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# COMPOSTING

## POLICY BACKGROUND

As defined in Directive (EU) 2018/851 of the European Parliament and of the Council, bio-waste includes „biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants". According to this definition, bio-waste does not include forestry and agricultural residues, manure, sewage sludge, or other biodegradable waste such as paper or processed wood.

The theoretical potential generation of bio-waste has been calculated as 114 million tonnes per year for the EU 27+ countries (EU 27, Norway and Switzerland) by the European network of communities 'Zero Waste Europe' in 2020. The data report released by the European Compost Network (ECN) in 2022 verifies that less than 40 million tonnes of municipal bio-waste are separately collected and processed annually into high-quality compost and digestate in Europe. This means that only 17% of municipal solid waste is organically recycled through composting and anaerobic digestion.

The Waste Framework Directive (2008/98/EC) mandates bio-waste collection from January 2024 onwards, furthermore, it includes another mandatory target: the goal of having at least 65% of municipal waste collected and prepared for reuse and recycling by 2035. As pointed out also in the ECN data report mentioned above, in order to reach this overall recycling target there is a **need to set further incentives to improve the separate collection and the biological management of bio-waste at the European level.**

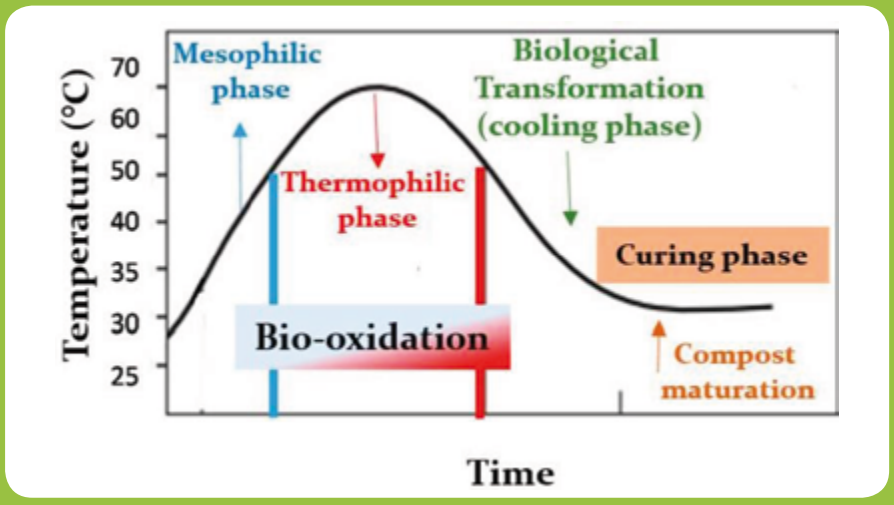
## HOW DOES COMPOSTING WORK AND WHY IS IT IMPORTANT?

If prevention at source is not possible, bio-waste can be managed in various ways, among others by separate collection and composting. Composting is a natural, self-heating, solid-phase biological recycling process, during which organic waste materials are degraded by aerobic microorganisms. The bioconversion of organic household waste and residues through the composting process results in a **stabilised, nutrient-rich, humus-like end-product** known as compost. This material is hygienically safe and can be used as a **soil improver or fertiliser**. Composting creates a **natural source of nutrients for plants** and promotes the circular use of renewable resources and thus can significantly reduce the amount of household waste disposed to landfills.

Compost plays a crucial role in improvement of the structure of the soil:

- It allows more air into the soil, improves drainage and reduces erosion.
- It helps to stop the soil from drying out in times of drought by holding more water.

During composting the materials go through several physical, biological and chemical transformations. The composting process is characterised by four phases, which are depicted in the following figure (Papale, M. et al., 2021):




## (1) MESOPHILIC PHASE:

The composting process starts at ambient temperature and in a short time (few days or even hours), the temperature rises to 40-45˚C, initiating organic matter decomposition by mesophilic microorganisms, which function best between 30 and 50 ˚C. Metabolic activity of various heterogeneous group of these microorganisms results in increased temperature as they utilise the N and C of the organic matter for their body assimilation. Decomposition of soluble compounds, such as sugars, produces organic acids and hence, pH can drop to 4.0-4.5.

## (2) THERMOPHILIC PHASE:

When the temperature in the pile rises higher than 45 ˚C, within 24 to 72 hours of the pile formation, the mesophilic microorganisms are replaced by the thermophilic ones (mostly bacteria) which has capacity to grow at higher temperature. They facilitate the degradation of complex organic plant materials, i.e., cellulose and lignin. Conversion of nitrogen into ammonia by the thermophilic microbes results in pH rise of the compost pile during this stage. The most active “hot phase” (65-70 ˚C), where decomposition is the most rapid, lasts for two to eight days.

## (3) COOLING PHASE:

After the exhaust of carbon and nitrogen sources from the raw material, the microbial activity decreases and thus the temperature of the pile declines again. As temperature goes below 45 °C, mesophilic microorganisms recolonise and pH of the compost pile slightly decreases, whereas in general pH of the compost pile remains slightly alkaline. This cooling phase requires several weeks.

## (4) CURING/MATURATION PHASE:

The temperature of the compost pile drops from 40-45 ˚C to the ambient temperature level. The oxygen consumption declines, and organic materials continue to decompose and biologically stable humic substances that are characteristic to the mature compost are formed. A long curing phase is needed if the compost is immature, which usually happens if the pile contained too little oxygen or either too little or too much moisture.

## HOME COMPOSTING

Composting (including the selective collection of bio-wastes for composting) is a traditional and probably the most convenient way to recycle bio-waste produced at smaller scale. Home composting is a great way of being greener, improving soil in farms and gardens, and making use of organic waste which would ordinarily be sent to landfill. Obviously not all household waste materials are suitable for composting, even if they are bio-based or biodegradable. The table below presents a list of waste materials that should and should not be composted.

| | |
|---|---|
| Compostable materials **FROM THE YARD** (garden waste) | • shredded branches, twigs and bark of garden plants<br>• withered flowers, cut plant stems<br>• grass clippings<br>• leaves<br>• untreated wood<br>• potting soil |
| Compostable materials **FROM THE KITCHEN** (household organic waste) | • unprocessed fruit and vegetables leftovers (peels, leaves, stems)<br>• eggshells (crushed)<br>• coffee ground and tea leftovers (without filter), spices, herbs<br>• overblown flowers, potted plants and their soil (without pot)<br>• pets' litter (only herbivorous) |
| Materials **WITH LIMITED SUITABILITY** for composting | • conifers, weeds, walnut leaf, peels of non-treated tropical fruits<br>• wood ash<br>• shredded uncoloured or untreated, non-glossy paper packaging, newspapers,<br>• undyed or untreated textiles with 100% natural ingredients (e.g. cotton, wool) |
| **NON-COMPOSTABLE** materials | • packaging materials,<br>• hazardous waste, chemicals, paints,<br>• leftovers of cooked and processed food, baked goods,<br>• bones, dairy products, fat, used household oils,<br>• content of vacuum cleaner dust bag, cigarette butts,<br>• litter of carnivorous and omnivorous pets |

Compost feedstocks are the organic material you put in your compost pile. There are two broad categories of feedstock to put in the compost bin or pile: **greens and browns**.

**Greens** the nitrogen source, are colourful and wet (e. g.: grass clipping, fresh manure, garden clean out, food scraps). They provide nutrients and moisture for the compost decomposers, so they grow and reproduce quickly.

**Browns** the carbon source, provide energy, and are also used for absorbing excess moisture and giving structural strength to the compost pile. They help keep the pile porous, facilitate airflow and prevent compaction (e. g.: brown leaves, branches, straw, paper, sawdust, woodchips).

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Layering and choosing the right organic materials creates an optimal environment for the composting process. Building of a compost pile is started with a layer of coarse “browns” in contact with the soil. Then a well or depression is made in this layer and the “greens” are put into the well. The food scraps should be kept away from the outside edges of the pile, only brown material should be visible. The layer of “greens” has to be covered with a generous layer of “browns” so that no food is showing. The pile can be finished with a layer of soil or finished compost. These covering methods will keep insect and animal pests out of the pile and filter any odour.

A minimum volume of 1 m3 (1x1x1 m) is required for a pile to become sufficiently self-insulating to retain heat. Heat will help reduce pathogens and allow the process to occur more quickly. This size is usually enough for the kitchen and garden waste of an average family. More containers can also be used: when a bin is full, while it is processing and curing, a second one can be started to be filled.

Composting bins can be either three or four sided, with a removable front to facilitate turning. Containers can even be built of scrap wood, pallets, fencing or cement. Ready-to-use metal, wood and moulded plastic composting containers can be purchased as well.

Location of the pile can have a significant effect on the composting process. It should be located in a level, well-drained area. In cool climates, putting it in a sunny spot can help trap solar heat, while shade in warmer climates may keep it from drying out.

Different management choices can be made when building the pile. Passive composting requires less labour but more time. If there is time and space to wait for a usable product (9 to 15 months after building the pile), the process can be let work passively. If processing space and time is limited, turning will help to speed the process. The pile can be turned with a pitch fork or shovel, which helps to break up material and better homogenise the mass.

Composting process largely depends on raw materials and environmental conditions, and several parameters affecting compost preparation (e.g. moisture content, aeration, carbon-nitrogen ratio, particle size etc.) have to be appropriately set and kept in an optimal range.

Finished compost is applied to the soil at rates from 10 to 100 tonnes per hectare or 1 to 10 kg/m2. The bulk density of compost ranges between 420 to 655 kg/m3. A pile size of 1 m3 is roughly enough for a 50-500 m2 garden plot, depending on the dose of application.

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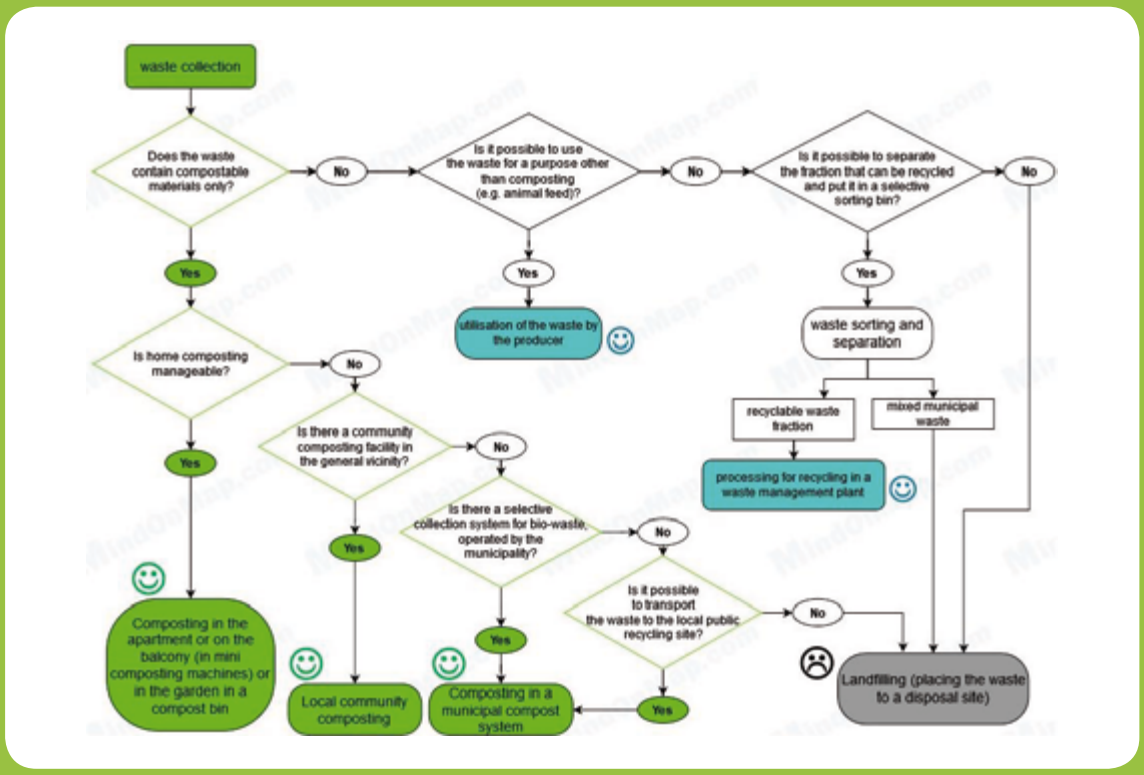
The aim of the flowchart below is to present the possibilities regarding waste management at the level of individual waste producers. The green elements on the left side of the chart show the different options for composting.




## BENEFITS OF COMPOSTING

1. reducing the waste stream
2. reducing personal food waste
3. recycling nutrients in a controlled and accelerated way
4. positively impacting the environment (improving soil structure and health, and lessens erosion)
5. minimising environmental impact (reducing CO2 emissions; cutting methane emissions from landfills)
6. source of renewable energy
7. producing a valuable product that can be utilised as a high-quality fertiliser or soil additive
8. saving money on buying expensive fertilisers
9. making a shift toward a greener future

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