping and causing smells.



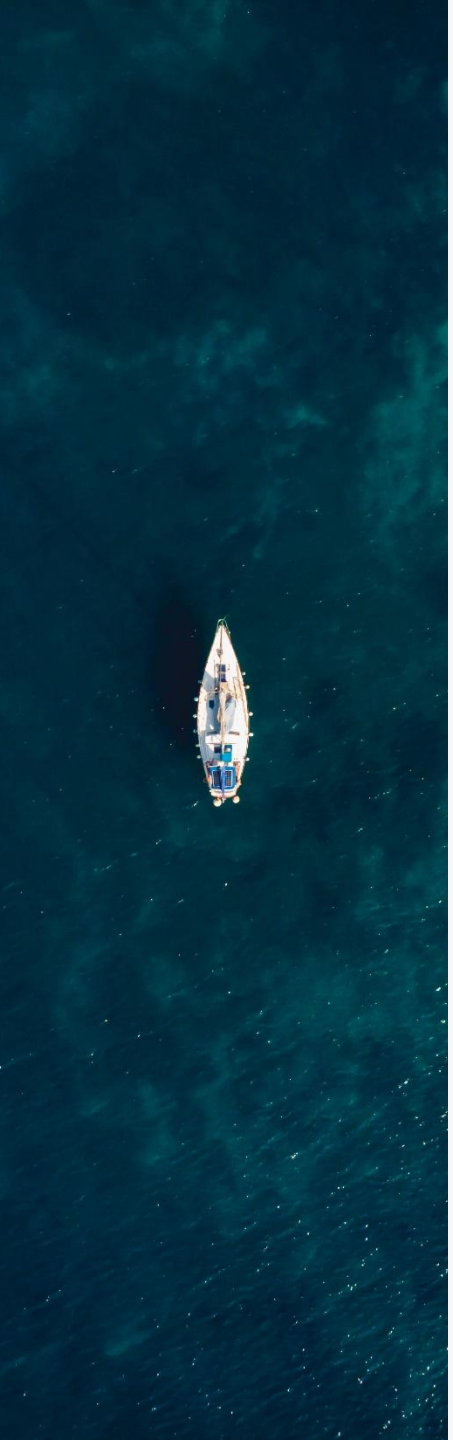
Working landfill

1. DAILY COVER

At the end of each working day, the waste is covered with six to twelve inches of soil or other acceptable material. This daily treatment lowers smells, stops litter from spreading, and deters scavengers.

2. WASTE REDUCTION

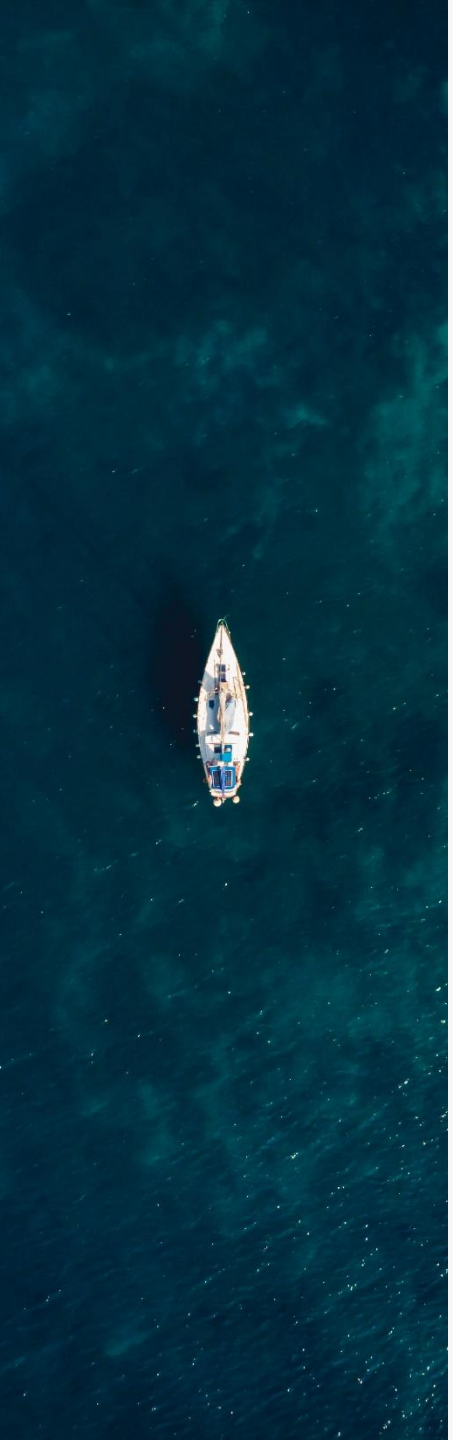
In order to reduce the amount of space that waste takes up, it is compacted within layers. This practice also lowers odors, keeps litter from spreading, and discourages scavengers.



Leachate Collection System

The liquid that has penetrated into the landfill is called leachate. Precipitation is the primary source of leachate, with natural waste decomposition playing a small role. The leachate collecting system captures leachate from the landfill so that it may be treated or disposed of properly.

Such leachate collecting system is made up of the following parts:

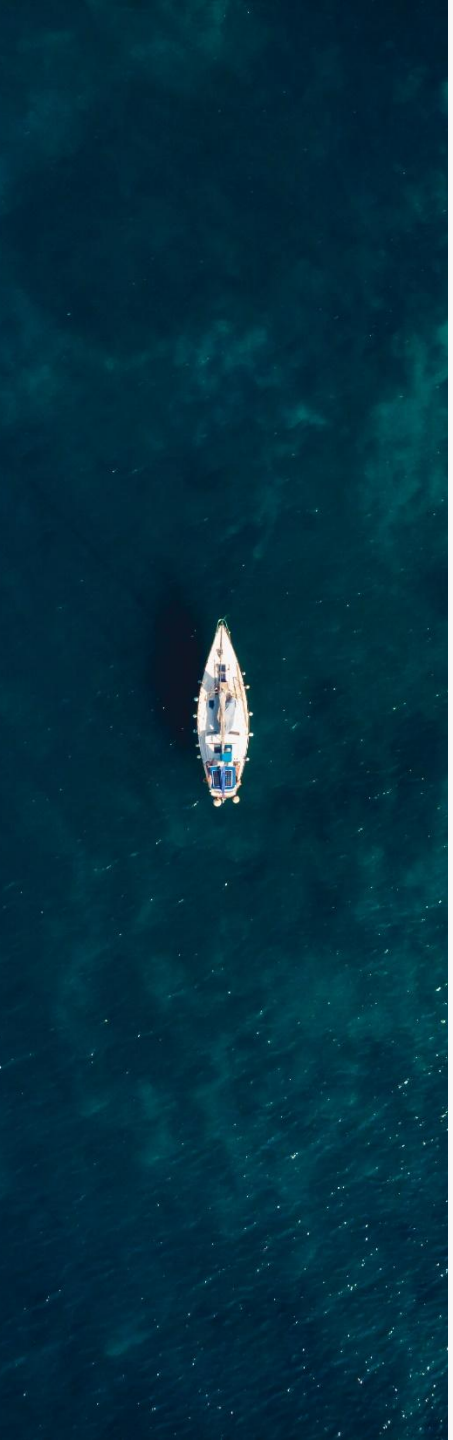


1. **LEACHATE COLLECTION LAYER**

   A geonet is a layer made of either sand, gravel or a strong plastic mesh that catches leachate and allows it to drain to the leachate collection pipe system with the help of gravity.

2. **FILTER GEOTEXTILE**

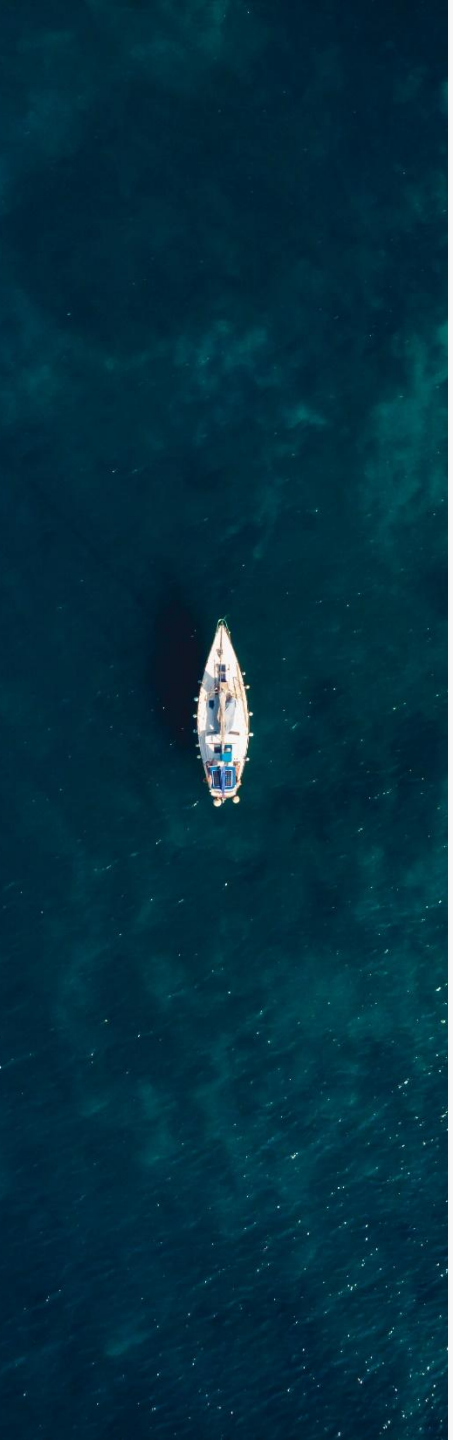
   To separate solid particles from liquid, a felt-like geotextile fabric may be placed on top of the leachate collection pipe system.
   This keeps the piping system from clogging.



3. LEACHATE COLLECTION PIPE SYSTEM

With the help of perforated pipes and a gravel bed as a base, leachate is transported to specifically created low spots called sumps.

Pumps located inside the sumps mechanically extract the leachate from the landfill and then carry it to the leachate management facilities for treatment or another suitable means of disposal.



Composite Liner System

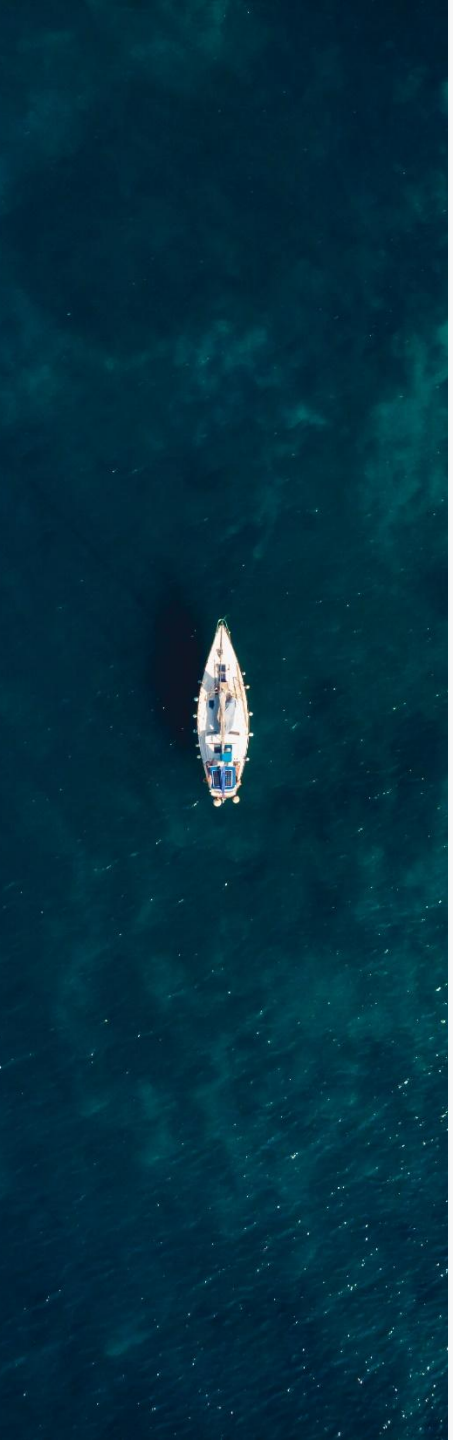
1. **GEOMEMBRANE**

   A thick plastic layer forms a liner that prevents leachate from leaving the landfill and entering the environment. This geomembrane is usually made using high-density polyethylene or HDPE.

   This special type of plastic is extremely resistant and impermeable to the chemicals that might be in the leachate. This layer also helps to prevent the escape of landfill gas.

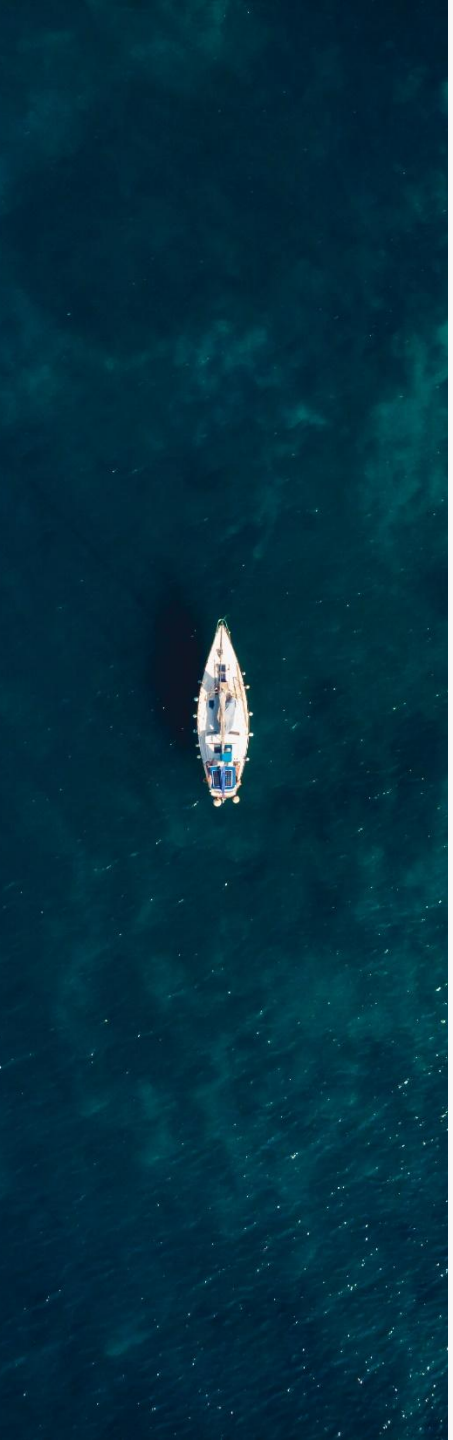
2. **COMPACTED CLAY**

   This clay serves as an extra barrier to stop both leachate and landfill gas from escaping and entering the environment. It is located directly below the geomembrane.



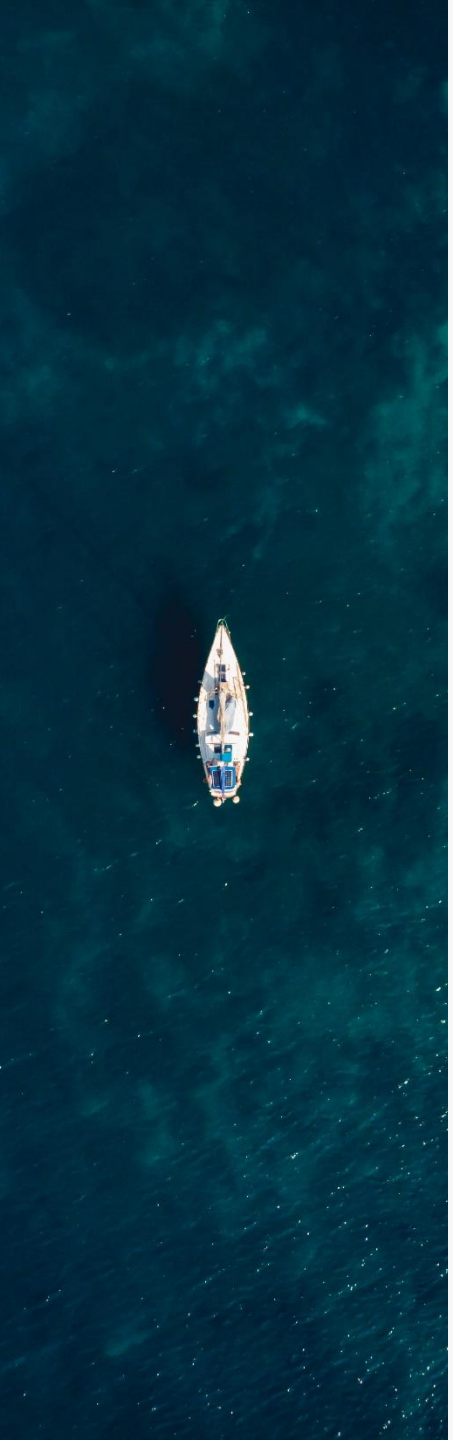
3. PREPARED SUBGRADE

Before starting construction on the landfill, the native soils beneath it are prepped as necessary.



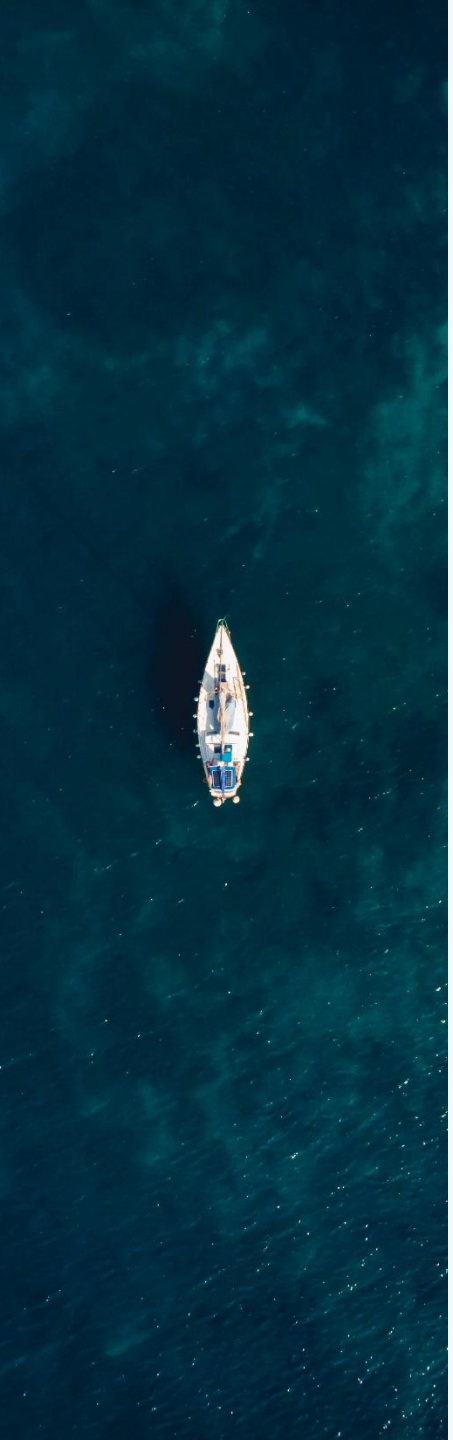
Zero waste strategy for green supply chain management (GSCM)

Supply chain model to practically eliminate waste from the system while consuming a minimum amount of energy.



"Zero waste is the conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning, and with no discharges to land, water, or air that threaten the environment or human health."

Zero Waste International Alliance (ZWIA)

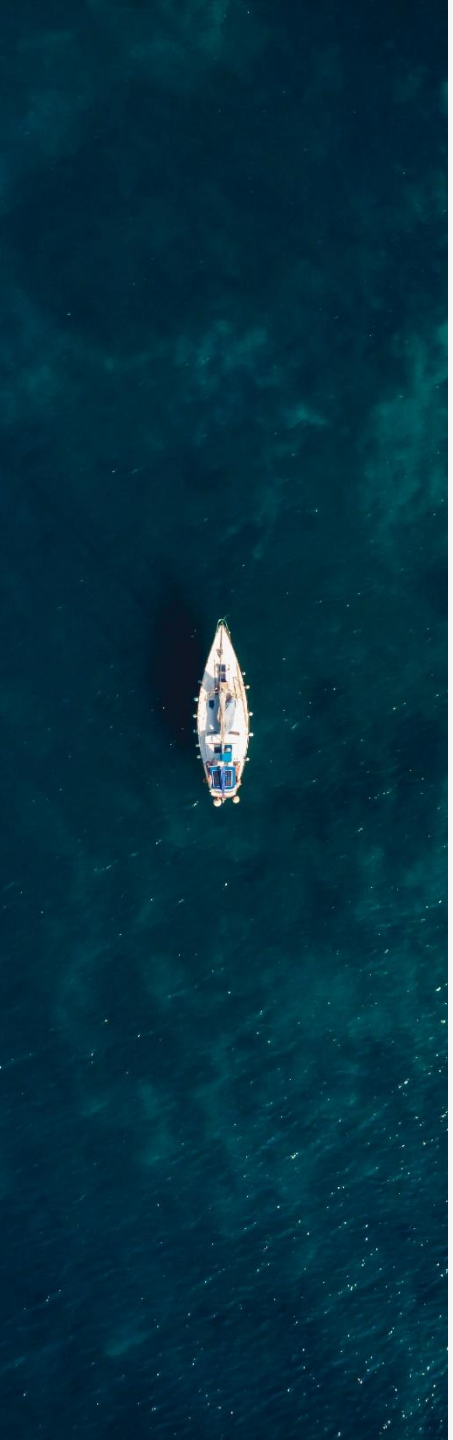


“What Is a Zero-Waste Supply Chain?”

A zero-waste supply chain embraces a redesign of the resource lifecycle, evaluating every step to ensure that each product is reused or recycled.

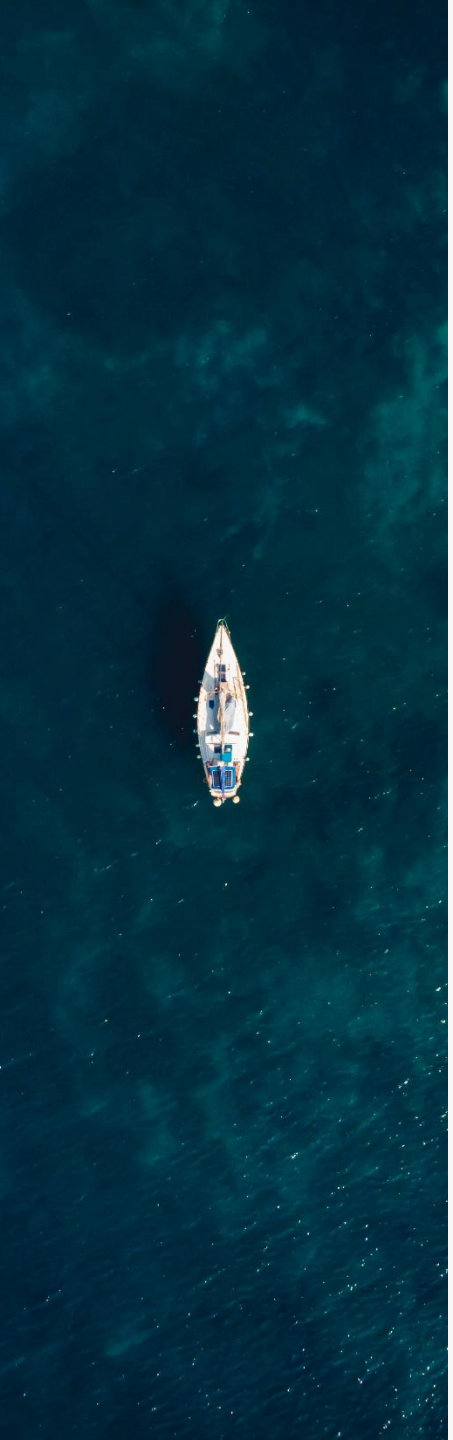
The goal?

Eliminate trash sent to landfills, incinerators, or worse — the ocean.



“What Is a Zero-Waste Supply Chain?”

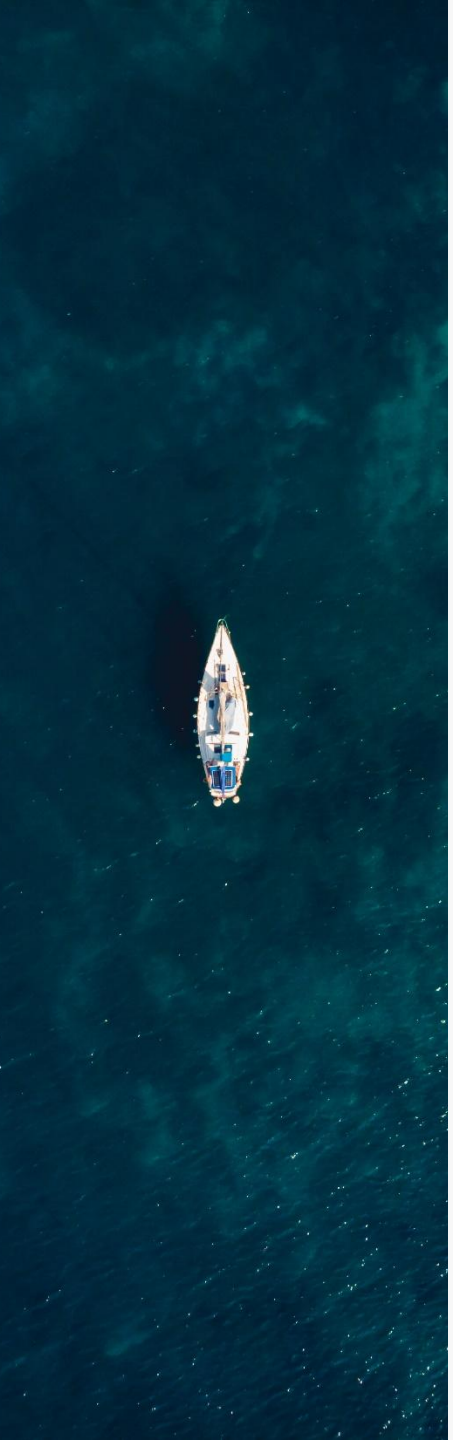
AZero-waste strategies emphasize overall waste prevention and seek to change the way materials flow through the entirety of the production pipeline.



What is Waste-to-Energy - Incineration?

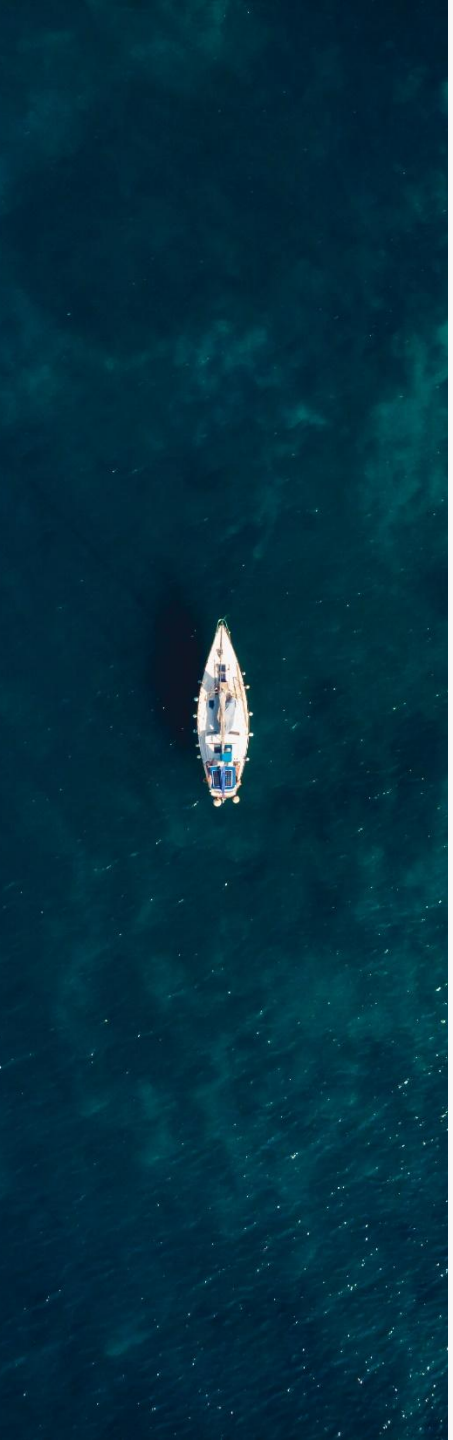
Waste-to-Energy plants burn household and similar waste that could not be prevented or recycled.
From this incineration process the plants recover energy. This can be in the form of steam, electricity or hot water.

The electricity is fed into the grid and distributed to the end-users; the hot water, depending on local infrastructure can be sent to a nearby district heating (or cooling) network to heat (or cool) homes, hospitals, offices etc., and the steam can be used by the nearby industry in their production processes.



What is Waste-to-Energy - Incineration?

Waste-to-Energy is a hygienic method of treating waste, reducing its volume by about 90%.
Modern European Waste-to-Energy plants are clean and safe, meeting the most strict emission limit values placed on any industry set out in the EU Industrial Emissions Directive.



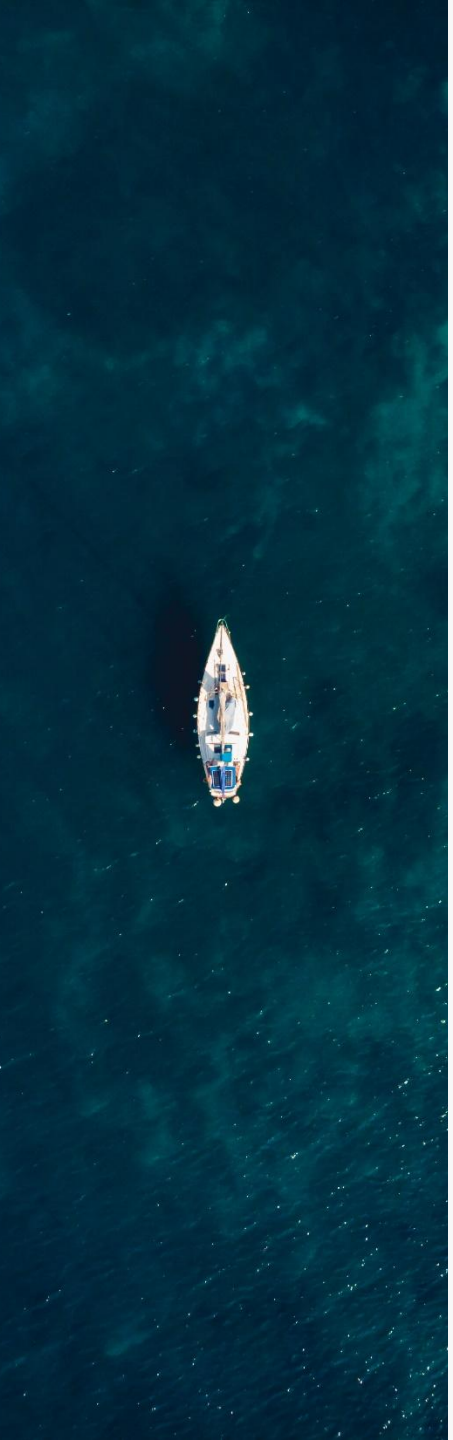
What is the role of Waste-to-Energy?

- It turns the non-recyclable waste into secure energy and valuable raw materials in an environmentally safe manner.

Waste-to-Energy helps reach the targets set in the **EU Landfill Directive** that aims to reduce the amount of waste being landfilled (Benefits of diverting waste from landfills).

Waste-to-Energy and **Recycling** are complementary waste treatment methods in integrated waste management systems. Household and similar waste should be sorted at source and the clean materials should be sent to high quality recycling. The remaining waste, that cannot be recycled in a technically or economically viable way, should be used to generate energy.

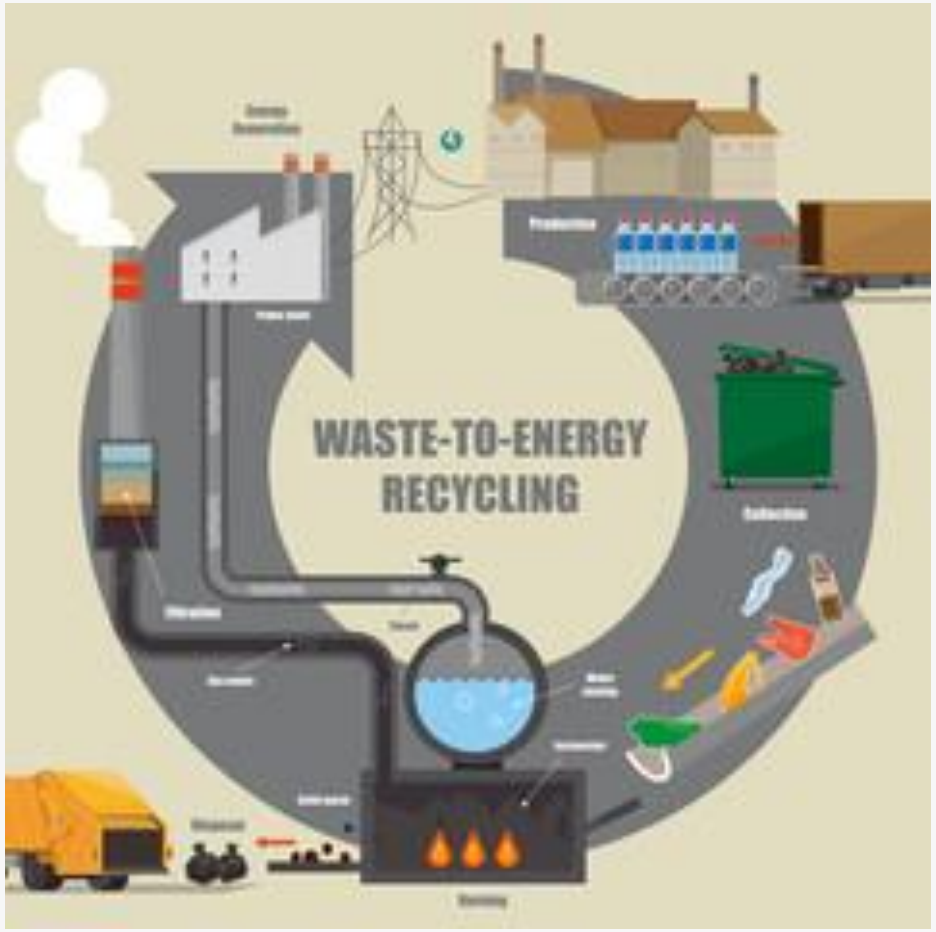
- It keeps the circle clean by dealing with unwanted components in the material cycles (act as a pollutant sink, fulfilling a hygienic task for the society).



How to deal with residual waste that cannot be recycled?

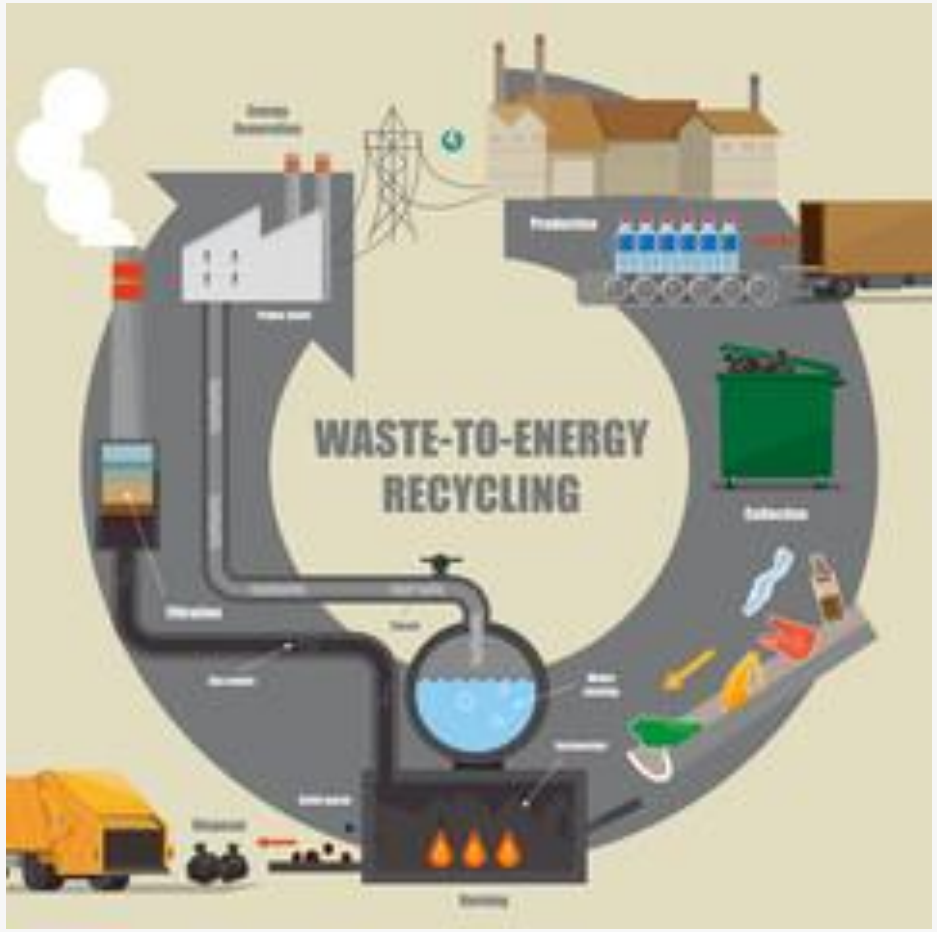
This is the waste that contains mixed materials, substances of concern or simply has been recycled too many times.

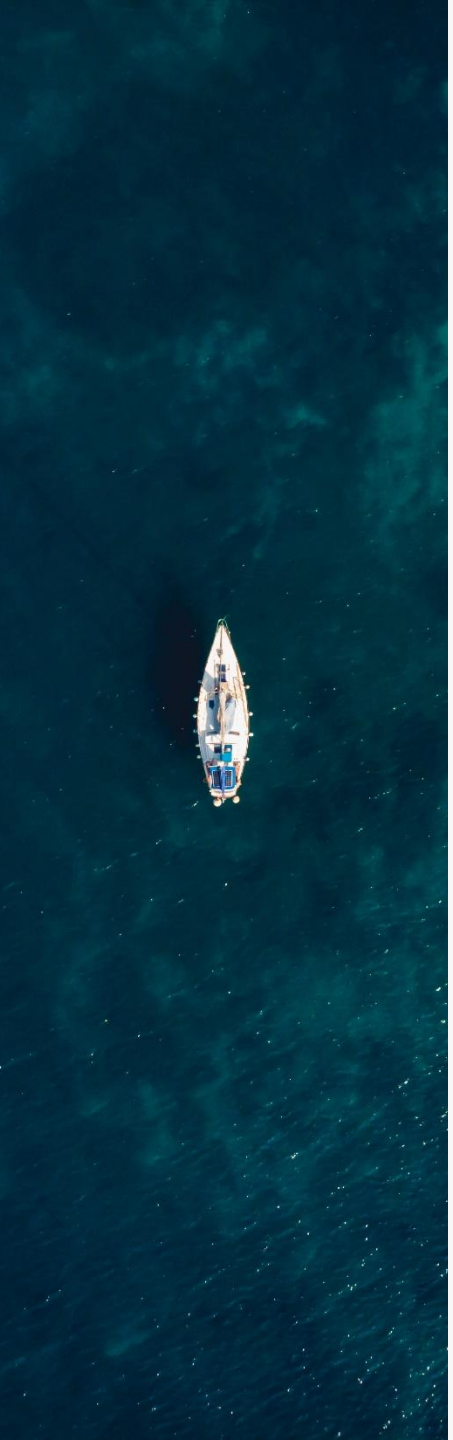
As the EU Policy rightfully restricts exports of waste that have harmful environmental and health impacts on third countries, we are left with the options of **disposal or recovery.**



Is Waste-to-Energy helping or hindering climate protection?

1- Substituting fossil fuels with a partly renewable alternative. Residual waste is a local and secure source of energy that can work It has a key role to play in phasing out fossil fuels and decarbonising the electricity and heat sector, especially where district heating and cooling infrastructures are in place.

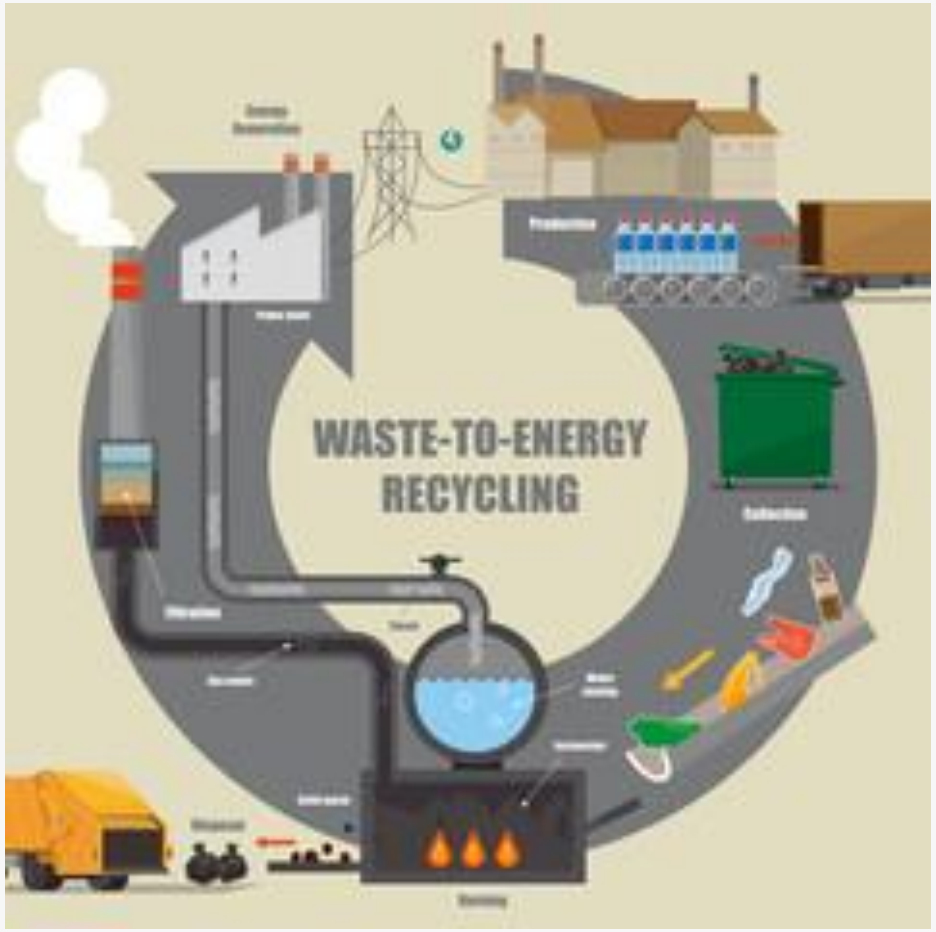




Is Waste-to-Energy helping or hindering climate protection?

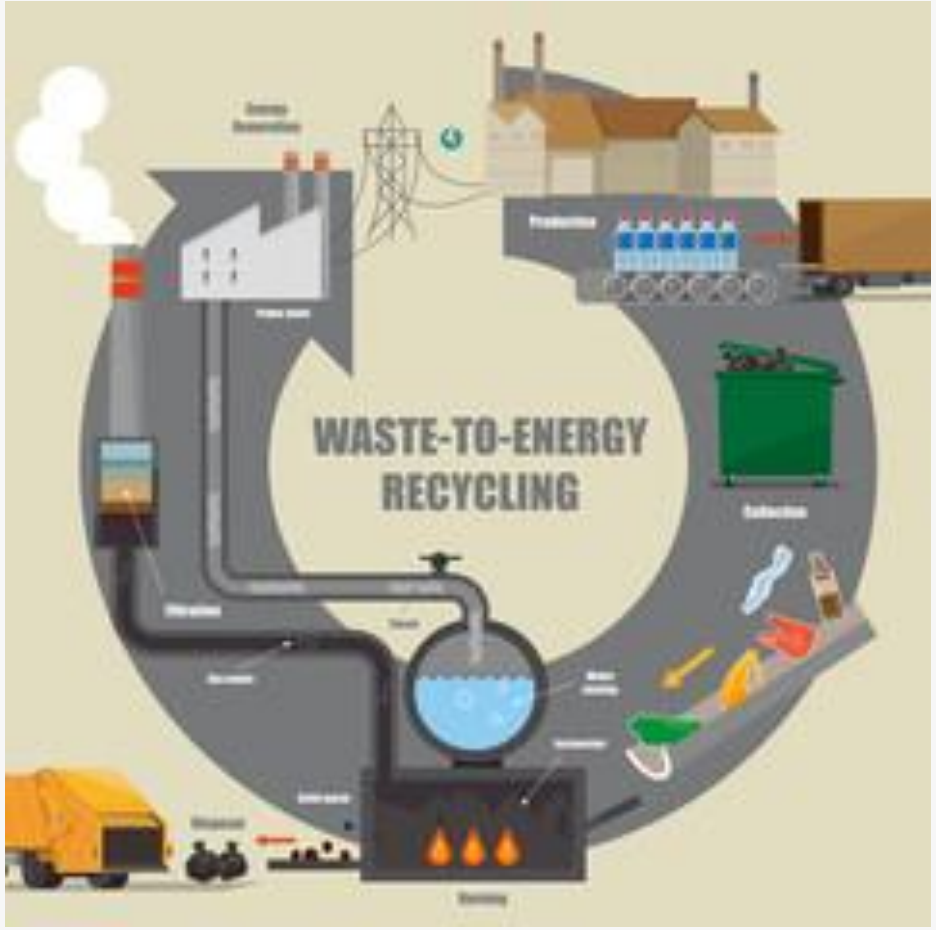
2-Reducing methane emissions by diverting waste from landfill. A recent UN Report suggests that the waste sector offers the largest potential in Europe for mitigating methane emissions and that methane mitigation is arguably the strategy with the greatest potential to decrease global warming over the next 20 years.

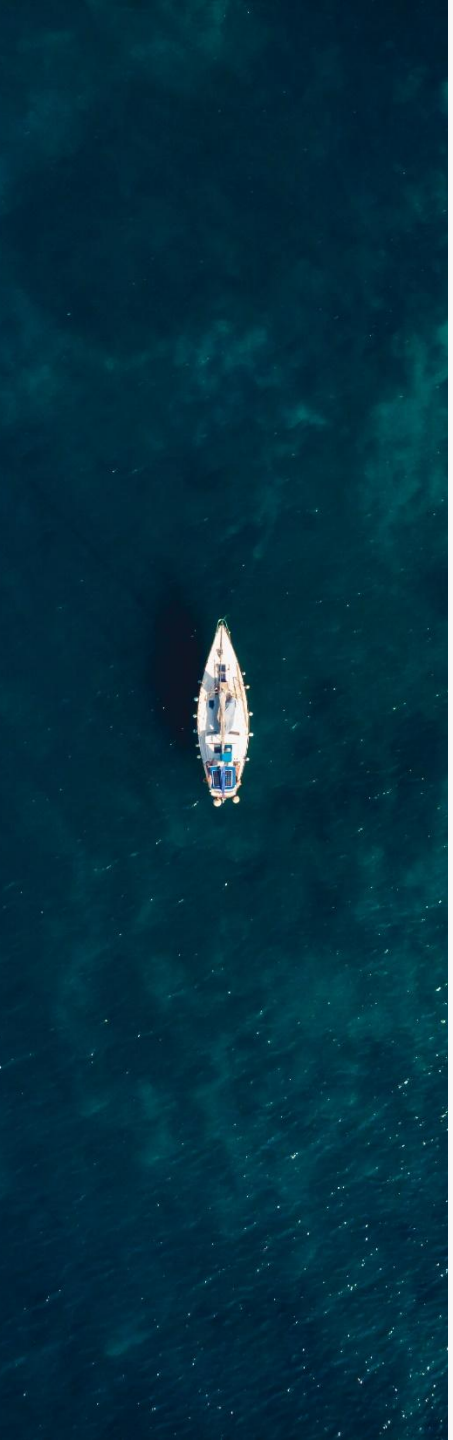
To put this into perspective, over a 100-year period, the global warming potential of methane is 28 times higher than that of CO2. ; over a mere 20-year period this figure soars to 86 times higher.



Is Waste-to-Energy helping or hindering climate protection?

3- Recycling metals and minerals from bottom ash that is left over from the incineration process. See the specific question below.

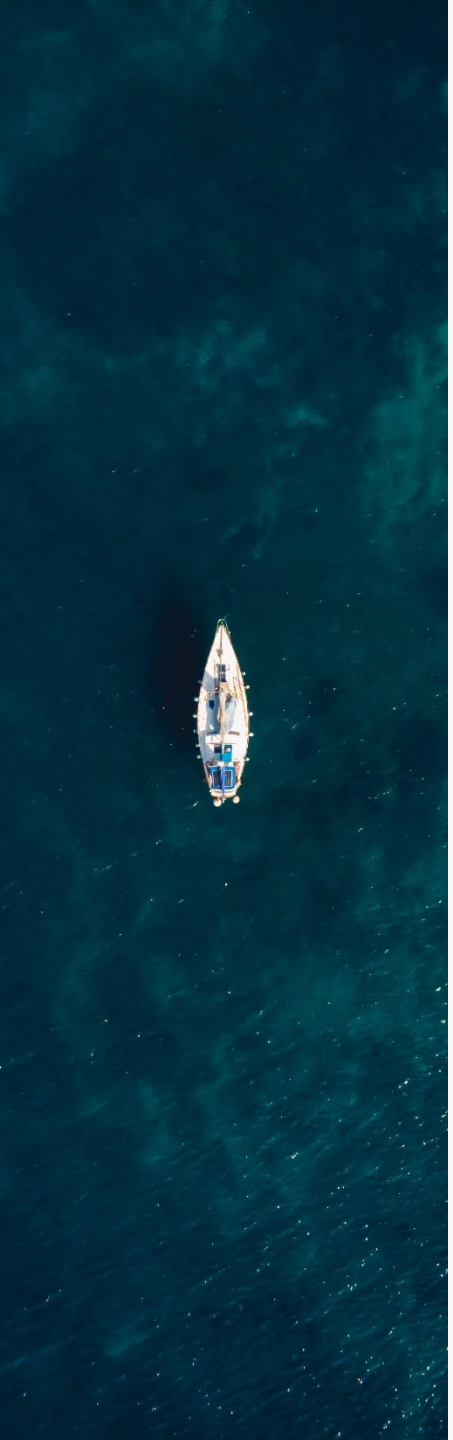




What about dioxin emissions and health impacts?

Thanks to the installation of complex flue gas cleaning systems in modern Waste-to-Energy facilities, dioxin emissions have been reduced significantly in the past 30 years.
The **Waste-to-Energy sector** is one of the most strictly regulated industrial sectors in Europe, resulting in a share of less than 0.2% of the total industrial dioxin emissions.

The European Waste-to-Energy plants carefully monitor their emissions and impacts on the environment during different operating stages.

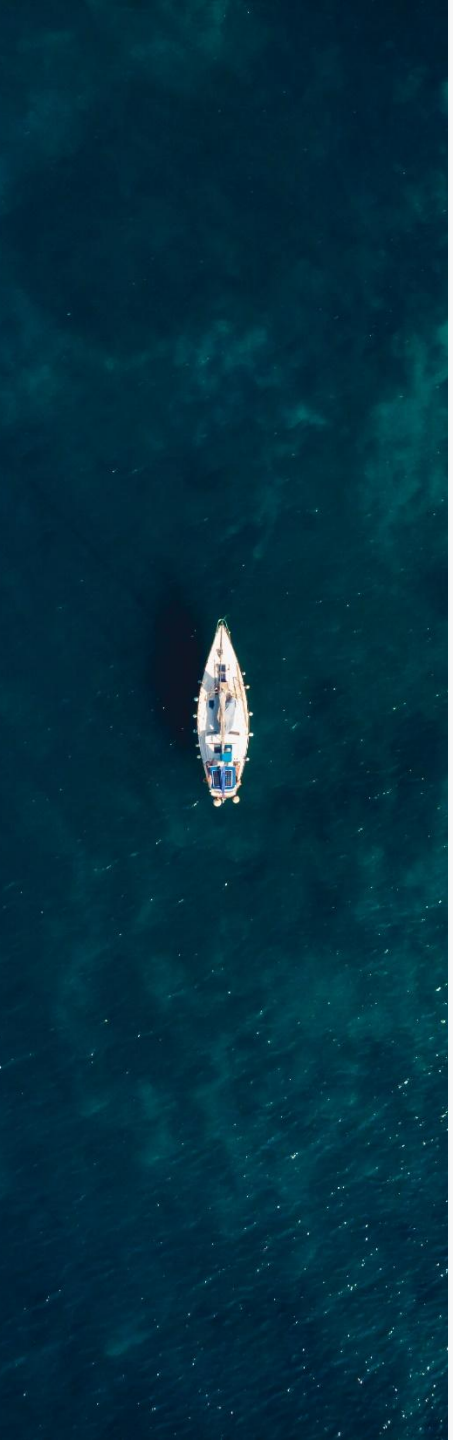


What about the ashes? Where do they go?

In a Waste-to-Energy plant the bottom ash is collected at the end of the furnace's grate. It consists of non-combustible materials, and is the residual part from the incineration of waste.

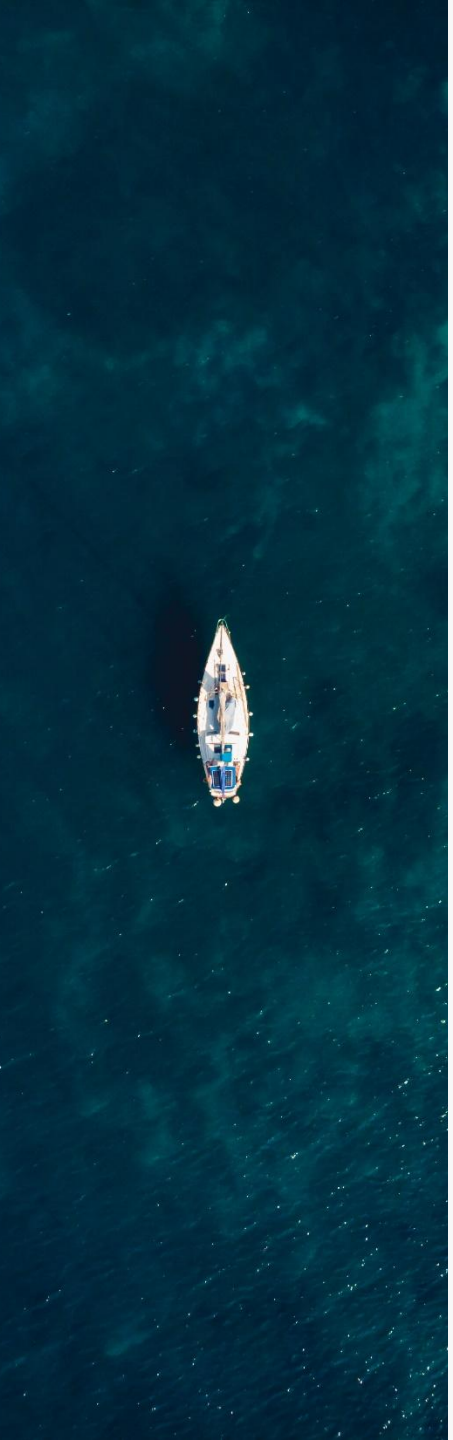
Even if the waste was sorted before hand, there are metals found in it. Both ferrous metals and non-ferrous metals can be taken out of the bottom ash and recycled.

After the metals are taken out, the rest of the ashes, which are like gravel or sand, are stored for a period before being used in road construction or as a covering layer on landfill sites.



What about the ashes? Where do they go?

Waste incineration concentrates the environmentally harmful substances (lead, cadmium, mercury, etc.) which were already present in the waste in the flue gas cleaning residues.
This makes further handling easier: these substances can be better managed and safely disposed of.
The residues from the flue gas cleaning system amount to 3-4 % of the mass of the waste entering the plant.

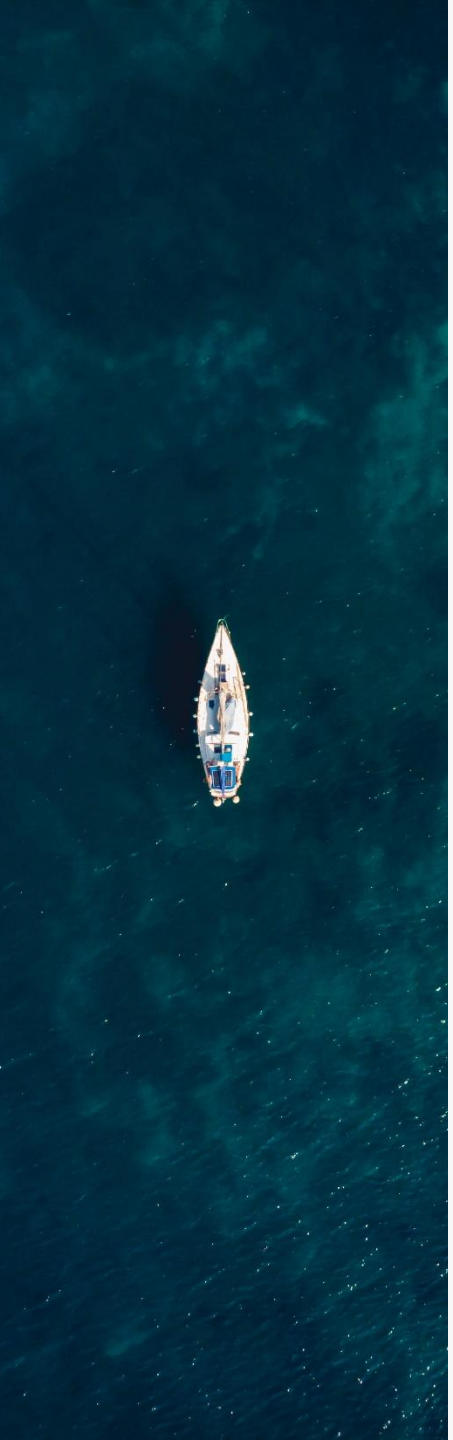


What about the ashes? Where do they go?

These residues are collected after the filtration process and are carefully stored to ensure no escape of the material into the local environment.

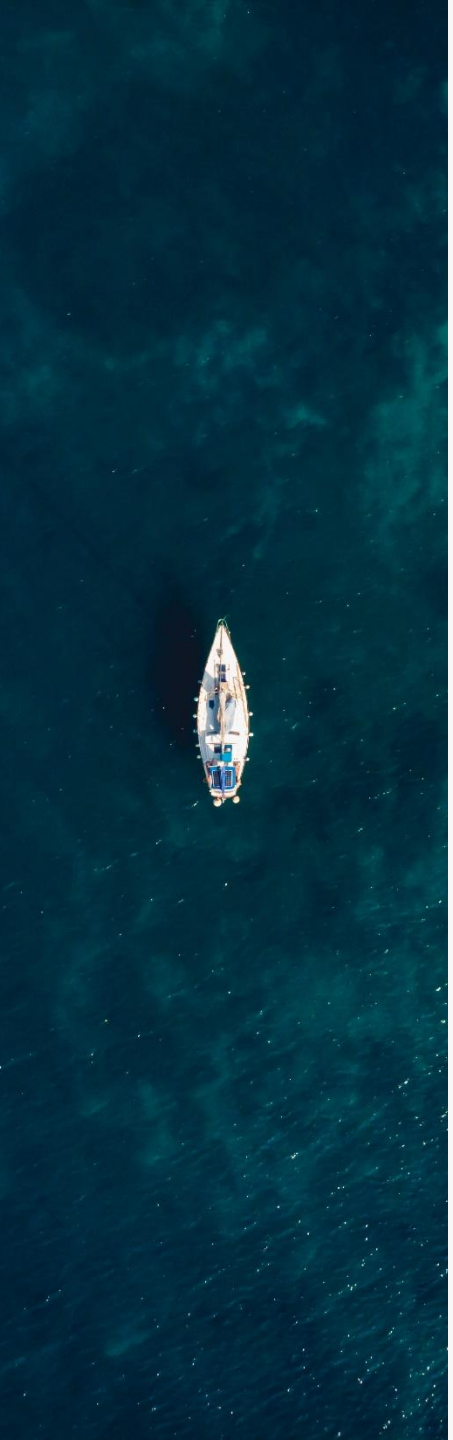
The material is then transported in sealed containers to hazardous landfill sites, to treatment plants or salt mines.

These sites are fully contained so that the material cannot leach out into the environment.



Transforming production and consumption systems

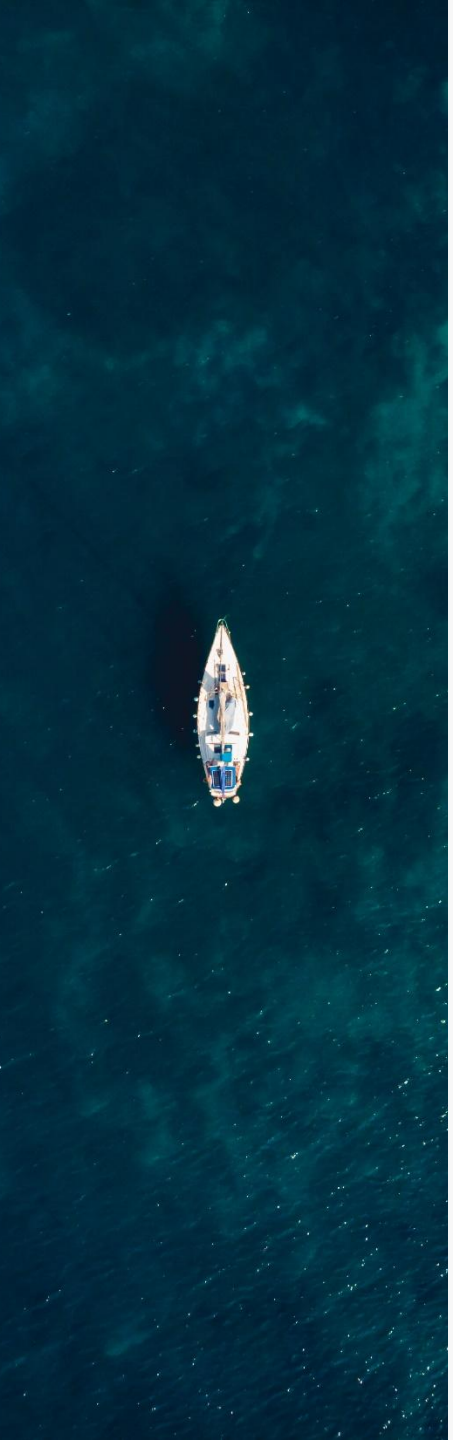
Moving from a linear to a circular economy and the role of products



Product trends and their implications

Increasingly complex product design and functionality.
Examples:

- the inclusion of additives in packaging to improve shelf life;
- the integration of light-emitting diode (LED) lights or other gadgets into clothing;
- the introduction of electronic modules for the remote control of appliances such as washing machines;
- interactive toys for children; or the integration of intelligent electronic control of ventilation, lighting, security, … etc., into the infrastructure of buildings.



Product trends and their implications

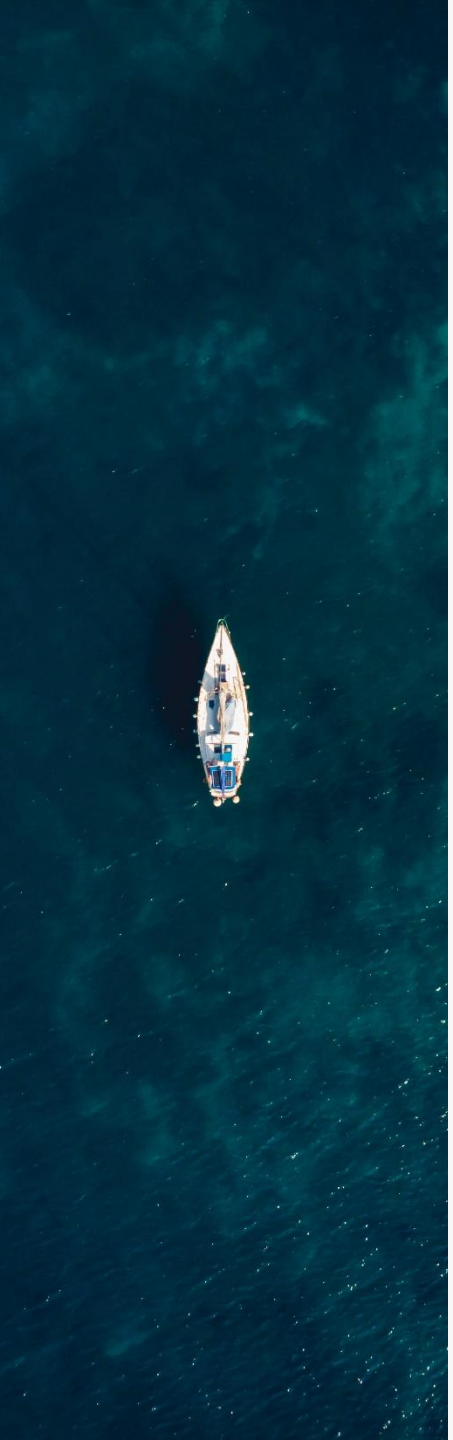
Increasingly complex product design and functionality-IMPACTS

- Lower demand for materials,as a number of the functions for which various products were once needed can now be integrated into a single item.

  AT THE SAME TIME:

- multi-functionality, mobility and versatility lead to the production of smaller and more robust products, with components often glued together or integrated into the main product structure

- **The rising complexity of products and new material mixtures can make products incompatible with existing recycling schemes**

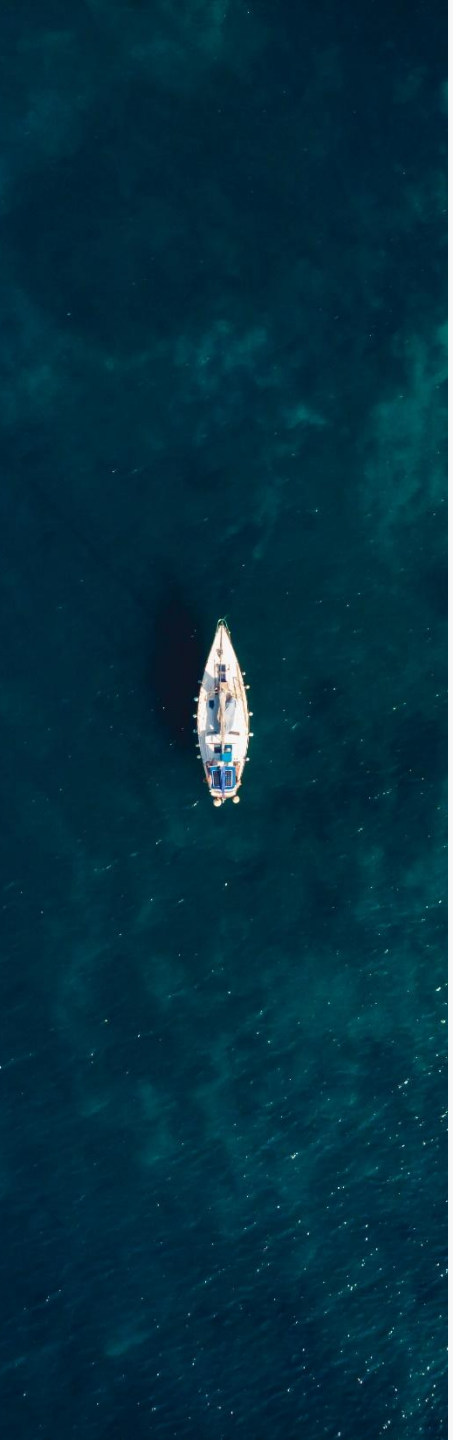


Product trends and their implications

Identifying effective levers that enable products to contribute *to the transition to a circular economy*, requires
analysis of the complex and non-linear relationships between many economic system drivers.

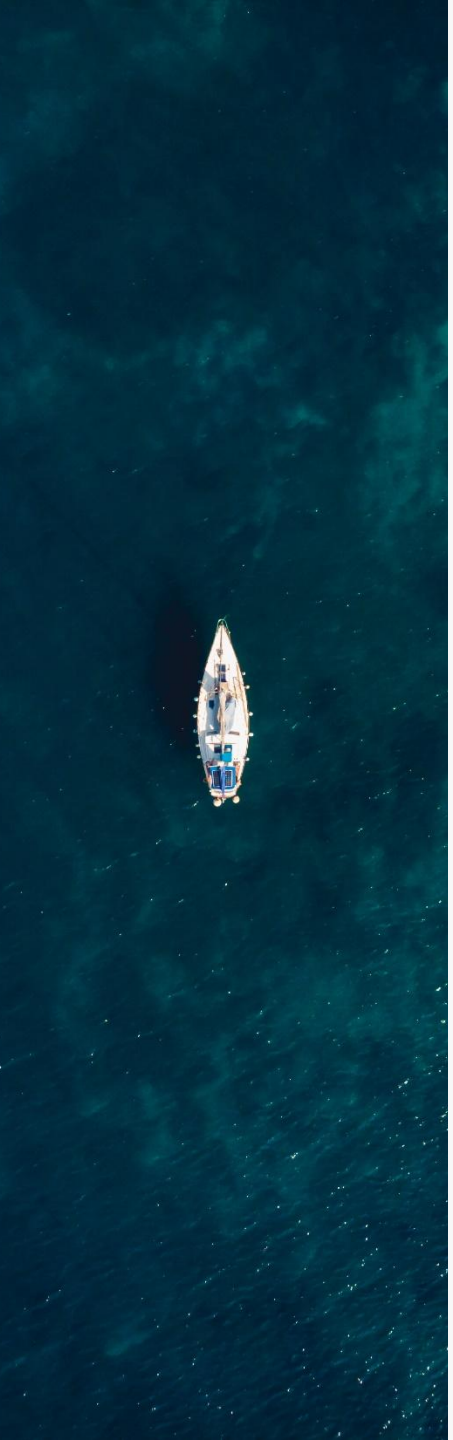
HOW?

(1) shifting from product-based to service-based business models
(2) making additive manufacturing and the Internet of things work for product circularity
(3) aligning policy instruments throughout a product's life-cycle.



(1)Shifting to service-based business models

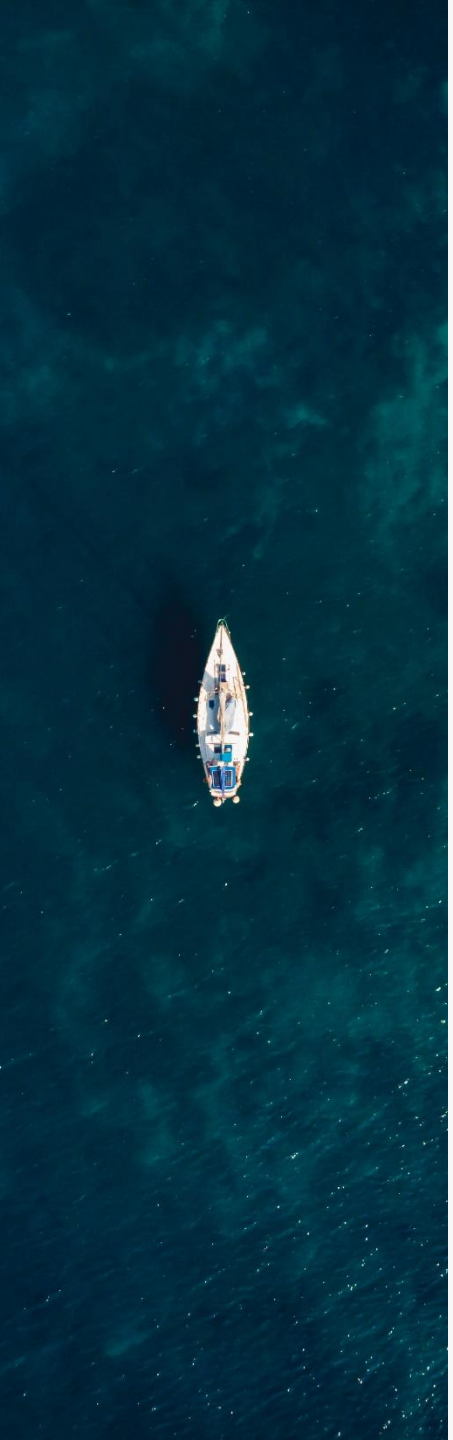
- Exploiting reinforcing trends
- Tackling system barriers
- Conditions required for product-service systems to contribute to product circularity



(2) Making additive manufacturing & the internet of things work for product circularity

Information regarding product *recycling, reuse and remanufacture* should be effectively transmitted to product designers, and the flow of information from processors involved at the product's end-of-life stage to product designers needs to be reinforced.

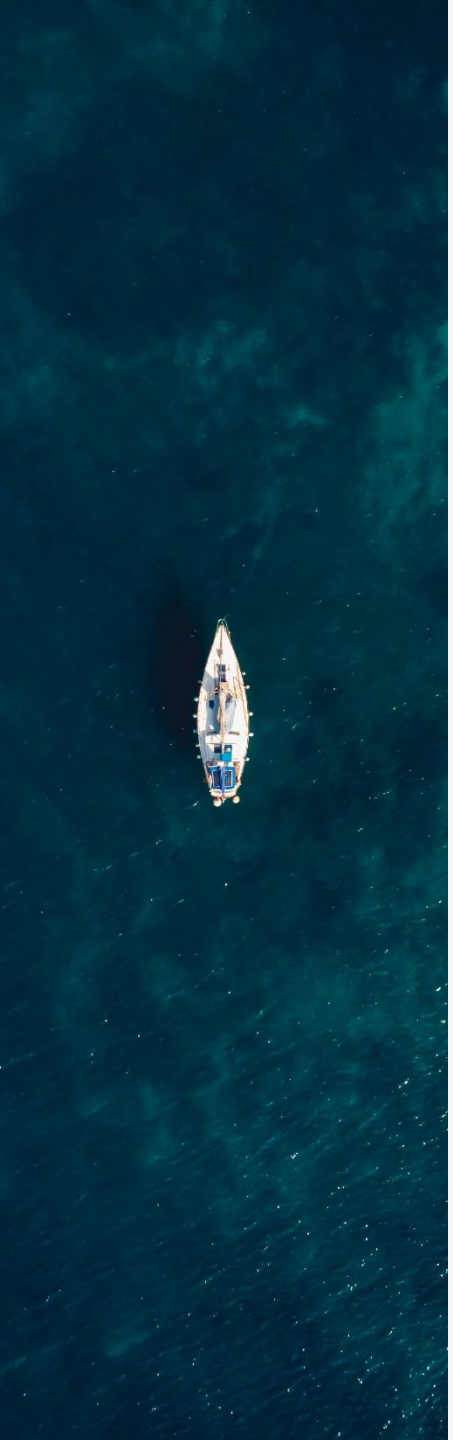
Smart waste management systems, for example incentivising waste separation by households through a reward system, could become standard practice.



(3) Aligning policy instruments throughout a product's life-cycle

Stimulating markets for recycling is an important part of the transition, but the inner circles of circularity should be equally stimulated.

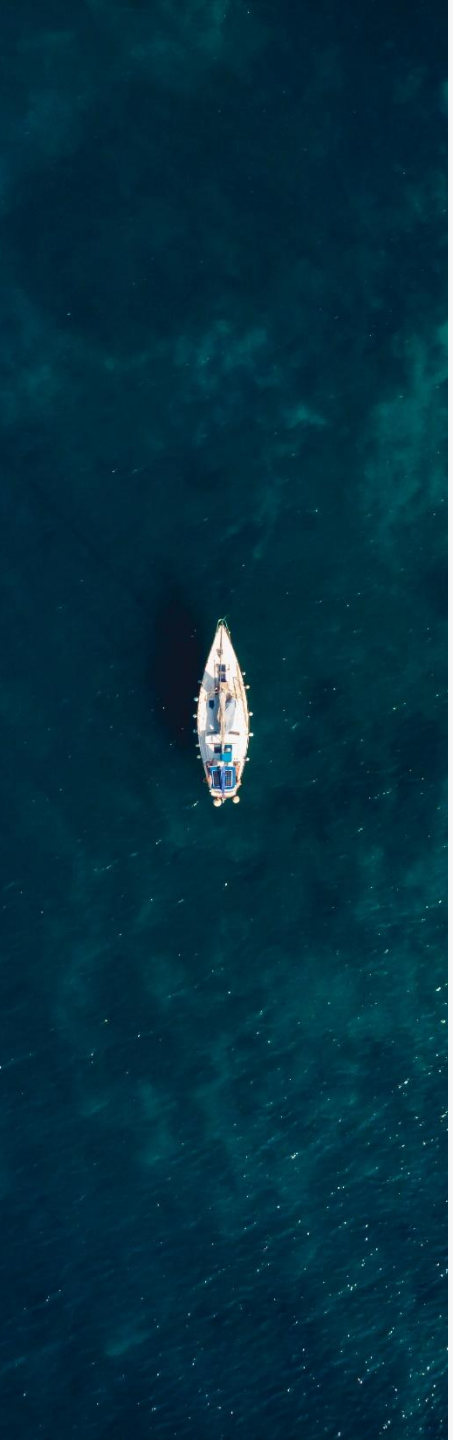
At the EU level, *durability, reparability, upgradeability, and design* for disassembly and ease of reuse and recycling will play a bigger role when setting eco-design requirements.



In general, a wide range of possible policy instruments to improve product circularity can be applied throughout a product's life-cycle:

Figure 4.2 Overview of potential policy instruments affecting product circularity throughout the product life-cycle

Note: * WEEE: Waste Electrical and Electronic Equipment.

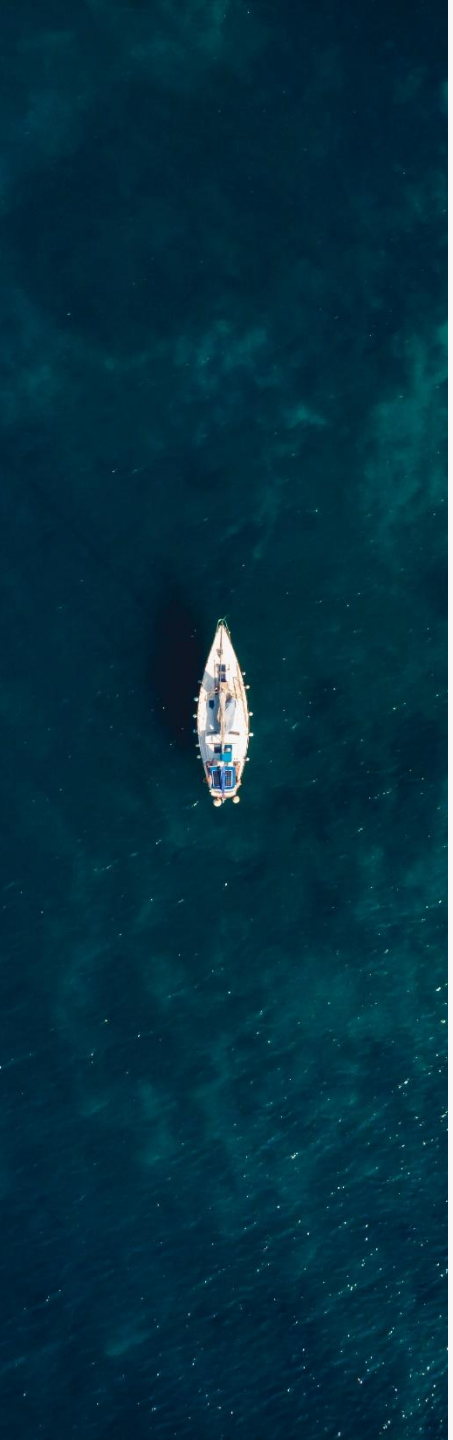


The transition to a circular economy can be compared to trying to sail across the ocean to another continent. A clear idea of the desired destination — *the vision of how the circular economy should look* — and a navigation plan will not suffice.

One needs to understand the effects of actions at the steering wheel on the boat's behaviour (regime trends), to know how the wind blows and what the currents are (landscape trends), and to appreciate how all this affects the boat's behaviour.

By monitoring key parameters, such as wind speed and location, the effect of steering the boat can be evaluated and corrections made.

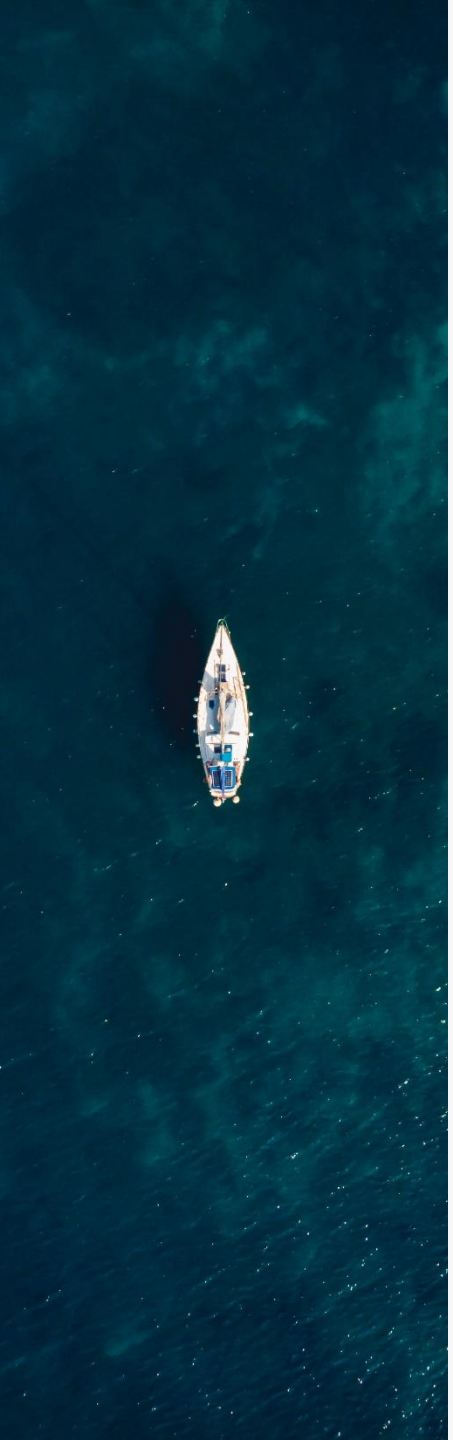
Along the way, specific events (niche innovations) can reinforce the boat's course, or can drive the boat off course entirely, depending on their strength.



Taking a systemic perspective can help navigate a transition to a circular economy.

Learning to identify and observe key mechanisms, as well as landscape, regime and niche trends relevant to product circularity, is a key asset in developing the knowledge base on the circular economy.

It enables the design of more appropriate ways to monitor the transition, and to take action that has a higher probability of leading to change in the right direction.



Resources

INTOSAI, Working Group on Environmental Auditing: Definition and Classification of Waste

Plastic Oceans, 7 Types of Plastic (2021)

Less Waste, Compostable, Degradable, Biodegradable - What's the difference?

Earth911 - Recycling Center Research & Recycling Guides

Sciencelearn - Measuring Biodegradibility (2021)

WM - Typical Anatomy of Landfill (2003)

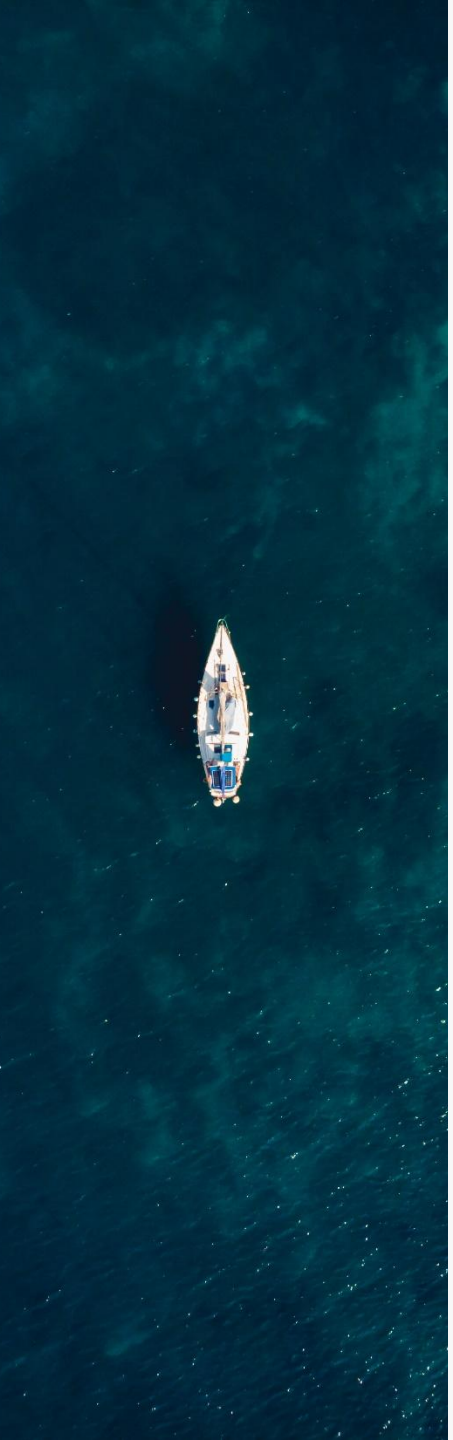
Dumpsters - What Are the Different Types of Landfills (2022)

CHRON - The Definitions of "Upstream" and "Downstream" in the Production Process (2019)

BMUB - Step-by-Step Guide to Sustainable Supply Chain Management A Practical Guide for Companies (2017)

WHY WASTE YOUR ENERGY?

Dioxins and Waste-to-Energy: State of the Art.



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IMS2020, 2010, IMS Roadmap on Sustainable Manufacturing, Energy Efficient Manufacturing and Key Technologies.

Discussion & Remarks

IDEAS

REMARKS

SUGGESTIONS

FURTHER QUESTIONS

Contact us

www.enicbcmed.eu/projects/mysea

Promimpresa Società Benefit SRL

Via Trieste 80-84-90

P.O.Box: 93017

San Cataldo - Italy

Tel: +39 0934 572555

Website: www.promimpresa.it

Email: info@promimpresa.it

SPEHA FRESIA

Centro Informazione Educazione allo Sviluppo (CIES) Onlus

Via Merulana 198 - 00185

Rome - Italy

Tel. +39 06 77264636 / +39 06 77264638

Website: https://www.cies.it/progetti/mysea/

Emails: mysea.communication@cies.it

mysea.coordination@cies.it

Thank you