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Common borders. Common solutions.

Guide with best practices in Zero Wastes practices

Project «Methods and Implementation in Black Sea Basin» ZeroWasteBSB eMS BSB 788,which is funded by the Joint Operational Program «Black Sea Basin 2014-2020»

CROSS BORDER COOPERATION

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1. About ZeroWasteBSB 788 project

This Guide is based on analysis zero waste systems in Europe and target countries under GA T2 - Activities for increasing public awareness on zero waste systems of the **«Zero Waste Strategy: Methods and Implementation in Black Sea Basin- ZeroWasteBSB» eMS BSB 788 project, which is implemented in framework of the Joint Operational Programme «Black Sea Basin 2014-2020». This project is funded by European Union.**

Project Beneficiaries are:

1. Kirklareli Special Provincial Administration-Lead Beneficiary/Turkey;
2. "ANTIGONE – Information and Documentation Centre on Racism, Ecology, Peace and Non – Violence"/Greece;
3. The Institute of Market Problems and Economic & Ecological Research of the National Academy of Science of Ukraine/Ukraine;
4. Tsarevo Municipality/Bulgaria.

ZeroWasteBSB project is a project for research the methods of implementation of the zero waste practices and platform for realization of one of them in Kirklareli region, Turkey. The project is based on the good cross-border partnership between regional, local authorities, NGO and research institute from four different countries in the BSB. The main aim of the project is: Increasing awareness on environmental challenges and good waste management practices related to river and marine litter within the Black Sea Basin for ensuring improvement of the welfare of the people in the Black Sea Basin regions.

For the implementation of the project, the partners will apply a project approach based on combining good governmental solutions, creation of properly and effective waste management plans and developement of social activities for increasing public awareness and involvment of the local people for minimizing the marine litter in the Black sea basin. There will be realized the following joint cross-border activities: Act.1 Analysing and Planning activities of the pollution situation in the target areas: First project activity aims preparation of the right feasibility reports regarding the existing waste in target areas - the type of the waste, the

possibilities of their right collecting, recycling and reducing chances. Act. 2 Activities for increasing public awareness on zero waste systems: wide informational campaign among the young people, students and local citizens in four target areas will be realized: Four project partners will realize informational campaigns for schools in Odessa, UKR, people living in the rural areas of Bulgaria and Turkey, citizens of Thessaloniki in Greece. Young people will learn how to prepare their own compost boxes and to recycle local organic waste.

Act. 3 Development of sustainable cross-border partnership for Zero waste in BSB: One of the main project aims is to be developed sustainable partnership between stakeholders for ensuring transferring of Zero Waste activities and after the end of the project.In this frame the project partners will develop stable Zero Waste Centers in their own institutions and an online network for transfer of achieved knowledge, experience and duplicate the project results to other target areas in Black Sea Basin.

Two administration partners will implement important and effective Zero Waste system investments in their countries: for Integration of Zero Waste system by innovative way in huge territory covering 39 villages in Kirklareli Region, Turkey, and invetsmenting in the necessary machine-equipment for double collection and ensuring clear public areas in Tsarevo, Bulgaria. Also, Realized public awareness campaign and trainings for decreasing litter in the basin, will involve more than 18.000 people and youth living in rural areas of the basin and in its biggest cities as Thessaloniki, GR and Odesa,UKR. Important cross-border clean-up campaigns will be realized.

This publication has been produced with the financial assistance of the European Union. The contents of this publication are the sole responsibility of The Institute of Market Problems and Economic & Ecological Research of the National Academy of Science of Ukraine and can in no way be taken to reflect the views of the European Union.

2. What is Zero Waste?

This is a set of principles aimed at minimizing pollution through the reusable use of objects and things. The purpose of Zero Waste is to stop sending any garbage to landfills, incinerators or the ocean. Currently, only 9% of plastic is recyclable. According to the Zero Waste system, the material is used to the optimal level of use.

The concept of Zero Waste is a holistic, systematic approach that aims at mass transformation: it requires a radical change in the way materials are used. No waste is achieved not only through recycling and reuse. The main thing is a complete rethinking of the principles of production and distribution of raw materials.

The Zero Waste International Alliance (ZWIA) interprets the term[1]:

"Zero Waste: 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 is an ethical, financial, effective, and visionary aim that guides people in transforming their habits and behaviors to mimic renewable natural processes, in which all recycled products are intended to become tools for others to use.

Zero Waste involves actively avoiding and eliminating the amount and toxicity of waste and materials, conserving and recovering all energy, rather than burning or burying them.

[1] Last updated December 20th, 2018

Zero Waste would remove any discharges to soil, water, or air that endanger the welfare of the earth, humans, animals, or plants.

The Zero Waste movement gained publicity and reached its peak in 1998-2002 and has since moved from "theory to practice", focusing on the structure and rules of conduct of a "zero waste society".

In 2008, the term Zero Waste was used to describe methods of producing materials and managing household waste. Bea Johnson, an American of French descent living in California, decided to use it in her home of four people. In 2009, she began sharing her experience through the popular blog Zero Waste Home, and in 2010 was published in the New York Times. The article, which turned the concept of Zero Waste into mainstream, has received much criticism from people who confuse it with a bohemian lifestyle. The opinion of critics began to change after the publication of photos of the family and their home interior in the media. In 2013, Johnson published “Zero Waste Home: The Ultimate Guide to Simplifying Your Life by Reducing Your Waste”. The book provides a simple 5R methodology with detailed practical advice on household waste disposal, namely Refuse, Reduce, Reuse, Recycle and Rot (Refuse, Reduce, Reuse, Recycle, Compost).

In her interview, the author notes that at first her family gave up everything she didn't need. For example, from plastic bags, food in packages and disposable products, which can find a reusable alternative. "In our society, people are used to taking what they give for free, whether it's an extra package or a flyer. It took time to learn to say no. I think the right wording helped. We have several of them: "No, thank you, we do not need it", "I am a minimalist", "I simplify my life". My son simply

says, "No, I'm fine anyway." That's enough to explain my position to people, "says Bea Johnson.

After the refusal, the Johnson family moved to a reduction - they lost a lot of electronics and furniture. Bea writes that in their house there is one dining table, four chairs, one sofa and one armchair, three beds, two desks and three office chairs. Almost everything was bought from the hands.

The author also reviewed her wardrobe, because usually people wear only 15-20% of the total number of things. They lie on the nearest shelves and often go to the laundry, and everything else is stored in the closet just in case - well, suddenly ... "After in my closet were only those things that I really liked and in which I felt comfortable , I realized that not all of them are quite versatile. So I decided to find a replacement for them in second-hand. Now I have 15 items of clothing and 5 pairs of shoes. It's not boring at all, " writes Bea Johnson.

Ms. Johnson's bestseller has been translated into 27 languages and has inspired many to join the Zero Waste lifestyle. Thousands of social media channels, blogs, unpackaged stores, and organizations have sprung up around the world. And, in turn, this fast-growing mass movement has created a demand for large corporations, such as Unliever and Procter and Gamble, to create alternative reusable products.

It is estimated that an increase in the volume of waste generated by society almost exactly correlates with the growth rate of national GDP (the EU today seeks to ensure that these volumes grow 15% slower than GDP, and in a number of Western European countries - Denmark, the Netherlands, Switzerland, Slovakia, etc. Estonia - the indicated correlation is weakened). In any case, however, the historically formed "garbage civilization" will soon approach its natural limits: neither the transport shoulder for waste disposal, nor the area and number of landfills, nor the costs of all this can increase indefinitely. In addition, it is increasingly recognized that the generation of waste means the loss of materials and energy, additional and increasingly burdensome environmental and economic costs to society.

The main trend in solving the waste problem, which has become the norm for a number of countries, is the transition from landfill disposal and incineration to industrial processing. A new "waste economy" is emerging: with the opportunities that industrial technologies open up, waste in a significant part turns into a resource. The “linear economy” with its principle of “extracted - produced - consumed - thrown away” is being replaced by a “circular economy” based on the principles of recycling products and movement “to the source”, i.e. such a production that, at the very beginning of the life cycle of products, minimizes the waste that will remain from them in the future. "Cleaning at the end of the pipe" loses its meaning.

Zero Waste Business Principles

On April 5, 2005, the Zero Waste International Alliance's Planning Group adopted the following Principles to direct and review existing and prospective Zero Waste strategies and initiatives. These Zero Waste Business Principles can be used to assess businesses' contribution to achieving Zero Waste. This Principles would also make it easier for employees, clients, consumers, vendors, regulators, and the general public to assess a company's resource quality. These principles can be described as follows:

• **Triple bottom line dedication** – We make sure the civil, environmental, and economic success requirements are all reached at the same time. For our investors and clients, we maintain transparent accounting and reporting processes and work with the highest ethical expectations. We publish annual environmental or sustainability reports that detail how we put these policies into practice. We educate our employees, consumers, and the general public about the environmental effects of our manufacturing, goods, and services over the life cycle.

• **Apply the Precautionary Principle** – We use the precautionary principle when implementing new goods and procedures to prevent introducing wasteful or toxic products and practices.

• **Zero Waste to Landfill or Incineration** – At all of our plants, we divert more than 90% of the solid waste we produce from landfill. Landfilling accounts for less than 10% of our waste. To recover energy or components, no solid wastes are treated in facilities that run above atmospheric biological temperatures (greater than 200 degrees F).

• **Take back products and packaging** – We take financial and/or physical responsibility for the products and packaging we manufacture and/or sell under our brand(s), and we want our vendors to do the same. We help and collaborate with existing reuse, recycling, and composting businesses to make the most of our goods and packaging, or we set up new programs to return them to our processing plants. All new items must follow our design requirements for reuse, repairability, sustainable recycling, or compostability.

• **Purchase reclaimed, recycled, and composted materials** – We use recycled content and compost items in all facets of our activities, including manufacturing, workplaces, and new facility building. To design new and remodeled facilities as Green Buildings, we use LEED-certified or similar architects. Wherever possible, we purchase re-used items and make our surplus inventory of equipment and products eligible for reuse by others. We mark the amount of post-consumer recycled content in our goods and packages, as well as whether chlorine-free and forest-friendly fabrics are used in our documents. No heavy metals are used in the printing of the labels, which are printed with non-toxic inks.

• **Minimize emissions and waste** – We overhaul our supply, processing, and delivery processes to reduce natural resource use and waste. We avoid contamination and waste by evaluating our processes on a regular basis and revising

practices, protocols, and payment policies. We advise customers of the contents of our goods and how to properly handle them at the end of their useful lives according to the take-back processes we have developed, and we will strive to design them out of the loop to the degree that our products contain materials with proven or suspected adverse human health or harmful environmental impacts.

• **Highest and best use** – We continually evaluate our markets and guide our discarded products and packaging to recover the highest value according to the following hierarchy: reuse of the product for its original purpose; reuse of the product for an alternate purpose; reuse of the product's parts; reuse of the materials; sustainable recycling of inorganic materials in closed loop systems; sustainable recycling of organic materials in closed loop systems; sustainable recycling of inorganic materials in closed loop systems.

• **Economic benefits for consumers, employees, and suppliers** – We use economic incentives and a comprehensive systems analysis to enable our customers, workers, and suppliers to reduce waste and optimize reuse, recycle, and composting of recycled products. We lease our goods to consumers and reward staff, vendors, and other partners who reduce waste with bonuses or other incentives. To inspire our vendors to follow Zero Waste standards, we offer financial rewards. We assess our waste and see whether there are any other productive market options for these assets, or if they can't be re-manufactured sustainably, we plan them out of the process.

• **Marketed goods and services are not costly or harmful** – We review our products and services on a daily basis to see if they are wasteful or toxic, and we create solutions to remove those that are. We

don't use POPs, PVC, or polystyrene in any of our stuff. We review all of our goods and, if we may, sell them as services from our own business. To promote reuse and repair, we produce items that are simple to disassemble. We make our goods to be long-lasting, to last as long as the technology does. We eliminate the use of non-renewable resources while still developing the technologies to do so. Our goods can quickly be remade to look like the original.

- **Use non-toxic processing, reuse, and recycling processes** – In our production, reuse, and recycling processes, we avoid the use of dangerous materials, including persistent bioaccumulative toxics. We minimize the threats to our workers' health and welfare, as well as the societies in which we work. All goods shipped to countries with weaker environmental requirements are handled in accordance with ZWIA's recommended Best International Practice.

Zero Waste Community Principles

Local governments will contribute to mitigating climate change, protecting public health, creating green jobs, and promoting local sustainability by implementing Zero Waste systems. For long-term resource management, three overarching priorities are needed.

At the front end of the issue, manufacturers are responsible for industrial development and design. Consumption, discard use, and recycling are all community responsibilities at the back end of the crisis. Community and industrial responsibility must be taken together as a harmonious whole through government responsibility. Zero waste is an important first step toward achieving other goals such as protecting public health, improving equity, and achieving sustainability. Sustainable agriculture, architecture,

electricity, manufacturing, fiscal, and community growth can all be related to Zero Waste.

Every human on the planet generates waste and thus contributes to a non-sustainable society. With strong political leadership, however, everybody will participate in the crucial transition to a prosperous society. In this case, good political leadership entails considering people as vital partners in the fight to defend human health and the environment, as well as in the transition to a more prosperous future. Rather than attempting to "manage," governments should "control" this shift to renewable resource management activities. This requires substantial support for civic outreach and education so that people can assist neighborhoods in making the right decisions possible.

Communities should:

- Adopt the Zero Waste definition: "Zero Waste: The recycling of all resources by responsible processing, consumption, reuse, and regeneration of goods, packaging, and materials without burning or discharges to soil, water, or air that harm the atmosphere or human health."

- Set benchmarks and a timetable for meeting targets so that progress can be calculated and milestones can be monitored. Communities should strive to make substantial progress every five years, investing civic resources and expertise in creating concrete and measurable accomplishments that illustrate this new path to the public as soon as possible. Within 10-15 years of implementing a strategy, some cities have set a target of diverting at least 90% of waste created from landfills and incinerators. Others also set longer deadlines, such as the target of Zero Waste by 2040 set out in the Urban Environmental Accords. Establishing a realistic target for the city and acknowledging the importance of acting effectively to combat climate change is an important part of the planning process.

- Involve the whole society. It's vital not to entrust Zero Waste to "waste experts." The drive toward Zero Waste and recycling would take a wide variety of skills. Everybody has a job to do. Citizens or groups must take the lead in planning gatherings that have representatives from all sectors of the population. In order to

reach Zero Waste, all groups (nongovernmental organizations, grassroots campaigns, businesses, and governments) that offer waste disposal, takeback, reuse, recycled, or composting services should be involved. As their neighborhoods create longer-term plans and services for the whole city, both of these organisations and people should be challenged to achieve Zero Waste at home, at school, at university, at work, and at recreation. Existing utility providers should be encouraged to embrace Zero Waste as a priority and exploit the opportunity to minimize waste, offer takeback services to local suppliers and consumers, and assist municipalities and companies in their efforts to achieve Zero Waste. Throughout the preparation and execution processes of the Zero Waste programme, continuous coordination with all aspects of the city should be maintained.

- Demand policy makers control capital rather than squandering them. Existing incinerators must be decommissioned, and no new ones must be built. Pre-processing all residues at landfills before burial to stabilize the organic fraction and deter methane generation, as well as the use of Residual Separation and Research Facilities. These types of plants, on the other hand, can not be used to pre-process waste until it is sent to incinerators or other thermal treatment technologies. Landfills are a major source of greenhouse gases (especially methane, which warms the atmosphere 23-72 times faster than carbon dioxide) as well as pollution of the ground. Incinerators and other burning and thermal treatment systems that use waste as fuel, such as biomass burners, gasification, pyrolysis, plasma arc, cement kilns, and power plants, emit greenhouse gases both directly and indirectly, and convert energy that can be minimized or recycled into radioactive ashes that must be safely disposed of. Neither landfills nor incinerators are suitable responses to the threat of peak oil, which would render any new incinerator inefficient within its lifespan due to the high cost of replacing embedded energy and oil in materials. Through minimizing waste, reusing goods, recycling, and composting, more electricity can be saved and global warming effects avoided than by burning waste or recovering landfill gases. Communities should oppose any attempt to build new incinerators, in any guise, and substitute current landfills and incinerators with Zero Waste strategies and services, such as EPR, resource recovery parks, reuse, recycle, and composting facilities.

- Using stimulus funds and fees collected on tons of waste hauled or landfilled to finance projects that teach and prepare Resource Managers to use a Zero Waste plan, implement programs for dealing with neighborhood discards, generate green jobs, and follow environmental laws.

- Residents, corporations, and tourists should all be educated. Zero-waste is more of a technique than a technology. As a result, it aspires to improve organisation, schooling, and industrial design. Communities must develop programs to teach and prepare people, school children, college students, businesses, and tourists about new laws and programs in order to accomplish the systemic transformation needed to get to Zero Waste.

- Assessing for zero waste is a good idea. To determine the volume and form of waste generated in their city, communities should perform a waste audit. If money is not available, data can be obtained locally or from neighboring populations. These audits can be seen as a starting point for identifying rehabilitation and job prospects, as well as cost savings and measuring the reduction and recovery program's performance. Assess what additional source diversion, take-back, reuse, recycling, and composting systems and facilities are needed to make those services more user-friendly than mixed-material collection and disposal services.

- Develop Testing and Residual Isolation Facilities. Until the remaining inerts are able to be deposited in a landfill intended to have no air or water pollution, residuals can be sent to Residual Separation and Research Facilities in the interim. This facilities can serve as a connection between community and industrial responsibility. If the society is unable to reuse, recycle, or compost it, industry should either return it to the community for reuse, recycling, or composting, or design it out of usage. In order to render these residuals “disappear,” expensive incinerators are used. The residuals must be made very clear in a Zero Waste policy because they reflect either poor factory design or poor buying practices, all of which must be improved by committed study and education.

- Create new rules and incentives to help them get to zero waste – With new laws, regulations, and benefits, communities will dramatically alter what is

considered "economic" in the local marketplace. Communities should restructure contracts and regulations so that the avoided costs of collection and storage is a primary driver of zero waste progress.

- EPR (Extended Producer Responsibility) laws should be applied. Communities must assist and enable area retailers to accept returned goods and packaging from customers at their supermarkets and factories. They can also lobby for EPR strategies and services for brand owners and manufacturers at the state and national levels. Through most municipal systems, the costs of discard maintenance for goods and packaging that are impossible to reuse, recycle, or compost should be moved as far as possible from municipal government to the product's manufacturers. This offers a financial opportunity for suppliers to redesign goods so that they are less toxic and easy to reuse and recycle. Items and items that cannot be reused, recycled, composted, or composted domestically or are hazardous should be needed to be returned at the point of sale, or manufacturers should set up warehouses to purchase those goods at no cost from the general public. Both returned items and containers must be properly reused, recycled, or composted. Producers should not be able to export damage to countries with poorer environmental requirements under EPR policies. EPR policies should encourage the creation of collaborative projects with the help of independent, local companies and nonprofits, rather than relying on a single agency for reuse, recycling, and composting.

- Remove government subsidies for waste – Governments have enacted a slew of tax incentives to promote no longer-needed mining and timber harvesting, effectively subsidizing resource waste. Incinerators have also been funded by governments under the name of "Energy from Waste," including the fact that such facilities waste energy. Leachate, methane generation, and eternal long-term care, which is an indirect subsidy for wasting, are all unaddressed by government landfill rules. Rather than embracing Pay As You Throw rewards, communities have embraced trash fee systems, making it easier to dump rather than recycling. Communities should abolish subsidies for pollution under their jurisdiction, as well as demand the abolition of all other subsidies.

- Support Zero Waste Procurement – To eliminate toxic products and services, local governments should adopt the Precautionary Principle for municipal purchasing; purchase Zero Waste products and services; avoid single-use products and packaging; return all wasteful packaging to vendors; reduce packaging and buy in larger units; use reusable shipping containers; purchase reused, recycled, and compostable products.

- Infrastructure for Zero Waste Expansion - City communities and partners, including Resource Recovery Parks, should be active in creating places for reuse, recycling, and composting companies to gather and process goods, produce items, and market products to the public.

- Businesses, NGOs, and community associations should all be encouraged to reuse. Identify, assist in the expansion, and promotion of reuse enterprises, non-governmental organizations (NGOs), and citizen organizations. Concentrate on the volume of reusables rather than the quantity of goods in the stream. Establish effective repair and reuse systems to keep items in their original shape and work. As a necessity, assist with the reuse of materials for their initial intended purpose.

- Compostable Organics (including garden clippings, food scraps, food-soiled paper, and clean wood waste) should be removed from landfills and returned to the earth. Methane and other landfill gases are created by organic materials. Communities should implement policies and services as quickly as possible to accomplish this aim. Encourage planning departments to favor agriculture over subdivisions and composting as a crop. Small municipal composting operations should be favoured over massive consolidated plants wherever possible. To improve food protection, local self-reliance, and biodiversity, compost should be used locally to cultivate food and regenerate soils. Composting helps to minimize greenhouse gas emissions by sequestering pollution in soils and reducing the use of irrigation, pesticides, and fertilizers.

- Support Zero Waste practices in businesses and institutions – Communities should make it mandatory for all enterprises and entities to adhere to Zero Waste systems, requiring that recycling and separate hauling services be offered to all of them, and requiring that recycled materials be source segregated to ensure the maximum and efficient use of those materials.

- C&D stands for construction, demolition, land clearance, and remodeling. Adopt citywide deconstruction, reuse, and recycle strategies (including forcing all vendors to request schedules and deposits to achieve neighborhood targets), and introduce Zero Waste systems and facilities. Work with Green Building projects to prioritize deconstruction and reuse, and make it a requirement for all new buildings to provide recycling bins.

- Small establishments that are owned and run by local residents. Communities can promote locally owned and run community businesses wherever possible in order to sustainably handle and use local waste, as well as build employment and educational opportunities in the area.

- Encourage businesses to take the lead in achieving Zero Waste – Thousands of Zero Waste Companies around the world now divert over 90% of their waste from landfill and incineration. Businesses who practice zero waste reduce their costs in handling capital and discards, improve their operational performance, reduce their carbon footprint (including oil use), and reduce their long-term responsibility. Locally, define, accept, and support Zero Waste Companies, and inspire others to do the same.

3. Zero Waste Hierarchy and Regulatory framework

New waste management practices, and this should be especially emphasized, are extremely complex (highly complex) in nature, covering infrastructure, management, financial and socio-cultural components. From this point of view, the topic is considered in this review. His subject is experience in waste management in the European Union. At the same time, the evolution of waste management policy at the level of EU institutions is shown and the experience of individual - the most advanced - countries in this area is considered.

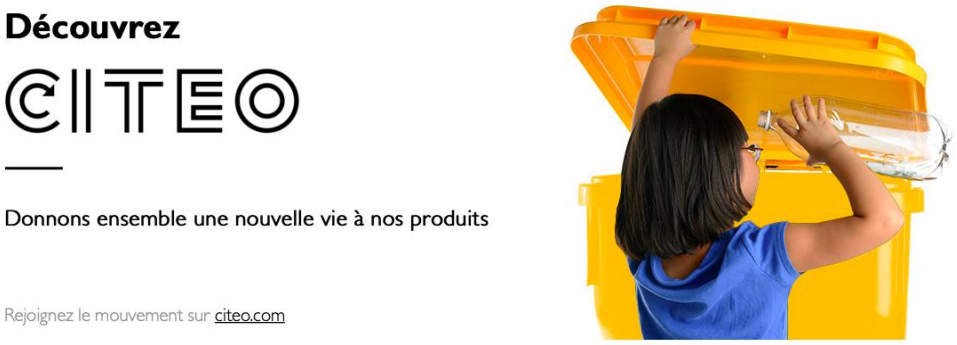
By now, the European Union has adopted the order 20 directives dealing with various aspects of the waste management problem. Their systematic analysis obviously requires a special monographic study. The purpose of this review is to identify the general logic of the development of the waste management system that has developed in the EU to date, and to illustrate this logic with specific - “living” examples from the practice of the most developed countries in this respect.

Until the early 1970s, waste legislation was within the internal competence of the EEC Member States. In 1975, in order to bring different national practices closer together, the European Council adopted the so-called Waste Framework Directive (75/442 / EEC), which established general requirements and basic definitions (concepts and terms) in this area. In 2006, the Directive was reissued and “codified” (brought to the text, replacing the previous versions), and today it is in force in its latest version from 2008. under the designation Directive 2008/98 / EC.

Directive 2008/98 / EC has highlighted the topic of “waste management hierarchy” - a concept showing the sequence of the most preferred methods of operation, ultimately ensuring the reduction of waste “at the end of the pipe”, i.e. at the stage where they undergo burial, grinding, gasification and / or other “final operations”. According to the long-standing consensus between experts and legislators, the first place here is given to "prevention" - such an organization of production, which takes into account the requirement to minimize waste from a given product in terms of loss of consumer qualities. This is followed in descending order by reuse (with preparation), recycling (recycling), use and disposal (disposal).

As of the end of 2014, the EU countries had adopted 36 national and regional “prevention” programs - different in content, goals and time horizons. Programs are targeted at households, municipalities, agriculture and the extractive sector; most of them deal with such types of waste as organic (bio waste), electrical and electronic components, batteries, packaging, hazardous waste.

In France, Eco-Emballages provides training and advice to all comers, but mostly engineering students, on minimizing packaging waste.[2]



Belgium has a regional program (Flanders) to significantly reduce household waste; in this case, part of the waste after grinding is used to obtain energy. At the same time, the so-called reuse centers are developing, collecting, sorting, repairing and then selling "thrown into the trash" household items - clothes, household appliances, furniture, dishes, books and bicycles. The centers, among other things, are tasked with: 1) collecting at least five kilograms of things to be restored per person per year; 2) provide employment for a certain number of people; 3) serve at least 4 million consumers.

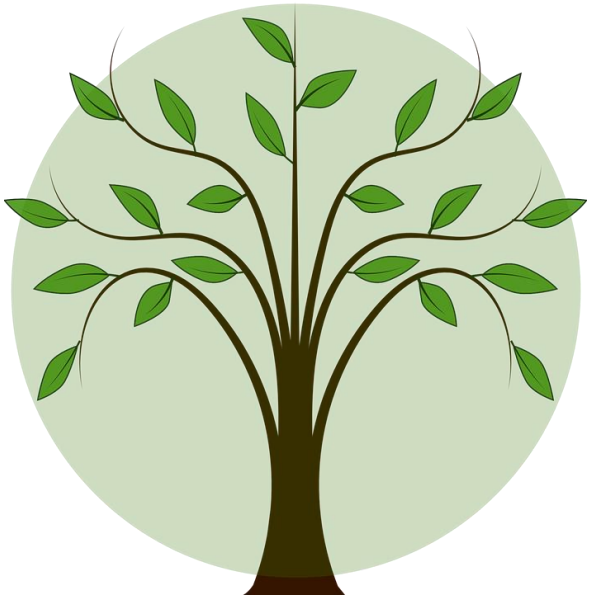
In Ireland, under the auspices of the National Waste Prevention Committee, there is a so-called Green Business Initiative that assists businesses and organizations in three areas - waste, water and energy. In addition, there are programs for technical assistance, financing and incentives for small and medium-sized enterprises, non-governmental organizations and local authorities implementing waste prevention projects. The Center for Clean Technologies was

[22] Source http://www.ecoemballages.fr

established, a non-profit research organization providing scientific support in this area.[3]

In Finland, the Smarter with Less Waste program is being implemented in cooperation with private entrepreneurs, municipal authorities and households.

In Hungary, it is increasingly practiced to reuse and exchange building materials between construction firms: objects of exchange cover 12 categories - bricks, tiles, wooden construction components, window frames, etc.



In Austria, the Waste Management Act provides for the initial eco-design of products, appropriate organization of production and distribution processes and work with consumers. Among other things, the following have been developed here: 1) an Internet-based “flea market” through which consumer goods, construction and garden tools are sold; 2) repair and maintenance centers - dozens of small centers where you can cheaply repair household electrical appliances; 3) programs in the spirit of "change lifestyle", focusing on services instead of purchasing goods.

In Italy, a regional initiative (Piedmont) provides training and other services to households on food waste composting.

In Directive 2008/98 / EC, reuse means “any operation by which products or components that have not become waste are reused for the same purpose for which they were originally produced.” In practice, reuse covers such types of waste (total that households can donate to the economically less advanced segments of the population), such as car parts, furniture, refrigerators, televisions, computers, clothing, kitchen utensils and kitchen appliances, other household items, building

[3] Source https://www.epa.ie/mobile/waste/gbi/

materials, garden tools, out-of-fashion jewelry, books, etc. To collect all this, special centers are being created, where the renovation (repair) and sale of all of the above are carried out according to the second hand principle. A huge department store has been built in Sweden, which combines the traditional municipal center for the reception of old items (furniture, computers, clothes, toys, bicycles, garden equipment, building materials) and the sale of all this already "in a marketable form." At the same time, the movement for DIY reuse of things and materials in everyday life: this is a very popular topic in the media and on the Internet, where you can find hundreds of useful tips for all ages, including for children and schoolchildren, on what can be made of things, have served their time. This is how creativity and the "culture of repair" are brought up.

Recycling is defined in Directive 2008/98 / EC as any operation in which a waste material is recycled into products, materials or substances, whether the resulting product serves its original purpose or for any other purpose. A specific type of recycling is the processing of organic waste for composting. The use of waste for energy purposes does not belong to this level of the hierarchy.

Recycling is a key element in waste management today. It is believed that up to 80% of municipal solid waste, as well as construction and demolition waste, lend itself to it. In practice, "recyclates" are glass, ferrous and non-ferrous metals, textiles, paper, plastics, leather, fur, wood, cork, rubber, food and vegetable waste, vegetables, fruits. In some cases, material recycling aims to recover the original material - for example, paper from recycled paper or polystyrene from polystyrene products, but the goal may also be to extract certain elements from complex products - for example, lead from car batteries or gold from computer boards, and also hazardous substances like mercury from thermometers.

The EU Waste Directive prescribes the separate

collection of at least four fractions of municipal solid waste - glass, paper, metal and plastic. In doing so, different national legislation can carry out an even more thorough sorting of waste. The collection of "recycled" at the municipal level is plastic or metal containers of various colors and / or inscriptions. As a rule, plastics are placed in yellow containers, paper and cardboard in blue containers, glass in green ones, metals in red ones, and gray (black) - waste that does not fall into any of the listed categories; sometimes brown biodegradable waste containers are installed. In addition, the so-called curbside waste collection is carried out in some countries. The service is provided to households in urban and suburban areas using special machines that work with small containers: this is the most automated way of collecting waste. The method differs from the general municipal one in its direct focus on households and is considered the most “clean” and effective. Garden greenery, kitchen waste, and, depending on location, office paper, newspapers, cardboard, fibreboard, glass, copper, aluminum and steel are removed.

Since the strategies for the implementation of EU directives are known to be determined at the national level and depend on many factors (levels of waste generation, technological capabilities, the development of tourism as a factor of waste accumulation, etc.), the results achieved in the recycling of municipal waste vary widely - from level (rounded off) 70% in Germany and 60% in Austria, Belgium, Switzerland and Sweden up to 2-10% in Serbia, Turkey, Slovakia and Malta. and by 2030, 65% of municipal waste was recycled or treated for reuse.

In theoretical studies, more and more attention is paid to the "economics of recycling". Two points in this regard are of particular importance: recycling a) turns waste into a resource and b) prevents the costs that society would incur if they were buried in landfills. In addition, this type of waste treatment creates additional jobs: it has been established that the removal of 10 tons of waste to the landfill creates 6 jobs, and the

recycling of the same 10 tons - 361. An additional economic effect is achieved when the processed waste is used “In place”, eliminating the need to import a given category of materials from other locations or other countries. Recycling, like no other waste management method, paves the way for tremendous resource savings. In the production of aluminum, it saves up to 95% of energy, copper - 85%, steel - 74%, lead - 65% 2. Glass can be recycled any number of times without loss of quality or purity, while acquiring a variety of shapes; at the same time, one ton of natural raw materials is saved for every ton of recycled glass. Hundreds of items are produced from plastic, depending on the type, up to the so-called high-tech fabrics and materials, from which durable (often sports or professional) clothing, shoes, bags, finishing, construction and construction materials, furniture (more often total tables, chairs and benches), toys; woven and non-woven textiles, packaging, beams, pipes and many other products. Recycling one ton of plastic saves 5,774 kWh of energy, 1,000–2,000 gallons of gasoline, 685 gallons of oil, and 48,000 gallons of water.

Various ways of using recycled plastics for road construction are being discussed in the professional community today. An ordinary asphalt road lasts a maximum of 50 years and constantly requires repairs - the Dutch company Volker-Wessels is now promoting the concept of a plastic “eternal road”, which will not take long to build, which requires a minimum of maintenance and is safe at the same time. The basis of the project is modular plastic slabs with a hollow interior for rainwater drainage and the placement of communication cables. The modules being developed are resistant to temperature fluctuations from minus 40 to plus 80, they are able to withstand the same load as traditional asphalt, they are easy to transport, and the soil under such highways is less susceptible to subsidence.[4]

An important and not always easily solvable problem is the recycling of construction and demolition waste (hereinafter referred to as construction waste). Construction waste makes up one third of all waste controlled in the EU: in terms of composition, they are concrete, bricks, tiles, wood, glass, plastic, gypsum, bitumen mixtures and resins, metals (ferrous and non-ferrous), stones, insulating materials, chemical substances, packaging materials etc. In general, there are two ways to

[4] Source https://www.volkerwessels.com/en/projects/plasticroad

reduce construction waste. Experts suggest that instead of the traditional demolition of structures, practice their dismantling - "deconstruction", during which, as far as possible, the floor coverings, siding, window and door frames, whole bricks, plumbing units, etc. would be preserved. - everything that, to one degree or another, can be used in new construction. Since the dismantling process is more labor intensive and requires much more manual labor than conventional demolition, new jobs could be created here. During construction, it is recommended that contractors are required to provide a detailed plan for waste reduction, reuse or recycling.

Back in the late 1990s, the EU embarked on a course towards a radical reduction of biodegradable waste. Composting is the ideal way to recycle organic kitchen, garden and agricultural waste. Today, composting theory has become a well-developed subject area of science, but in practice a variety of systems are used - from industrial composting technologies to home (garden) composters. Large production facilities (composter plants) are also covered by the European Compost Network, which has 72 associate members from 27 EU countries and serving over 3000 enterprises. “Best Practices” are widely promoted, of which we note the following.

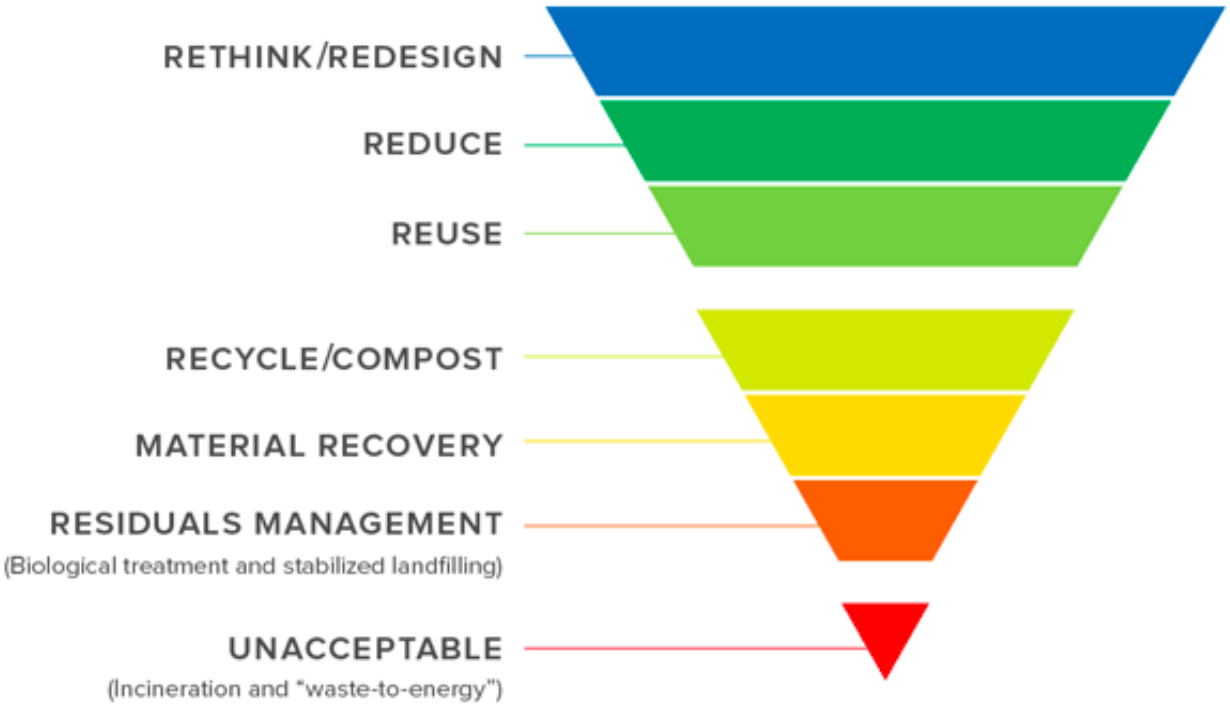
For example, home composting in Italy (Piedmont). The project, which has been implemented since 2004 under the general leadership of a “public consortium”, has covered 19 local communes. The program had three goals in mind: to improve the waste collection system, to reduce waste generation and to reduce the fees charged to households for collecting waste. Promotion of the project included such activities as arranging exhibitions, outreach work with local municipalities and public organizations, schools and families. Special courses taught various composting techniques, distributed technical documentation and distributed relevant manuals free of charge. Each household was provided with special equipment. A network of “eco-volunteers” has been formed, actively participating in the project; all the work was served by his own website. As a result, up to 80% of households in communes began to use the methods of “selective” collection of food waste; 90% of households, as shown by the analysis, have mastered the methods of home composting "at the proper level"; household waste collection fees have declined across the board.

The next level of the “waste management hierarchy” defined by the directive 2008/98 / EC is “other uses”. Most often, the issues of waste processing for energy purposes are considered here - for the production of electricity and / or heat: in the EU documents and scientific literature, all this is covered by the term "waste-to-energy". The physical basis of the technologies used in this area is incineration - waste incineration in special installations.

In modern incinerators, a 95% incineration rate is achieved, which greatly relieves another area of waste management - landfill disposal. At the same time, the unburned residue no longer contains rotting organic substances, which are associated with the danger of epidemics and spontaneous combustion. In a number of EU countries - Germany, Belgium, Sweden, the Netherlands, Austria and Denmark - the percentage of waste sent to landfills is now in the range of 1-2%; at the same time, 35–50% of waste is incinerated in one way or another, and 50–60% is recycled and composted; In all these countries, landfill disposal without preliminary treatment is legally prohibited. In other countries, the same problems are solved through increasing taxes on landfills.

The principle applies: everything that is possible must be recycled, and if recycling is not possible (due to the quality or composition of the waste), it must be converted into energy, but not buried in landfills. Apart from the high level of initial investment costs, a number of factors make waste-to-energy economics a highly profitable industry: municipal solid waste is a fuel comparable to peat and some brands of brown coal; it, this fuel, is formed in places where energy is most in demand, i.e. around major cities, and has a predictable renewal. In this situation, the growth rate of venture capital and investment in this area in the EU has recently reached 200% per year.

Thus, the waste hierarchy can be represented as follows:



RETHINK/ REDESIGN	Design and order items that are durable, repairable, reusable, completely recyclable or compostable, and easily disassembled from reclaimed, recycled, or sustainably harvested organic, non-toxic materials. Funds and financial benefits should be moved to endorse a Circular Economy** rather than the exploitation and use of virgin natural resources. Introduce new financial benefits for cyclical material use and disincentives for pollution. Facilitate the transition from "ownership" of resources to "sharing" of goods and services in order to meet end users' needs. Support and extend frameworks in which product manufacturers

	view the whole life cycle of their goods in accordance with the Zero Waste Hierarchy, resulting in more sustainable products and processes. In a scheme based on the Zero Waste Hierarchy, producers return their goods and packaging. Materials that pose issues with Closed Loop Systems should be identified and phased out. Encourage and sustain local economies by facilitating and implementing policies and programs. Evaluate the buying preferences and search at commodity ownership alternatives. Make knowledge available to allow informed decision-making. Recognize and oppose schemes that encourage unnecessary use.
REDUCE	Plan the perishables use and sales to reduce waste from spoilage and non-consumption. Use Sustainable Purchasing** to promote social and environmental goals, as well as small markets where possible. Reduce the volume of chemicals used and their toxicity. Reduce the environmental impact of the commodity, its use, and the availability of services. Choose goods that have a long useful life and can be reused again and again. Choose items made from materials that can be recycled repeatedly and effectively. Make the use of edible food for citizens a priority. Make the use of edible food for animals a priority.

REUSE	Get the most of your goods and supplies by reusing them as much as possible. Maintain, restore, or refurbish to preserve the value**, utility, and function of the object. Dismantle and save “spare” parts for restoring and preserving still-in-use products; remanufacture from disassembled parts. Repurpose goods for new purposes.
RECYCLE/ COMPOST	Support and extend programs to retain products in the initial product loop and to ensure that they are used to their maximum potential. Maintain diversion programs that enhance and optimize the use of all products, including organics. Recycle and bring materials to the best possible use. Wherever feasible, develop resilient local markets and uses for collected materials. Incentivize the development of clean compost and recycled feedstock flows. Composting should be encouraged and expanded as close to the generator as possible (prioritizing home or on site or local composting wherever possible). If home/decentralized composting isn't an alternative, try commercial composting, or anaerobic digestion if local conditions require/allow it.
MATERIAL RECOVERY	After extensive source isolation, maximize materials recovery from mixed discards and for testing purposes. Only use systems that run at Biological Temperature and Pressure**

	to recover energy if conditions warrant.
RESIDUALS MANAGEMENT	Examine the products that exist and use this knowledge to strengthen the processes for rethinking, minimizing, reusing, and recycling to eliminate further waste. Biological stability of fermentable materials will guarantee that impacts are reduced. Encourage environmental management and avoid destructive disposal or dispersal. Plan for changes in processes and facilities as discards decrease and the distribution of the waste changes. Reduce gas demand and release thus increasing gas collection Make the most of existing landfill capacity by extending its existence. Make sure it's being managed responsibly. Toxic residuals must be contained and managed responsibly.
UNACCEPTABLE	Supporting programs and structures that promote the Destructive Waste of organics and/or the degradation of recyclables is not a smart idea. Supporting resources and Destructive Disposal schemes that are reliant on the continuous processing of waste is not a good idea. Discards should not be incinerated. Toxic residues should not be allowed to enter consumer goods or construction materials.

Guiding Questions

7 Rs	Guiding Question
Rethink / Redesign	What has contributed to our current linear material usage

	and, as a result, what needs to change in order to transition towards a closed loop model?
Reduce	How do we redesign processes to reduce excessive and/or unwanted consumption?
Reuse	What evidence exists to justify the use of fewer and less hazardous materials?
Recycle/Compost	What inspires us to make more use of the goods we already possess in ways that maintain their worth, utility, and function?
Material Recovery	How do we guarantee the materials are returned to the materials cycle?
Residuals Management	What was found in the mixed waste?
Unacceptable / Regulation	What's left and why is it still there?

Guiding Principles

Guiding Principle	Definition
System with a Closed Loop	Develop structures that employ services in a closed loop rather than a linear fashion.
DO NOT EXPORT HARMLESS ENERGY FROM Near TO THE SOURCE	Processes should take place as close to the source as possible.
Engage the Group to the	Through minimizing waste, reusing goods, recycling, and

Fullest and Best of Your Ability	composting, more electricity can be saved and global warming effects avoided than by burning waste or recovering landfill gases.
Improvement & Information	Avoid shipping harmful or potentially hazardous waste or products to emerging countries, as well as materials with restricted, unknown recycling markets that would be landfilled or incinerated in a different country.
Local Business Environments	Changes and processes that interact with groups to encourage positive and long-term engagement, improve empathy, and affect attitudes and expectations should be encouraged.
Resources are Materials.	Creating and retaining goods and resources for a purpose that is as high in the hierarchy as possible and as long as possible in the functional cycle. Keeping products from being downcycled because there are few potential applications or choices.
Discharges should be kept to a minimum.	Gather data on processes and use it as a source of input for performance development.
Costs of Opportunity	To minimize greenhouse gas emissions from transportation, strengthen transparency, and expand repair and parts opportunities, encourage the development and expansion of local economies (production, repair, and processing).
Principle of Precaution	Until extracting raw natural resources, save supplies for future use and make use of used materials.
The polluter is kept accountable.	Reduce any discharges to soil, sea, or air that could threaten planetary, human, animal, or plant health,

	including greenhouse gas pollution.
Systems that are long-term	Consider investment incentive costs and position investments as far in the Hierarchy as possible.
System with a Closed Loop	Ensure that a drug or behavior that poses a risk to the environment is not allowed to have a negative impact on the environment, even though there is no definitive empirical evidence linking the substance or activity to environmental damage.
DO NOT EXPORT HARMLESS ENERGY FROM Near TO THE SOURCE	To allow companies to internalize environmental costs and incorporate them in commodity prices, whoever causes environmental destruction or resource depletion should bear the "absolute cost."
Engage the Group to the Fullest and Best of Your Ability	Develop structures that are adaptable, modular, scalable, resilient, and appropriate to the constraints of local ecosystems.

The policy aspects for bio-waste management at EU level can be summarized as follows:

1. The European Directive (EU) 2018/851, also known as the Latest Waste Framework Directive (WFD), requires the division of bio-waste collection as of January 1, 2024, as part of the 'Circular Economy Package.' It amends article 22 of the WFD to include a European Union-wide duty to introduce bio-waste collection.

2. A major concern is high-quality recycling. The assessment of recycling rates to determine compliance with EU goals (65% "preparation for reuse and recycling," i.e. net recycling including sustainable recycling, by 2035) would have to exclude rejects, which are directly linked to impurities found in split fractions; this places a premium on collection systems that can guarantee good quality of collected materials.

3. In addition to the Circular Economy vision and policy, other environmental drivers are driving interest in the isolation, recycling, and reuse of bio-waste; in summary, they are:

3.1 Land use changes, new farming practices, and climate change are forcing Europe's soils to loss organic matter at an alarming rate. Nearly half of European soil has low organic matter content, limiting its ability to hold water and nutrients while still storing carbon. This, in turn, limits the land's fertility and farmers' ability to grow crops. Compost is made from accumulated bio-waste, and it can be a valuable source of healthy organic matter. As a result of this process, a mixture of organic carbon compounds is produced, which contributes to the carbon pool in the soil.

3.2 Repeated applications of compost can help enhance soil functions such as composition, microbial diversity, and water retaining capability by increasing soil organic matter content. These factors are significant in the long and short terms, and they can help to deter deforestation, eutrophication, and desertification:

3.3 In recent years, strategies to combat climate change have emphasized the capacity for carbon "sequestration" in soils linked to the use of soil improvers. The EU's "Soils and Climate Change"2 study emphasized the crucial role of carbon reservoirs in soils in the global carbon balance, as well as the ability for sequestration to offset climate change. The IPCC repeated these points in one of its most recent reports3, urging lawmakers to conserve and raise soil organic matter (through measures that include organic fertilisation).

3.4 The updated WFD, as well as other EU regulations, mandate EU Member States to encourage the use of bio-waste-derived products. This substance includes useful compounds that could be used as bio-based feedstock. The use of these bio-waste sources as feedstock and conversion into value-added applications is still in its infancy.

All of this leads to a greater emphasis on bio-waste isolation, recycling, and recovery at the global level. This creates a "potential bio-waste tonnage" that could become available for recycling in the future, but is currently largely untapped. In

addition to country-specific estimates, the following parts would include calculations of such "untapped capacity" at the EU level.

Only a well differentiated management of bio-waste can meet the goals of recycling and limiting waste landfilling.

Changes to the “TEEP” provisions (article 10) in order to restrict and track certain situations that could be deemed exceptional. It has been shown that bio-waste management is feasible in any territory and setting (broadly speaking).

The Waste Framework Directive (effective May 30, 2018) includes the following main elements for group and individual/home composting:

• By December 31, 2023, it will be mandatory to separate and recycle (treat) bio-waste at the source.

• In terms of the enforceability of handling bio-waste selectively, it equates composting with limited selection.

• Composting is a form of waste recycling that takes place on-site (so it is confirmed that the idea of framing it as a bio-waste prevention practice should be ignored). Furthermore, the tonnes handled by home and group composting must be factored into the waste recycling concept in terms of achieving targets.

• Member states must take action to facilitate and encourage composting at home and in cities.

• Composting recycling systems must have a high degree of environmental conservation and yield production that meets applicable high-quality requirements. Such requirements must also be met while composting at home.

According to Article 22 member states shall ensure that, by 31 December 2023 and subject to Article 10(2) and (3), bio-waste is either separated and recycled at source, or is collected selectively and is not mixed with other types of waste.Member States may allow waste with similar biodegradability and

compostability properties which complies with relevant European standards or any equivalent national standards for packaging recoverable through composting and biodegradation, to be collected together with bio-waste.

Member States shall take measures in accordance with Articles 4 and 13, to:

(a) encourage the recycling, including composting and digestion, of bio-waste in a way that fulfils a high level of environment protection and results in output which meets relevant high- quality standards;

(b) encourage home composting; and

(c) promote the use of materials produced from bio-waste.

By 31 December 2018, the Commission shall request the European standardisation organisations to develop European standards for bio-waste entering organic recycling processes, for compost and for digestate, based on best available practices.'

4.Glossary

Term	Definition
Biological Temperature and Pressure	Temperature and pressure that occur naturally without the use of additional energy, or that do not exceed 100 degrees Celsius or 212 degrees Fahrenheit in any case. Unless elevated temperatures are used as a pretreatment (e.g., to manage viruses or kill pathogens), not to exceed 150 degrees Celsius, to be composted or anaerobic digested later.
Circular Economy	A restorative industrial economy with two types of material flows: biological nutrients engineered to safely re-enter the biosphere and technical nutrients that circulate at high quality without entering the biosphere. Materials are mostly reused rather than recycled.
Closed Loop System	In comparison to an open loop system, which allows information to flow in and out, a closed loop system does not rely on matter sharing outside of the system.
Destructive Disposal	Landfills or incinerators are used to dispose of waste goods.

Diversion	A precaution taken to discourage a product from being disposed of in a detrimental fashion.
Incineration	Incineration is a type of Destructive Disposal that involves burning or thermally converting discarded materials into ash/slag, syngas, flue gas, fuel, or heat at temperatures above 100 degrees Celsius. Incineration refers to fixed or mobile facilities and structures that recover energy from heat or electricity and operate in one or more phases. Any of the words used to characterize incineration are resource recycling, energy reuse, garbage to steam, waste to energy, energy from waste, fluidized bed, catalytic cracking, manure, steam electric power plant (burning waste), pyrolysis, thermolysis, gasification, plasma arc, thermal depolymerization, or refuse based fuel.
Minimize Gas Production and Release	This involves removing as many source-separated organics from landfills as possible, as well as chemically stabilizing those that do. In existing landfill cells that also contain unstabilized organics, gas production can be decreased by keeping rainwater out and not recirculating leachate. Reduce

	methane emissions by covering closed cells indefinitely and installing gas storage facilities within months of their closure (not years). Hold suction on collection wells tight and don't dampen or rotate them off to induce methane leakage. The gaseous toxins are filtered into a stable medium, which is then containerized and stored on site. This is not a renewable energy outlet, it should be remembered.
Problematic for a Closed Loop System	Materials that find it impossible to recycle or compost the materials or other materials. Chemical contaminants (for example, such biodegradable plastics or labels on fruits and vegetables) or chemicals that clog manufacturing systems are possible (like plastic bags).
Responsibly Managed Landfills	Manage landfills to minimize discharges to land, water, and air that damage the planet's, people's, animals, and plants' health. Closing plans and financial obligations must be included.
Sustainable Purchasing	The buying of goods and services that takes into account their economic worth (price, expense, supply, and functionality) as well as their local, regional, and global

	environmental and social impacts.
Value	Something's economic, social, environmental, or nostalgic worth, utility, or importance.
Individual or home composting	Treatment of bio-waste created by individuals or families in their own houses, terraces, plantations, vegetable gardens, and so on, using the composting method. It implies that the compost produced would be used in a specific way.
Community (or collective) composting	Composting-at-source is a technique for handling bio-waste created by multiple people, households, or generators in a single module, within a common area with a common intent.
Restricted in situ modular composting for large or singular generators	Composting-at-source is a technique that allows bio-waste produced by a single person or operation to be handled together by composting in a region or site on the generator's property.
Municipal/communal composting	Composting is a technique for treating organic waste that is created in a location, community, neighborhood, municipality, or other location.
Supramunicipal composting	Composting is used to handle bio-waste produced in many neighboring municipalities, in a district or county, and so on, in a single facility of limited space and simple technology.

Technical unit of community composting	Set of facilities or equipment used to build the entire neighborhood composting process, including all phases and structuring material storage.
Information/awareness campaigns	Acts and events aimed at local citizens in terms of communication and distribution. Their aim is to reveal the core features and functions of the current bio-waste management model, as well as to answer questions and solicit public feedback in order to improve its performance.
Module	The bio-waste is deposited through the upper part of the cell and then removed through the side or front part until it has been filled to begin the maturation process in another module or region. A group composting site is created by integrating multiple components. When a module is designated to accept waste feedback from consumers, it is referred to as an input module.
Community composting sites	The shared composting modules, in which many families or generators handle their self-generated bio-waste, are located here. Users' access to them may be unrestricted or limited.
Community site for home composting	One or more Technical Units of Community Composting can be found at a community composting facility.
In situ modular composting sites for large generators	Each family has its own composter, which is used solely for the treatment

	of bio-waste.
Composting rods of their own	Commercial composter made of recycled plastic with rods connecting the individual pieces. Each of them is treated as a separate Module on the group composting scale.
Hut composters	Hut composters are a form of wood-based community composter with four modules: two for input and two for maturation. For bulking stuff, they typically have an annexed storage area.
Modular slatted composter	A group composter of removable wood-plastic slats to render operating procedures and, in particular, transfers simpler. The modules may be linked to build composting sites with differing treatment capacities by sharing walls.
Bulking/complementary material	Woody or ligneous plant material that enables air circulation in the blend, avoids compacting, supplies carbon, and controls moisture when combined with bio-waste in appropriate amounts. It is critical to supply it in sufficient quantities to ensure the proper conditions for the composting process.
Master composter	Technical person in charge of tracking the composting process and managing each composting point or location. It is also effective at energizing and educating participants.
Turning	Periodic material mixing is

	performed with the aim of regaining matrix porosity and thereby maintaining aeration, homogenization of bio-waste and the structuring material, and optimization of the moisture level of the mixture.
Watering	Homogeneous water input to the entire volume of the products mixture being treated, guaranteeing optimum moisture levels and degradative biological behavior of the microorganisms responsible for the composting method. The content is usually turned after watering to ensure that the supplied water is spread as uniformly as possible.
Transfer	When the first module has been loaded with the participants' inputs, the information being transferred is transferred from one module to another.
Sampling	Extraction of a minimum representative quantity of substance from multiple points in order to study and/or test it later.
Traceability	On the one side, a set of protocols ensuring the follow-up of the compost processing process at each of its phases, and on the other hand, the applied maintenance tasks. In the case of group composting, the composting site's operating procedure must provide certain instructions for

	properly identifying all materials during the various stages of the process, as well as ensuring that the prescribed process requirements and duration are followed.
Batch	Set of bio-waste for composting that is physically isolated from the rest of the waste. It is required to have identical conditions all over, and it is handled at the same time and under the same conditions in the process. The mixing of sub-batches may occur during and/or after the process, depending on the model of composting sites and organizational nature, in order to gradually produce a final batch consisting of multiple batches from the same site, location, or even municipality.
Sanitation	Pathogen microorganisms and viable seeds are decreased to appropriate amounts due to the effect of process conditions (primarily temperature and time) on the presence of pathogen microorganisms and viable seeds.
Follow-up visits	Examinations at neighborhood composting sites on a regular basis in order to track, follow-up, and record them. They are carried out by the site's responsible technicians with the aim of testing the condition of the composting operation and recording the tracking criteria.
Maintenance visits	Periodic inspections of group

	composting sites by conscientious technicians to perform various operating tasks such as turning, watering, input of structuring material, and so on, with the goal of ensuring proper process conditions and allowing correction of deviations if necessary.
Audits	An impartial inspector inspects or verifies the location of a group composting site in order to ensure that the specified regulatory standards are met, both in terms of the model's architecture and its operating procedure.
Transparency	Transparency is essential. Both registries and data resulting from the operation of the group composting site are open to the administration, users, and other stakeholders.
Database	Compilation of all recorded data resulting from the service of the group composting site in a standard format.
GHG emissions (greenhouse gases)	Gases that could be created as a result of improper composting conditions that have the potential to contribute to climate change (N2O and CH4). CO2-equivalent units are used in their formulation. Since the CO2 emitted during the process comes from biogenic sources, it is not taken into account.
Bio-waste	Garden and park waste that is

	biodegradable, food and kitchen waste from homes, offices, restaurants, wholesale, canteens, caterers, and retail establishments, and comparable waste from food processing plants (as specified by the Waste Framework Directive, as amended by Directive (EU) 2018/851).
Waste management	Collection of operations aimed at steering waste to the most suitable destination depending on its characteristics, in order to minimize harm to people and the environment. It includes the collection, transportation, recovery (including sorting), and disposal of waste, as well as the supervision of such operations and the after-care of disposal sites (as specified by the Waste Framework Directive as amended by Directive (EU) 2018/851).
Risk	Possibility or probability that handling, releasing into the atmosphere, and being exposed to products or waste have harmful impacts on human health, other living beings, water, air, and soil, habitats, and goods and resources held by people.

5. Bio-waste organizational models that are currently in use

Current organizational models for capturing bio-waste (with an emphasis on food waste/kitchen waste) have been considered, with a focus on efficiency in terms of collection, as demonstrated by evidence and sectoral studies.

A study of organizational practice reveals many bio-waste disposal techniques, which can be categorized as follows:

- In some countries, such as most of Denmark, certain parts of the Baltic states, and most of France, almost no food waste is collected separately for composting or digestion, though municipalities do collect garden waste separately.

- Separate storage of bio-waste takes place using biobins, or biotonnen, usually wheeled bins where garden and food waste are gathered commingled in Belgium, the Netherlands, Austria, and Germany, both of which have historically rated among the best performers for both bio-waste processing and recycling in general.

In certain countries, such as Belgium (Flanders) and the Netherlands, 'VGF waste collection' (vegetable, fruit, and garden waste), which includes meat and fish, is targeted. This results in a significant number of food scraps ending up in residual waste, as shown by the high concentrations of organics in residual waste.

All food waste products (Küchenabfälle) are aimed in Germany and Austria. Kitchen caddies are usually given to households for temporary collection and storage in the kitchen.

	FOOD WASTE IN MASS %	
	(Gusia, 2012)	(Hübsch and Adlwarth, 2017)
Residual waste	37	33
Biobin	42	34

Home composting	9	9
Feeding	4	6
Sewerage	8	14
Others		3

Table 1: distribution of food waste across different streams in Germany, summary findings

Many areas in Norway, Italy, and Spain (for example, Catalonia and the Basque Country) have a traditional collection scheme that focuses mostly on food waste, leaving garden waste as a separate fraction to be collected at civic amenity sites or through special collection rounds (at reduced frequency of collection so as to promote home composting to the largest possible extent). The simple idea is to keep surplus garden waste out of the recycling system by supplying small bins to households for food waste collection only. Caddies with paper or EN-13432 certified compostable bag liners are distributed to households. Additionally, the caddies are usually vented to facilitate evaporation of excess moisture to making the contents more manageable, increasing consumer friendliness. Because of the greater density of food scraps, they are usually collected in non-compacting (and therefore less expensive) trucks at a higher frequency, which increases interest in the program. Usually, such systems allow for the collection of 60-100 kg of food waste per capita per year.

• the city of Milan (1.37 million inhabitants, Europe's first city to protect 100% of the population with a food waste recycling system, collecting 103 kg per capita) as an indicator of scheme adoption in heavily populated cities;

• many other Catalan, Welsh, and Italian areas, as seen in the accompanying diagram.

Figure 1: Food waste capture in Italy, kg per capita (kg/ca), 2018[5]

[5] Source: ISPRA

An estimation based on typical EU-wide criteria will not be acceptable due to the wide variety of conditions in bio-waste management and significant variations in collection models. As a result, data for the EU27+ was extracted from country-specific calculations.

The theoretical capacity was calculated using a series of public reports and national results, with the following assumptions: Bio-waste was described as the amount of food waste and garden waste, with the following indicators:

The comparison data comes from a 2014 survey[6] on municipal food waste production (households + food service). These figures are country-specific and closely match projections from the EU-funded project FUSIONS, which arrive at an EU average of 113 ± 12 kg per capita. In any case, if more precise and accurate figures could be found at the national level, they were used. Table 3 shows the ideals that were chosen.

EU 27+	116.7	FRANCE	122.3	NETHERLANDS	111.8
AUSTRIA	118.5	GERMANY	94.4	NORWAY	78.8
BELGIUM	105.7	GREECE	142.7	POLAND	112.0
BULGARIA	80.2	HUNGARY	110.0	PORTUGAL	12.,2
CROATIA	84.4	IRELAND	118.2	ROMANIA	127.7
CYPRUS	79.8	ITALY	127.7	SLOVAKIA	84.4
CZECHIA	93.7	LATVIA	107.4	SLOVENIA	108.4
DENMARK	103.5	LITHUANIA	121.4	SPAIN	144.0
ESTONIA	111.8	LUXEMBOURG	118.3	SWEDEN	105.7
FINLAND	102.0	MALTA	113.3	UK	118.1

Table 2. Adopted unit values for generation of food waste

6 Bräutigam, K.-R., Jörissen, J., Priefer, C. The extent of food waste generation across EU-27: Different calculation methods and the reliability of their results (2014) Waste Management and Research, 32 (8), pp. 683-694

The following table illustrates how the possible maximum generation was estimated, taking into account the proportion of the population living in towns, suburbs, and rural areas (from EUROSTAT). However, since real national statistics diverged greatly from the effects of this estimate, they were considered and adopted.

	NORTHERN AND CONTINENTAL CLIMATE	MEDITERRANEAN CLIMATE
CITIES	40	10
TOWNS AND SUBURBS	160	50
RURAL	200	100

Table 3: Assumed unit values (kg/person.year) for generation of garden waste in various housing/climatic conditions

These criteria were then used to approximate the contribution of garden waste to overall bio-waste theoretical capacity using the following population distribution in different countries.

		FOOD WASTE GENERATION (THEORETICAL POTENTIAL)		BIO-WASTE GENERATION (THEORETICAL POTENTIAL)
	POPULATION, JAN 2019 (EUROSTAT)	ADOPTED UNIT VALUE Kgs/person/year	TONNAGE	BIO-WASTE (tonnes)
EU 27+	**513,481,690**	**116.7**	**59,938,718**	**113,816,770**
AUSTRIA	8,858,775	118.5	1,049,986	2,273,206
BELGIUM	11,467,923	105.7	1,212,159	2,745,650
BULGARIA	7,000,039	80.2	561,368	1,390,173
CROATIA	4,076,246	84.4	344,151	915,478
CYPRUS	875,898	79.8	69,901	103,728
CZECHIA	10,649,800	93.7	998,355	2,472,287
DENMARK	5,806,081	103.5	600,929	1,587,929
ESTONIA	1,324,820	111.8	148,153	1,587,929

FINLAND	5,517,919	102.0	562,898	1,251,314
FRANCE	67,028,048	122.3	8,199,668	15,982,965
GERMANY	83,019,213	94.4	7,834,000	18,264,534
GREECE	10,722,287	142.7	1,530,315	2,053,670
HUNGARY	9,772,756	110.0	1,075,121	2,383,107
IRELAND	4,904,226	118.2	579,621	1,153,415
ITALY	60,359,546	127.7	7,707,443	10,636,692
LATVIA	1,919,968	107.4	206,142	441,914
LITHUANIA	2,794,184	121.4	339,217	701,567
LUXEMBOURG	613,894	118.4	72,636	169,852
MALTA	493,559	55.934	55,934	62,933
NETHERLANDS	17,282,163	111.8	1,932,858	3,605,080
NORWAY	5,328,212	78.8	419,863	1,153,451
POLAND	37,972,812	112.0	4,251,877	9,378,206
PORTUGAL	10,276,617	127.2	1,307,414	2,510,189
ROMANIA	19,401,658	127.7	2,477,413	5,263,491
SLOVAKIA	5,450,421	84.4	460,170	1,279,042
SLOVENIA	2,080,908	108.4	225,520	548,644
SPAIN	46,934,632	144.0	6,758,587	8,761,288
SWEDEN	10,230,185	105.7	1,081,360	2,309,392

Table 4. Theoretical potential generation of food waste EU27+

It should be remembered that the theoretical capacity (potential generation) for food waste, which is the survey's main target, is just a theoretical objective. Any kind of separate compilation attempts to maximize catches, but it can never reach 100% of the content targeted. This is fair to assume, and it is contingent on the following reasons for food waste: • Errors/confussion in the actions of households and other waste producers: this is a component that can be constantly targeted through information and coordination, depending on the composition of e.g. residual waste to tell people what types of materials are most commonly improperly sorted (e.g. bones or shells, meat, food still attached to packaging).

• Errors in the collection scheme's architecture and implementation: for example, households leaving the city that can't wait for the next collection round.

While ancillary activities (such as drop-off sites at Municipal Recycling Centers) which help, the circumstances may be complex, so capture shortfalls must be agreed to some degree.

• Composting at home is becoming more common (which may be promoted to a larger extent in the near future). We found a more realistic aim, identifying a targeted "operational capacity" in accordance with best practices, since 100% capture would never be achieved. This can be set at about 85 percent of the theoretical potential8 based on evidence from long-standing and well-functioning systems in both villages and towns. Finally, we compared existing food scrap capture to ‘operational ability' to determine how much space for progress there is in food waste capture.

Garden waste was handled differently so urban recycling systems could strive for a lower catch rate. The basic premise is that if households produce garden waste, at least some of it can be handled in their own gardens by home composting, which can be supported by focused campaigns. Meanwhile, home composting schemes cannot fully eradicate kitchen waste, particularly in urban areas, which is why we set an 85 percent collection goal.

6. Composting process at community level

Composting for the disposal of agricultural waste has a range of benefits, one of which is its scalability. To put it another way, the same method will be used to transform the volume of organic materials produced in a single household as well as the hundreds of thousands of tonnes produced annually in a major city. Even if the biological mechanism is the same, the kinetics, evolution, and significance of physico-chemical parameters differ greatly based on the scale used.

Group composting is performed on a scale that refers to modular units (or modules) with a volume of around one cubic meter. Since some parameters of the mechanism are more susceptible to the surrounding conditions at such a scale, neighborhood composting sites need extra care.

There are two types of criteria in composting, depending on the phase:

-initial parameters, which control how the process begins and how successful it is in the first weeks;

-process evolution parameters, which decide the optimum conditions for the production of degradative biological behavior while preventing harmful environmental consequences.

In both types, there are conditions that must be closely controlled in order to ensure that the method progresses correctly. Each of these criteria is described in detail below, along with community-level requirements.

Original parameters[7]

Matrix or physical form The proper porosity of the materials mixture must be maintained from the start to allow air to pass into the interior of the mass.	
Scale of the particles Both the bulking content and the organic material to be composted are affected by this parameter. It has an effect on the biological process's ability to maintain heat, moisture balance, and carbon supply. The method cannot begin until the particle size is greater than 40 mm.	
Wetness It has an impact on the productivity of biological processes as well as the reduction of harmful environmental effects. During the initial process, as inputs occur, it is critical to keep this parameter about 50-60% to prevent leaching and to facilitate the start of microorganism operation.	

[7] Source https://zerowasteeurope.eu

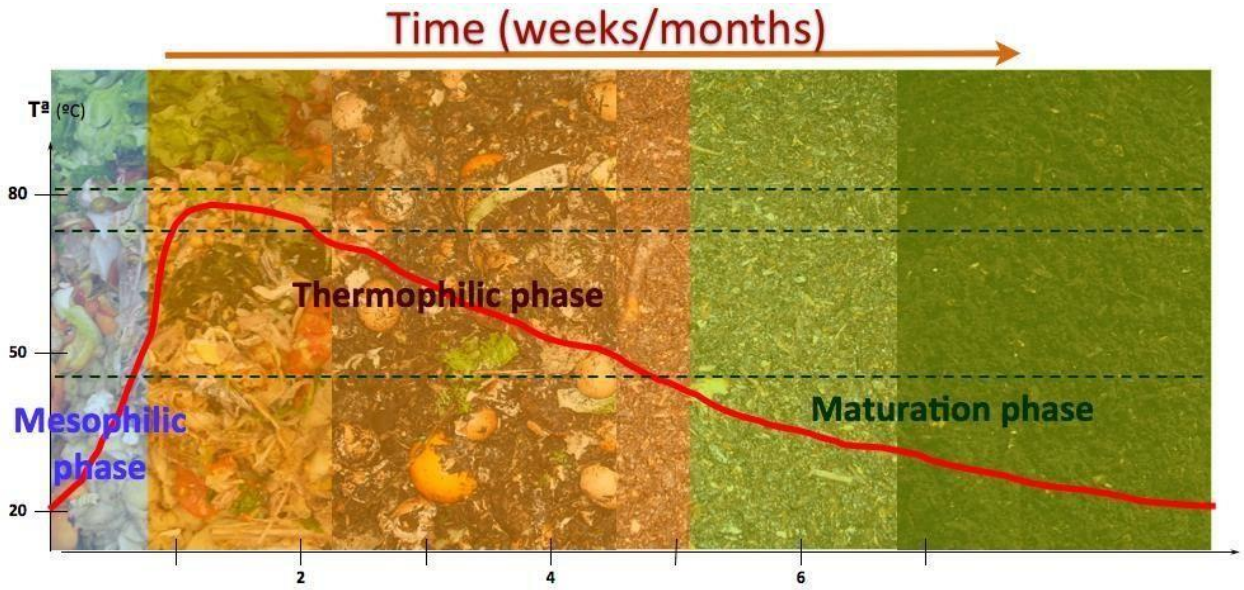
Ratio of surface to volume The heat produced at the start of the degradative process is preserved, allowing the temperature to steadily rise until it exceeds thermophilic conditions. The depletion of convection heat and content moisture is aided by a high surface/volume ratio. It is important that the frequency of fresh organic material input suits the volume of the composting module, as well as that the disposition of certain products in the module within the first days has a low surface/volume ratio.	
Carbon/nitrogen mixture that is biodegradable Also if the porosity and moisture are changed regardless of the initial input of structuring or complementary content, it might be important to consider a correction of the biodegradable carbon and nitrogen ratio, depending on the characteristics of bio-waste deposited in the composting modules.	

Parameters of the process Initial settings

Wetness The key reasons allowing a divergence from the optimum values of this parameter during the process period are the process volume, the products used by certain composters, and the exposure to environmental conditions. It is important to track it on a daily basis and correct it as soon as it deviates from the set of ideal values.	
Porosity The flow of air through the inside of the substance must be maintained at all times, according to the aerobic conditions of the operation. In passive ventilation systems, such as most group composting systems, this necessitates avoiding material compactions, especially in the composter's lower layers.	

Taking charge of this parameter includes a combination of an acceptable particle size, frequency, and turning intensity, as well as taking into account transfers in the operating procedure of the composting modules.	
Ratio of surface to volume The ability of this parameter to keep the temperature within thermophilic values is determined, once again, by the size of the operation. If the process continues, the volume reduction of the organic materials mixture will increase the surface/volume ratio, resulting in premature heat loss of the substance at periods of lower atmospheric temperatures, higher air relative moisture, or process maturation phases.	
Temperature Since this parameter determines the process phases, it must be tracked in a near-continuous manner over the duration of the operation. Adjusting and maintaining the other named parameters, as well as following the process protocol correctly, would enable thermophilic temperature values to be reached and maintained for long enough to ensure material sanitation.	

The composting process is broken down into three stages (mesophilic, thermophilic and maturation). These phases are specifically characterized by the temperature evolution of decomposing materials:



1. Mesophilic Phase: from room temperature to 45 °C. The amount that the original parameters of the process are modified to their desired values, often dependent on the needs of the organic materials to be composted, according to their characteristics, determines whether the temperature rises over a longer or shorter period of time.

2. Thermophilic phase: this phase of the process begins when the temperature exceeds 45 °C. The upper limit should be 70 degrees Celsius, since this temperature limits the variety of microorganisms that can intervene in the deterioration of organic matter, thereby reducing the biological process' effectiveness.

3. Maturation process: This is a slow cooling period with an unusually large number and variety of microorganisms in control. The length of this step will be determined by the amount of maturity and consistency required in the finished compost.

When applying the composting process to the local level, the phases of the process are dictated by the configuration of the composting site (primarily the number of modules), and this design, in turn, decides the operating or operational procedure.

Composting sites in communities have a lot of the same components.

The first factor to consider in the design of the sites is their venue. Points of convenient access and proximity to residents should be regarded in this respect. Composting sites are suggested as management models to replace or supplement the selective storage of bio-waste, but they must be placed using the same considerations as the organic fraction bins.

It's also crucial that they're properly dimensioned, so that the bio-waste input ratio matches the amount of usable composting modules. As a result, it would be possible to ensure that a treated mass of material is available to fulfill the specifications of the procedure (temperature, porosity, moisture...). Dimensioning is affected not only by the number of users, but even by other factors such as the composter model, the type of structuring/complementary material used, the operating procedure followed, and also the weather.

Both sites planned for the production of a group composting operation must have a set of common components, the number and distribution of which will be determined by each site's treatment capability and management model:

- Modules for composting.
- Having a place to store bulking materials.
- Intake point for water
- Thunderstorms.
- Instruments.

> "Dimensioning is influenced not only by the number of consumers, but also by factors such as the composter model, the amount of structuring/complementary material used, the operational procedure, and environmental conditions."

There are other facets of the sites that can be considered, but they are dependent on the neighborhood composting model's engagement and citizen awareness policy. They're all decorative elements:

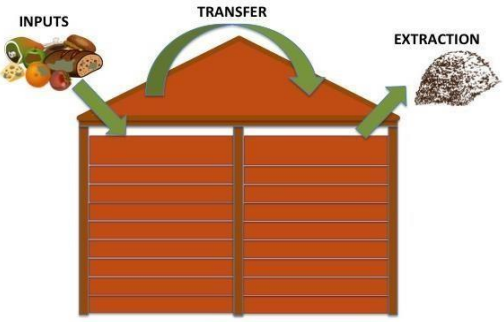
- A fence along the perimeter.
- Posters.
- A system for controlling entry.

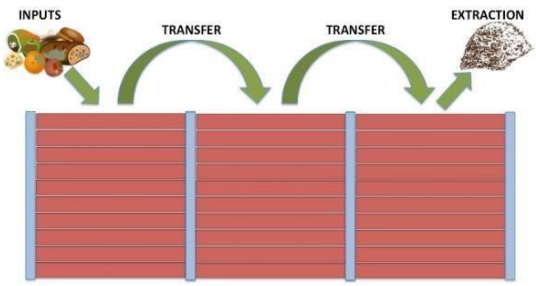
• A location where renewable waste can be deposited (trimmings, grass...).
• Proximity to selective storage bins, such as plastic bags, to promote the deposit of other fractions.

The amount of material transfers that are required to occur during the process is a crucial activity in the site design).

Without transfers, this method is generally correlated with the use of independentrod composters. These are small-scale static composting systems in which the waste to be composted is fed into the upper section and the stabilised material is extracted from the lower section. As a result, each composter serves as a separate room where the whole process takes place, including both the fermentation and maturation processes.

Despite the fact that it is not a valid model of group management—as seen in later sections—, after the composter is filled with the participants' inputs, it is closed and left without new inputs so that the maturation process will take place while a second composter is being filled. It is important to perform maintenance actions in the material of the closed composter to ensure that this maturation process is achieved, which does not always occur.





This complex composting system's operating model is focused on the fact that organic waste inputs are given in a first module. When it's complete, all of the output is moved to a second module, leaving the first one empty and open to new inputs.

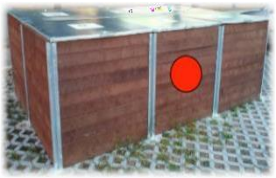
This method is similar to the previous one, with the exception that the material stored in the second module is moved to the third module until the first module is refilled. Following that, the content that has filled the first module is moved to the second, leaving the first one empty and ready to receive further inputs.

Two-transfer systems have proven to be the most effective, since they separate the various phases of the operation into separate spaces, allowing each phase's unique criteria to be met and controlled separately.

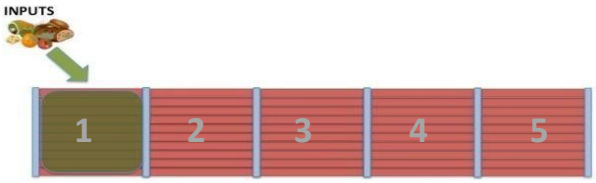
• Module 1: The first composter's filling stage (designated as the "input module") refers to the process's mesophilic phase and the start of the thermophilic phase.

• Module 2: After all of the material from the first composter has been moved to the second, the process is normally reactivated due to homogenization of the mixture, porosity recovery, and moisture correction. As a result, the thermophilic process of the project is still ongoing for this second composter. This increase in biological activity, and therefore temperature, is needed to ensure the sanitation of possible pathogens and the inactivation of viable seeds. The time spent in the second composter, as well as the process conditions, should be adequate for the material to achieve the minimum amount of maturity needed for end-of-waste status.

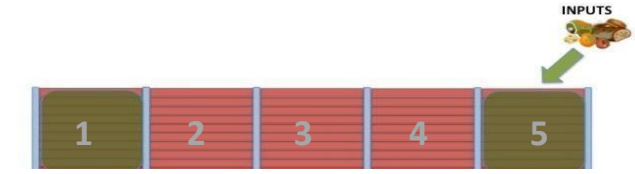
• Module 3: If the site has a third module, the maturation cycle could be prolonged there in order to improve the compost's stability.

			
Phase	Module 1	Module 2	Module 3
Mesophilic	✔	✖	✖
Thermophilic	✔	✔	✖
Maturation	✖	✔	✔

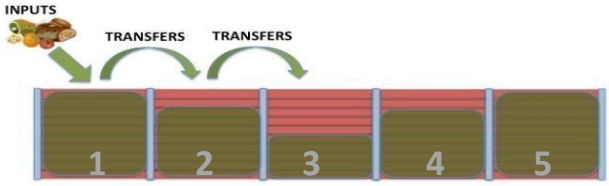
The number of modules per site varies depending on these two transitions, but most sites have three, five, six, or ten composting modules. The number of modules has a direct impact on process performance, but it also has an exponential impact on the composting site's treatment capability, since a good mix of input and maturation modules will improve residence times and process efficiency. The protocol for input and cumulative transfers that should be followed when running a site with five or ten modules (5 + 5) as seen on the next tab.



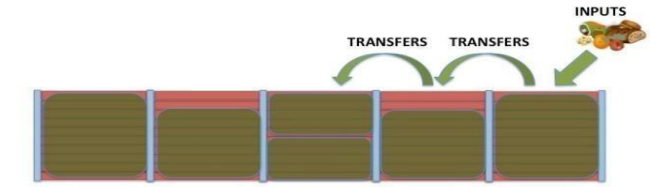
Start of inputs in module 1.



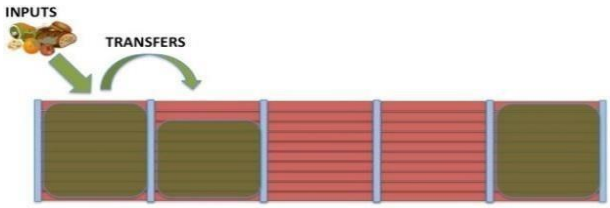
Once module 1 is filled, it closes and module 5 becomes the new input module.



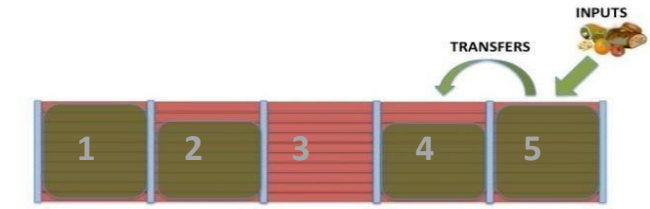
Closedown of module 5 once filled, transfer of material in module 1 to module 2, and module 1 becomes the input module again.



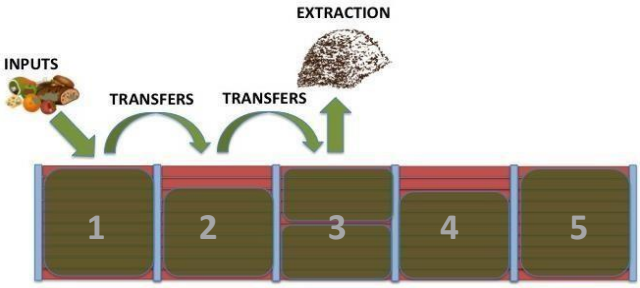
New closedown of module 1 once filled, transfer of material in module 5 to module 4, and module 5 becomes the input module again.



New closedown of module 5 once filled, material transfer from module 2 to 3 and from 1 to 2. Module 1 becomes input module again.



New closedown of module 1 once filled, material transfer from module 4 to 3 and from 5 to 4. New inputs in module 5.



Compost extraction from module 3. Closedown of module 5 once filled, material transfer from module 2 to 3 and from 1 to 2.Module 1 becomes input module again.

7. Waste materials accepted for community composting

The majority of community composting sites are solely dedicated to the treatment of so-called "bio-waste," or organic waste produced in the local area. However, the EWC codes in this group have a wide range of features, the most important of which are for composting. Seasonality, local gastronomy, environmental conditions, and other factors influence the organic waste composition in terms of moisture, purity, granulometry, and oxidisable carbon/nitrogen ratio, among other things.

EWC code	Description
20	Municipal wastes (household waste and similar commercial, industrialand institutional wastes).
2001	Separately collected fractions
200108	Biodegradable kitchen and canteen waste.
200138	Woodother than that mentioned in code 200137 (Wood containing dangerous substances).
2002	Garden and park wastes (including cemetery waste).
200201	Biodegradable waste.
2003	Other municipal wastes.
200302	Waste from markets.
Note: Under some conditions/authorizations, these EWC codes connected with large generators can be handled in a decentralized manner at this scale of process (community composting, captive composting for large generators, or municipal/community composting).	

Meat and seafood, which are waste referents with high protein content, are one of the most frequently asked questions about the types of organic materials that can be supplied to a composter; these considerations are also extended to any kind of cooked food. A vast number of home composting manuals have been written, warning new customers not to compost such waste, which has been

misinterpreted as a near-total ban or a process that should be avoided at all costs. However, since these materials allow for consistent temperatures for sanitation and pathogen removal at this rate, they must be used in community composting to maintain the operation running smoothly and improve the agronomic efficiency of the finished product.

The arguments for this stand against composting meat, fish, and even fried foods is based on the risks of excessive odors and animal interest during the process, as well as the fact that they would increase the conductivity of the resulting compost, preventing it from being used in the soil. Improper process conditions, mostly excess moisture and a lack of porosity in the materials mix, trigger this type of affection. Similarly, these affections all share one trait: a lower-than-necessary proportion of bulking or complementary material.

This material serves three purposes: (I) providing structure or porosity, (II) detecting excess moisture in organic waste by keeping the value of this parameter under process optimum limits, and (III) providing carbon to balance the nitrogen ratio available to microorganisms. As a consequence, the following aspects of the composting process are directly affected by protein organic waste inputs:

I Proteins are organic molecules that are readily degraded by microorganisms. As a result of their reliance on a rapidly degradable food source, they are likely to have higher oxidative biological activity and, as a result, a higher oxygen requirement. If this condition isn't met (due to a lack of porosity in the product mix), the available oxygen would be reduced to limiting thresholds, resulting in anaerobic processes. Certain gas compounds are produced as anaerobic microorganisms dominate the oxidation of organic matter in these environments, resulting in foul odors. That is the first reason why protein waste can always be composted with an appropriate proportion of structuring material, which contributes porosity to the mix, and a turning regime that retains porosity.

II The incorporation of protein materials in the waste mixture to be composted causes a strong hydrolysis of the organic matter degraded by microorganisms at the outset of the process, resulting in a higher degree of biological activity. This hydrolysis causes the breakdown of organic macromolecules and the release of water molecules preserved in their arrangements, as well as water output, in

biochemical reactions of organic matter degradation. As the thermophilic stage of the method starts, one of the first stuff that occurs is a huge water release in the phase where microorganisms are most involved biologically. "Metabolic water" is the name given to this kind of water. If the correct proportion of structuring or supplemental substance is not used to achieve this specific excess moisture, water may saturate the micropores of the materials mixture, reducing or completely covering the free space for air. As a result of this, and since this process already requires a large amount of oxygen, the process quickly enters anaerobic environments and produces gases that emit foul odors. In addition, if the excess water is not reduced, the process material will cool, raising the likelihood of animals entering and insect larvae emerging in this habitat. That is the second reason why, when composting high-protein waste, a good structuring material with a low moisture content must be added to the organic materials mixture in the appropriate proportion.

III Proteins are biochemical compounds that contain a considerable amount of nitrogen and are made up of amino acids. As a result, nitrogen is added into the composting process when protein-rich waste is fed to a composter, impacting the oxidisable carbon and nitrogen ratio (C/N ratio), which is one of the first parameters of the composting process. As a consequence of the nitrogen supply, the C/N ratio will drop, likely to values below the optimal equilibrium of both components.

Excess nitrogen is converted to ammonia (NH3), a reactive chemical, during protein degradation reactions, according to the biological mechanism. As a

consequence, if the C/N ratio is wrong at the start of the process, protein-rich waste composting will result in the volatilization of NH3, a compound that produces foul odors which is one of the reasons that animals are attracted to it. The primary carbon content of compostable organic waste mixtures comes from complementary material structuring, and a low C/N ratio caused by a disproportionate addition of protein materials is fixed by adding carbon to the initial mixture. The third explanation why a reasonable amount of structuring material is needed for composting high-protein waste is that it allows for the correction of the mixture's initial C/N ratio and the avoidance or minimization of NH3 volatilization.

As a result, the major effects of including meat and fish remains in the composting mixture are completely achievable provided there is an adequate proportion of structuring or supplemental material with the appropriate characteristics present (particle size, moisture, degradability, etc.). Obviously, this does not eliminate the value of adhering to the group composting site's operational and management rules, as well as the degradative process' consistency.

The existence of protein waste, or the input of all domestic organic waste to composting (in this case, community composting), is the safest way to guarantee that the solution reaches the appropriate temperature for sanitation of potential pollutants and the removal of viable weed seeds under the right conditions. If the process is more efficient, the compost can grow quicker and have a higher humification percentage, which is a measure of the product's agronomic quality.

Another question that has been posed in the past when protein content is added, as well as the input of cooked food, is that the resulting compost has a higher conductivity. While there is a correlation between these factors, other factors such as rainfall patterns, soil types, the source of the watering water, the operational and process control procedure, the input to compost of green waste from vegetables grown with a higher salt load, and so on are all closely related to compost conductivity. Compost conductivity has been related to the degree of compost maturity. In this respect, it should be noted that salinity (conductivity), which is exacerbated by the salts provided by the use of regenerated water when

watering, is the most important problem in preserving park and garden soils in urban areas.

Another similar feature of these models is how consumers gather bio-waste in their homes and move it to a nearby composting facility. We cannot believe that there is a single right answer for this element because the options are numerous. It all depends on the town's and/or local government's previous experience with bio-waste recycling restrictions and the use of compostable bags. The primary aim of the community composting model outlined in this paper is to make it a feasible complement to or complement to limited bio-waste production. In that context, public participation is intended to be maximized, within the correct dimensioning of each neighborhood composting area, in order to achieve the greatest amount of organic fraction, so an alternative for this fraction in terms of storage in households and transportation to the area with the highest participation must be sought. When deciding between the four most common choices, keep the following considerations in mind:

The participants do not carry any luggage. Bio-waste is collected at home and shipped to a local composting plant, where it is poured into the input composter directly. Since it prevents the use of bags (both plastic and compostable) and the waste that comes with them, it's a feature that can be sold and included throughout every model.

- Downsides: Since the buyer must return home to drop off the bin, the operation of transporting the organic fraction to the composter should be separate from the moment that they must leave home for any reason.

The participants are given polyethylene containers to use. It is a common model since it does not necessitate major lifestyle changes in most towns and cities. It is important in these cases that the composting site is near light packaging selective collection containers and that people are advised to dump the contents of the bag

rather than throwing it closed within the composter and put it in the closest light packaging selective collection jar.

- Disadvantage: each input necessitates the use of a plastic container, which is then discarded in the light packaging bin.Compostable bags are used by the participants. Only compostable bags that have been approved according to UNE-EN 13432 are suitable in this situation. They must be used in conjunction with aerated containers, as the simultaneous use of these components allows for a mass reduction during the period that bio-waste remains at home due to the combination of water evaporation and the start of the degradative process, preventing odour issues. The use of a closed bin prevents bio-waste from being ventilated or aerated, resulting in leachate accumulation, damage to the compostable bag, and unpleasant odors.

While these bags decay during the composting period, they are constructed to do so under harsh conditions, similar to those used in an industrial treatment facility, where the bags are manually opened and/or torn during the pre-treatment step to exchange their contents with the bulking waste, fragmenting them and exposing them to microscopic organisms' degradative action. When it comes to community composting, it's much more important that they're not only opened, but also fragmented so that bio-waste can be composted with them. Since the tenant is unable to tear the bag after emptying the contents into the bin, the master composter may have a new task. Since their deterioration is slower than that of bio-waste, they will pile up in the composter if thrown intact, making their handling impossible. If they are used, they can be disposed of in the composting site's bin after being dumped into the input composter.

- Drawbacks: Although they have a lower environmental impact than polyethylene bags, they must be treated with caution in order to benefit from their biodegradability. They are generally handled as trimmings so they must be ground or fragmented before being introduced for composting.

- Compostable bags designed especially for household composting scales are designed to be more readily degradable. They are more likely to break, according to our experience, while bio-waste is stored at home for many days, regardless of whether they are used in accordance with an aerated bin. Participants with a lower level of environmental awareness are more likely to have a negative reaction to it, and if they are not offered the option of using alternate types of bags to transport their bio-waste to the community composting site, they will abandon the model.

One of the most important aspects of the system's effectiveness is training both the users and the people in charge of the neighborhood composting sites. It must be connected to the original and subsequent initiatives in order to match composting to the needs of each form of group composting site. Both participants in this program must understand the steps should be taken for bio-waste separation and feedback, as well as the reasons for doing so.

It is vital that master composters or those in charge of the composting sites' upkeep and follow-up make professional visits on a frequent basis and that they have adequate realistic and scientific expertise to identify and recognize possible issues while introducing the requisite preventive and/or correction steps.

The opportunity to monitor the composting process has a significant impact on how effective it is at handling organic waste. In the case of group composting, the performance of the device, in terms of the “functioning” of composters or composting units, is largely determined by the following factors:

Factor	Considerations
Measurement	The number of participants, the type of composter, and the specifications of the domestic organic waste and other materials offered are all considerations to consider. Weak treatment capability planning results in non-optimization of process parameters, which encourages the emergence of complications and avoids the achievement of pre-determined targets.
Height of the load	The physical characteristics of the process material (particle size and porosity), as well as the fill level and, as a result, the composter load height, determine the needs in terms of turning, water absorption, bulking material, and so on.
The site's service	Every group composting site's operating procedure, as well as the frequency of technical and maintenance visits, must be tailored to the space and technical characteristics of the site.
Conditions of the process	Reasonable conditions in terms of certain parameters are required for proper biological degradation of organic matter: porosity, moisture, pH, oxidisable C/N ratio, particle size, and so on. The working procedure is essential for maintaining optimum process conditions that are often suited to the step of the content being composted.

Action plan

The following are the responsibilities of the master composters during the repair and follow-up trips to the neighborhood composting sites. It is recommended that at least one follow-up visit and two repair visits be made per week to ensure that the procedure is correctly developed and to respond in the event of an incident.

The responsible persons must conform to the realities of each town, and even adjust the initial prediction, when setting the visits schedule, as well as the frequency of the maintenance and follow-up visits, as the behaviors of the composting site users will be very different.

In either case, the liable people, the master composters, must be qualified and trained in order to better execute the tasks outlined below.

Temperature	It is the parameter that most clearly reflects the state of the process' biological function. It must be measured with a temperature probe (thermocouple or Pt100) in at least three different points of the mass: in the middle of the composter (theoretically, the most active position, or the place with the maximum temperature), in the transition region (theoretically, not as active, lower temperatures), and finally, next to the composter walls (theoretically the coldest place). Checking the temperatures diagonally is a good way to test it. This knowledge must be obtained in all of the site's modules, regardless of which process they are in. The air temperature must be reported before the temperature in the site's composters can be determined.
Moisture	The availability of a sufficient moisture level is needed for the composting process to continue. Excess moisture can drastically reduce the activity of aerobic microorganisms, resulting in odour issues. Low values stifle, if not outright hinder, biological behavior, and the mechanism comes to a halt. This parameter can be quantitatively analyzed in a laboratory from a standardized sample,

	but in the field, qualitative approaches are used to measure moisture levels and determine whether or not watering is needed. The so-called "fist measure" is the simplest way.
Porosity or degree of compaction	To ensure adequate air circulation within the mass, the composting matrix must have a minimum porosity. The moisture content and proportion of bulking material, as well as particle size, all affect material compaction. A proper proportion of bio-waste to bulking material, a homogeneous initial blend, and frequent turnings are used to achieve proper porosity. The waste that resides at the bottom of the composting module should be given special consideration, since the compaction effects are amplified there. Since the degree of compaction can only be calculated quantitatively in a lab, it is visually estimated in qualitative terms during turnings in the field.
Fill level	A tape measure is used to measure the distance between the surface of the process material within the composting module and the composter's upper limit. The fill level at any given time is the difference between this value and the total load height of the module.
Odour	When you come closer to the composting spot, look to see if there is something that can be smelled and what kind of odour it is. When it comes to content turnings, it's the same. If the odor indicates anaerobic operations, the appropriate steps must be taken to remedy the condition. It's important to remember the wind direction while inspecting the odour and the possible effects.
Incidences	Any time an incident is discovered in the composting site, it must be recorded and submitted to the appropriate authorities. In addition, the requisite disciplinary actions must be taken, which must be recorded.
Monitoring sheet	A follow-up sheet must be completed after or shortly after each tour. It will hold all of the data gathered and calculated in compliance with the operating protocol. Every input of structuring material, as well as the closedown of composters, must be

	documented on those papers. It's critical to photograph all related aspects, such as process occurrences, content condition, composting site defects, and so on.
Collection of bulking material	The drawers must be kept full of bulking material, which must be in good condition and of good quality. As a result, relying on logistics to get bulking content to each composting site is important. The following are features of strong bulking material: -The remains are woody materials, not herbaceous, and come straight from the trimming of branches and trees, with little prior care. -Trimming remains are sterile and different from all types of remains.
Registration	After the day's visits are completed, all details from the follow-up sheet must be entered into a registration scheme. This scheme would ensure that all bio-waste batches processed in the visited neighborhood composting sites are traceable.
Sample collection	When it's decided that a compost batch or sub-batch has to be tested, a representative sample of the specimen must be taken according to the protocol.

Process Checklist

Turnings	In the composter, the process content must be turned on a regular basis. Fermenting material needs more intensive and regular turnings, while maturing material requires less frequent spinning. It is advised that you use a long aerator with a spiral-shaped end for this process. The turnings' main goals are to restore matrix porosity and thereby ensure aeration of the material. Breaking lumps or clods of compacted material that may occur in

	the bio-waste and bulking material mixture to homogenize it. Both of the material's moisture levels are homogenized.
Watering	When the substance lacks moisture, it must be rewetted by watering the mixture. Watering should be performed slowly when turning the mixture to ensure the moisture is evenly distributed over the whole amount of material being recycled in the composter.
Input of bulking/ complementary material	An input of bulking material is needed to prevent extreme compaction or episodes of excessive moisture. It must be achieved during turnings to ensure that the mixture is homogeneous in the composter.
Emptying ofbins	If the community composting site counts on bins to throw the plastic bags where users transport their bio-waste, the materials thrown there must be emptied in each visit.

Whatever method and equipment is used to handle organic waste at a community level, regular visits must be made by anyone that has been qualified to operate the composting site and has realistic expertise that allows them to diagnose the process condition, ensure its effectiveness, and behave accordingly to prevent future incidents and affections throughout the surrounding. This number is often referred to as a "master composter" and is critical to the treatment model's effectiveness.

The need for workers in the growth of the community composting model opens the door to local job production, especially in isolated rural areas where the construction of new jobs is not the only benefit; thanks to this diversification of the rural economy, the population is encouraged to settle there.

Because of the type of operation that would be created, it may also be targeted at businesses and organizations who promote the inclusion of individuals who are at risk of social exclusion. In terms of how the local population embraces

the neighborhood composting model, the convergence of all factors—local jobs and social integration—is also an asset.

Their primary responsibilities are divided into two categories: technological and social.

TECHNICAL

The following are the activities that the master composter must accomplish during each visit:

• Take temperature readings in all of the site's modules where content is stored.

• Examine the moisture content of the materials processed in the same modules.

• Examine the process material's degree of compaction (or porosity).

• Check the amount of fill in the input modules.

• Inspect the neighborhood composting site for odours indicating poor operation and/or maintenance conditions.

• Track the site's status to spot any problems and take action to address them.

• Tours for maintenance. They can not be as regular as follow-up visits because they are linked to particular management and operating activities of the composters in order to ensure the process' effectiveness. The below are the key objectives of these visits:

• Composting modules' material turnings. The porosity and homogeneity of the materials, as well as their handling conditions, are thus assured.

• Watering the process content with a low moisture level in order to maintain the process' effectiveness.

• Materials are moved from one module to the next. During this process, it must be ensured that all transferred material receives the same moisture, homogeneity, and porosity conditions.

- Additional bulking or supplementary content input
- Sieving of the substance that has been considered to be done with the operation.

SOCIAL: The master composter is the visual face of the management model to the customers, as well as the point of contact for any questions, concerns, feedback, or grievances. Face-to-face contact is possible, but other communication systems, such as mobile, e-mail, a customer service office, social media, and so on, can also be used. One of the most critical responsibilities of the master composter is to be diligent in attending to certain individuals, energizing interest in the field, and encouraging the inclusion of new user.

The final product

Compost is a sanitized and stabilized substance obtained by aerobic and thermophilic biological decomposition under regulated conditions of allowed biodegradable organic materials that is often selectively collected, according to the rule. This description includes all of the aspects illustrated in various European regulations and rules.

The primary aim of using this compost is to promote public engagement and understanding in the fields of organic waste management and environmental conservation. This necessitates the use of compost in agriculture and gardening in the closest possible climate to where it was made. The proper treatment of organic matter becomes more apparent and patent for people in this manner. In any case, the municipal distribution of compost is not intended to be the subject of an economic enterprise, so its sale or commercialization is not seen as part of the neighborhood composting implementation plan. The following table shows the requirements that should be considered for the compost generated in this model:

GENERAL COMMUNITY (OR COLLECTIVE) COMPOSTING MODEL
The uses and analytical criteria considered would be defined by the product's mode of presentation and existing regulations at the time: 1. Bags of less than 1 kg: Since it is packaged in bags of less than 1 kg, its delivery and use are also excluded from meeting the national fertilisers regulation, so no research will be needed if it is used to "grow ornamental or flowering plants (domestic gardens and indoor plants)" in occupied homes or premises. This needs to be reported in the mark. It's an excellent alternative for environmental education programs and compost use promotion. 2. Bulk or bags weighing more than 1 kg: Its traceability must be guaranteed before it is put to use. Each dispersed lot should be connected to the accompanying documents, either physically or electronically. Such documents must provide the following details as specified by the regulations in effect at the time of its application: Fertiliser Registration Number (as a fertilizer). According to national rules, the batch and review numbers are assigned. There will be no limitations on use in this situation, but it cannot be used for private economic purposes. Traceability and annual review in compliance with national legislation act as the substrate. Use as a Substrate or Growing Media: Plants are grown in environments other than the natural soil. Those mentioned in the use of fertilizer as microbiological parameters are considered sufficient.

Compost characteristics

It should have a dark brown color, a homogeneous and loose look, and be free of non-organic materials such as glass, plastic, metal, and so on from an organoleptic standpoint. Furthermore, its properties must be durable over time in order to avoid undesirable odors or other issues associated with its extraction from composters with a poor level of stabilisation and/or maturity. It would be harmless to trees, wildlife, and humans in usual operating conditions.

Any type of compost must be accompanied by identifying documents that includes, at a minimum, the batch number, manufacturer, and origin, as well as information about the compost's composition, possible uses, and how to contact the maker.

Temperature documents must be included with each batch's reports to ensure that the composted content has been exposed to an active thermophilic phase for at least 14 days at 55°C. This condition is linked to adherence to the rules governing animal by-products (ABPs) that are not used by humans.

Distribution and storage

The finished compost must be kept dry and covered from the sun, wind, and rain, whether bagged or in bulk. To prevent possible pollution caused by human activities, the presence of livestock, and the proliferation of seeds of adventitious crops, access to compost would be limited.

Operation and usage guidelines

It can be used as follows in horticulture, fruit culture, and urban and domestic gardening:

1. fertilizer applied to the surface or buried in the first few centimeters of the soil, at a rate of 0 to 5 kg of compost per square meter, depending on the crop and edaphoclimatic conditions. Doses of more than 250 kg of nitrogen per hectare should not be applied to continuous surfaces of more than 5,000 m2.

8. Best practices

Waste management policies and practices are described below in four countries - Sweden, Germany, Denmark and the Netherlands. Since the general European content of this policy is quite universal, the emphasis is placed on the national specifics of the prevailing in this area. The choice of countries is dictated by their own considerations. The countries under consideration use the most active - at the level of the "national idea" - state environmental policy, one way or another reflected in the practice of waste management. The experience of the more southerly EU countries - for example, France or Italy - also deserves attention, but along the southern gradient of Europe there are too large regional and regional differences in how one or another environmental and sanitary problems of society are solved: the most striking example in this regard is Italy. The “more northern” countries highlighted for consideration avoid such differences and in this sense are holistic and consistent “case studies” that identify the most modern waste management practices.

Sweden

Due to the fact that, obviously, it should be understood as the peculiarities of the national culture, Sweden embarked on the path of creating a centralized waste management system very early - immediately in the post-war period. In 1947, Avfall Sverige, the Swedish Waste Management Association, was formed, today with 400 collective members and through them representing 99.9% of the country's population. During the 1970s, the foundations of modern legislation in this area were formed. In 1972, the Riksdag made municipalities responsible for the collection and disposal of household waste; In 1975, a program of state support for the construction of thermal power plants operating on waste was launched. In parallel with the development of waste incineration, the promotion of recycling began: in this case, the authorities, firstly, were guided by the idea of reducing landfills and, secondly, they met the requirements of ecologists who were always critical of “simple” incineration. Municipalities have been given the responsibility to plan ahead for waste treatment on their territory so that they can be used as a resource and at the same time do not pollute the environment.

In order to reduce landfills, the Riksdag introduced a tax on landfill disposal in 2000, banned the disposal of explosive wastes in 2002, and organic waste in 2005; later, a tax was imposed on household waste incineration. In the following years, an increasingly widespread transfer of the national waste management system to market principles began - with the abandonment of the practice of exclusive waste treatment at the municipal level. Today, when the “resource-based” approach to the problem has been established, municipalities collect only a quarter of the generated waste, and three quarters - private companies.

A system of division of responsibility for waste collection and treatment is in place. Households (municipalities) are responsible for the separate collection and placement of waste in appropriate containers; collection points are usually within 300 m of any household. The owners of houses and apartments pay on average about 2,000 SEK per year for garbage collection (the average salary in the country is about 30,600 kronor per month). Different fractions are taken out on different days of the week, so that every morning residents of private houses and apartments take out in containers exactly the waste that will be removed in the near future (which also facilitates municipal control over the entire process). The number of factions differs from municipality to municipality and can be up to 10-15. The local authorities are also responsible for the collection of waste generated by cafes, restaurants, shops, institutions, etc. "Roadside garbage collection" is also organized.

Depending on the profile of their activity, Swedish manufacturers are responsible for organizing the systems and procedures for collecting “their waste” - waste paper, packaging, electrical and electronic waste, cars, tires, batteries and pharmaceutical products; in doing so, they must provide consumers with relevant information. Finally, there is the responsibility of all kinds of business structures: they collect everything else - that is not collected by households and producers.

Linkoping, located in the south of Sweden, is the fifth largest city in the country. This is where Biogas AB and its plant, which produces biogas from local organic waste, are located. In the past, the city was on the verge of an environmental disaster: smog, soot-covered buildings, and a high level of air pollution were common here. The authorities saw the solution to the problem in the

development of the biogas industry, and in 1995 a pilot project for the production of biogas was launched here. Today it is the largest enterprise in the world and Linkoping has become synonymous with the "biogasification" of a modern city. The plant annually processes 2000 tons of animal manure and 36,000 tons of other organic waste generated by local food industry enterprises - fats, vegetables, slaughterhouse waste. The potential processing capacity of the enterprise is 100,000 tons. The plant is built according to the latest technology: waste is fed through an underground pipeline 1.7 km long; another pipeline supplies the prepared gas for distribution at filling stations.

The biogas produced by the plant is used by up to 100 buses in the city (in fact, the entire city public transport), the bulk of freight and a significant part of light transport, including city taxis. The pinnacle of Linköping's innovation was the launch of the world's first biogas train to neighboring Westerwik. Located in the center of Sweden, Örebro, the country's seventh largest city, began production of transport gas in 2007. Half of the gas produced today goes to the local bus fleet serving both urban and suburban rural routes, the other half to municipal gas stations and Stockholm where the biomethane market is growing exponentially. Örebro was the first Swedish city to set itself the goal of completely eliminating fossil fuels.

In addition, transport biomethane is produced in a dozen other cities in Sweden - in Uppsala, Vasteros, the provinces of Södermanland and Östergötland, around Stockholm and elsewhere. Today, two-thirds of the country's bus fleet runs on renewable fuels. In Stockholm, they provide over 90% of public transport; the Stockholm region has set the goal of completely phasing out fossil fuels in the transport sector by 2025. By 2030, the state sets itself the task of finally overcoming dependence on oil and natural gas.

“Hammarby Shestad is being built using environmentally clean technologies. It is designed in such a way that even household waste is put into special containers. But it is not taken out of the region by garbage trucks, but sent to the station through special multi-kilometer pipelines with a vacuum “vacuum cleaner” effect. This abandonment of waste collection vehicles has significantly improved the

ecological situation in the area. At the station, it is stored in containers and then transported to a waste recycling plant.

Moreover, at the waste recycling plant, the waste is again divided into fractions. Waste that can be used as fuel in generating power plants is mixed with sawdust and then burned, the resulting energy is used for heating and hot water supply. Another interesting point: the ash that remains after burning is also disassembled into fractions. The part of the ash that is safe is used in road construction as an additive to asphalt or in the production of building blocks in the construction of houses, and waste hazardous to the environment, for humans, is disposed of or buried.

In the aggregate volume, all hazardous waste is no more than 3%. That is, it is a system for working with household waste that is perfect today! Almost all human waste products are used to provide homes with warmth and hot water. Thanks to the use of modern technologies, both in the construction of these houses and in the use of recycled waste, energy consumption has been cut in half. And virtually all utility bills have also halved. This is an example for us of how modern technology can be used. Yes, according to the calculations of our Swedish colleagues, the cost of building such houses increases by 5-6%, but this allows you to get a different effect: in the future, the cost of utilities will be halved ”.

Germany

As in all of Europe, in Germany intensive development of waste legislation began in the early 1970s. Until that time, municipalities were responsible for garbage collection - a practice that turned out to be insufficiently effective: the current situation was widely recognized as an acute “garbage crisis”. In 1972, the country's Basic Law was supplemented with an article stating that waste management belongs to the joint jurisdiction of federal and state authorities, after which the Law on Waste Disposal was adopted (later amended several times), mainly directed against small, often unauthorized landfills and dictating the organization of large and centrally managed landfills. At the same time - as a reaction to the first energy crisis in 1973 - the search for ways to use waste to generate electricity and heat began.

According to the general opinion of experts, the 1972 law revolutionized the practice of waste management in Germany. Before its adoption, each city and rural settlement had its own landfills: their total number reached 50 thousand. By the early 1990s, there were only 2 thousand such landfills, after which this number was reduced to the current 160 large high-tech landfills. In the meantime, the number of incinerators, recycling plants and various infrastructure elements for the collection of municipal waste has grown dramatically.

The Packaging Act of 1991 played a huge role in the development of the country's “garbage” legislation. At that time, packaging materials accounted for up to half of all household waste and up to a third of the weight of all waste in general, creating an extremely high burden on utilities. The solution to the problem was the transfer of responsibility for their collection and disposal to manufacturers, importers and distributors of goods. The so-called "Dual System" of Germany (Duales System Holding GmbH & Co) was formed, today it is a joint stock company with the participation of manufacturers of goods, retail chains and waste management companies (in total, almost a thousand large participants). The "duality" of the system lies in the fact that an additional waste collection line was created: since that time, along with the usual garbage cans of communal services, special containers of the "dual system" were installed in German cities to collect waste from manufacturers.

According to the established practice, the manufacturer can either organize the collection and export of "his" packages and containers himself, or, on certain contractual terms, transfer this responsibility to the companies that are part of the "dual system". In this second case, under the terms of a license, he acquires the so-called "Green Dot" (der Grune Punkt) - a special sign (pictogram) meaning that the manufacturer has covered all the costs of processing its waste in advance and guarantees the acceptance and recycling of marked packaging material. In other words, the "Green dot" pictogram applied to the packaging means that the manufacturer is henceforth released from the obligation to take back used packaging from the public, and all further responsibility for the corresponding work is transferred to companies belonging to the "dual system" (or to one of the another eight large companies that collect and recycle packages nationwide). The amount of

the license fee is determined depending on the materials, weight and type of packaging, usually ranging from 15 to 70 pfennigs per item. Over time, the “dual system”, along with paper and cardboard packaging, covered a whole spectrum of waste - plastics, glass, sheet metal, aluminum and composite materials.

As the "dual system" developed, its practice was increasingly adopted outside of Germany. With the exception of a small number of states developing their own extended producer responsibility systems, Green Dot is now used throughout Western Europe and is a registered trademark in 170 countries.

Currently, the cornerstone of the entire waste management system and at the same time the foundation of environmental legislation in Germany is the so-called Circulation Law (Closed Material Cycle Law), adopted in 1994, then repeatedly supplemented and currently operating in the 2012 edition. The point of the law is to radically reduce waste incineration in favor of different ways of handling it, mainly in favor of “prevention” and reuse.

In terms of its technical level, the existing system waste management in Germany is one of the most developed in the world.

Treatment levels for various waste streams have been achieved, well above the European average. Thus, over 90% of household waste is recycled, while for Europe as a whole, this figure averages 37%. The overall recycling rate for various materials in Germany has exceeded 80%. Recycling plastic bottles saves energy to supply heat of nearly 2 million Berliners for 130 days.

In deep recycling programs and technologies, an increasing number of companies are recycling used plastic into new bottles for drinks or into products for the textile industry.

The total turnover of the industry has exceeded 100 billion euros per year. The waste management sector employs about 250,000 people, from engineers and administrators to grassroots community workers who take out garbage. Departments of waste management appeared in universities; separately there are all kinds of professional training in this industry.

Denmark

Denmark is believed to have been the first of today's EU countries to begin building a national waste management policy. Back in 1858, a law was passed here, obliging all cities in the country, starting with Copenhagen, to develop rules that would regulate the sanitary conditions of urban life. This was the beginning of the modern municipal waste infrastructure, where local authorities are responsible for water supply, sewerage and waste collection. Around the same years, the first gas factories started operating, then gas power plants and, finally, district heating utilities: today all this is covered by the concept of “municipal enterprises”. Since most Danish municipalities are too small to handle large projects, inter-municipal waste management schemes have been developed.

In 1997, Denmark became the first country in the world to legally ban landfills for waste that can be used for incineration to generate heat and electricity.

The first waste incineration plant in Denmark was built back in 1903 on the territory of the municipality of Frederiksberg in the center of Copenhagen. At the same time, it became the country's first combined heat and power plant. The nearest hospital was then provided with steam, hot water and electricity. Since then, dozens of waste incineration plants have been built. Essentially, every city in the country has its own waste incineration plant, either larger or smaller. Denmark ranks first in Europe in terms of “kilogram per capita per year”, burning or recycling the most waste and less than other countries subjecting it to landfill.

Here, on a par with Sweden, the highest per capita incineration capacity in Europe has been achieved - 591 kg for Sweden and 587 for Denmark.

When, in the early 1980s, the country's government set the task of re-planning the heating system, the five municipalities, despite differences in size and interest, joined forces. As a result, the Danes got a flexible system with simple technology that works on almost any type of fuel and can switch from one type to another. Incinerators in Denmark, integrated into the heat and power supply system of cities, save millions of barrels of oil and gas: 1 ton of waste is equal to about 200 liters of

diesel fuel. In Copenhagen alone, about 30% of the annual heat consumption comes from waste energy. The rest of the heat is produced from geothermal energy and fuels such as wood pellets, straw, natural gas, oil and coal. ”

In 1989, municipalities were given full responsibility for the management of waste generated on their territories; they perform this function in coordination and cooperation with the relevant private sector organizations and industrial enterprises. The principles of territorial proximity and self-sufficiency are adhered to: incineration facilities exist in almost every municipality or are organized on an inter-municipal basis. As a result, what is recognized in the world as the “Danish model of waste management” has developed. Experts point to the following elements and characteristics of this model.

1. Availability of a coherent and consistent system of legal regulation, public administration, planning and public control.

2. A clear division of roles, responsibilities and competencies between the actors of the system - the state, regional and local authorities, waste generators and waste management companies.

3. Well-tested structure of all waste management activities: the system covers all types of waste (domestic, industrial and hazardous); full responsibility rests with the local authorities, which determine the methods of waste collection and further treatment with them - the rules by which waste generators are strictly guided; strict adherence to the polluter pays principle; the whole process is based on the principle of separate collection.

In Denmark, Danish experts emphasize, “a whole range of solutions have been found to solve the waste management problem - private, public-private, semi-public, public and inter-municipal”.

How large a place waste management occupies in the public consciousness of the country is illustrated by the history of the construction of an incineration plant in the city of Roskilde, the former residence of the Danish kings. The architectural and construction project was carried out by the famous Dutch architect E. van

Egeraat, the winner of many awards in Europe. Today the Roskilde plant is a symbol of Green Denmark. As E. van Egeraat himself describes the concept of his work, “at night, the perforated and illuminated façade transforms the plant into a softly shining beacon symbolizing the process of energy production. Several times an hour, a spark of light slowly turns into a burning flame, illuminating the entire building. When the metaphorical fire is extinguished, the building looks like on embers".

For all its success in the use of waste for heat production (on a national scale, this covers over 20% of heat demand) Denmark has been setting new challenges for itself in recent years. It is recognized here that incineration - an environmentally faulty industry - can be replaced or supplemented by a combination of geothermal, wind and biogas energy sources. Back in 2013, the government published a national report prepared by the Ministry of the Environment, “Denmark without waste: more recycling, less burning”. In the meantime, the so-called Energy Agreement, prepared at the highest state level with the participation of a wide range of experts and representatives of political parties, entered into force: the national goal formulated in the Agreement is to ensure complete independence of Denmark from fossil fuels by 2050, in connection with which a sharp increase in financing of projects for the production of bioenergy.

Meanwhile, new forms of state private partnerships and collaboration between companies. In this regard, the municipality of Kalundborg demonstrates what has been called industrial symbiosis - “the world's first really functioning industrial symbiosis”. It is also called the world's largest eco-industrial park. Here waste from one production is directly and directly converted into a resource for another. Thus, agricultural waste is sent to a company that produces bioethanol from it, purchased by a local company. The municipal CHP plant produces heat and electricity - its waste is purchased by a gypsum company. In total, there are nine large companies in the "symbiosis", some of which are generally the largest in Denmark. The Kalundborg experience is widely promoted today as a model for organizing the municipality of the future.

Netherlands

In general terms, the Dutch waste management system is identical to those that have developed in other Western European countries leading in this field. The Netherlands is significantly distinguished by the fact that here, at the state level and as the first national priority, the task of gradually moving towards a circular economy has been set. In 2014, the government of the country, under the personal supervision of the Prime Minister, developed a special program, abbreviated as RACE, - “The Realization of Acceleration of a Circular Economy”. In 2016, the so-called “government-wide” program “Circular Netherlands by 2050” was initiated: the relevant documents emphasize its general government, not departmental nature.

The program provides for two time horizons, where for the first - until 2030 - the goal is to achieve a 50% reduction in the use of "primary resources" - minerals, hydrocarbon fuels and metals. Today, on a national scale, central and local authorities, experts and manufacturers are working on 17 product categories, identifying where and how to increase the “circularity”. In the “metal and electrical sectors” (as defined by Dutch experts), these are “basic metal products” (dozens of items), electronic components, home computers, TV sets, video and DVD players, other consumer electronics, lighting lamps, washing machines, microwave ovens, refrigerators and other devices. In relation to these groups, opportunities are being sought to improve the quality of goods, increase their service life, ensure repairs, full reuse and recycling at the end of the "life cycle".

It is estimated that in value terms, the volume of this “circular sector” for the indicated commodity groups is already more than 3.3 billion euros, and it is increasing by about 600 million euros annually.

Five priority sectors (programs) have been identified that require priority attention in terms of expanding “circularity”: “biomass and food”; "Plastics"; "production"; "construction"; "Consumer goods".

In the "biotic sector" 34 waste streams have been identified, which can be used to solve various economic problems. Enlargedly, they are grouped into three categories, namely:

primary - generated during harvesting, storage and transportation of agricultural products;

secondary - generated during the processing of agricultural products in the enterprises of the agri-food sector;

tertiary - generated in households and from others;

“Final” producers and consumers (in cafes, restaurants, etc.).

All this forms a very significant resource. 64% of the country's territory is occupied by agricultural production; it is estimated that a more complete recycling of waste generated here can bring the national economy up to 1 billion euros of added value annually, mainly due to the production of biogas.

Dutch experts distinguish nine levels of “circularity” - the so-called 9 Re. In descending order of importance, these are:

refusal from excessive use of raw materials -fishing (Refuse);

reducing the use of raw materials (Reduce);

reuse (Reuse);

maintenance and repair (Repair);

update (Refurbish);

production of new products from elements of the old (Remanufacture);

use of the product for other purposes (Repurpose);

recycling and reuse of materials (Recycle);

energy production from materials (Recover).

Part of the nationwide circular economics became a subprogram of "circular cities".

At the head of the movement is Amsterdam, where the maximum program the task has been set to obtain all the necessary energy from renewable sources. The idea of expanding the sphere of services in such a way that “use” (like “rent”) replaces “ownership” is becoming more and more popular.

In 2015, a roadmap for the movement of Amsterdam towards a circular economy was adopted, within the framework of which a total City Circle Scan was carried out to identify bottlenecks that hinder the entire process and determine further plans to overcome them. At the same time, the points were identified where a) it is possible to save "material flows" and b) there is a potential for job creation. More and more, "circular" methods are used in urban construction. “In circular Amsterdam,” write the Dutch experts, “the emphasis is on smart demolition. During the demolition of old buildings, structural elements and materials are preserved that can still find use in new construction: everything is done to preserve their physical and economic value. In such works, a special area is allocated (for example, an unused space close to a given structure), where materials are stored to be used in the construction of new buildings or renovation of old ones. For all this, special databases are created, linked together in the online market system, where sellers and buyers can easily communicate with each other”.

The construction of new buildings is subject to the principle of “smart design”, the aim of which is to integrate the building into a “regional circular chain” that takes into account the characteristics of local transport, the location of offices and manufacturing companies, the requirements of residents and property owners. Houses are built in a “modular and flexible” way, allowing for the possibility of remodeling dwellings without radical rebuilding.

Best practices of the food waste management

Milan: Food waste collection from door to door in a heavily populated area

Milan is a great example of how a big, heavily populated city like Milan has incorporated residential food waste management. With 1.4 million inhabitants, more than 80% of whom live in multifamily housing, and a population density of more than 7,000 people/km2, it has become a blueprint for other cities around the world in terms of food waste generation.

According to the most recent data (2019), Milan alone captures about 105 kg of food waste per capita per year. This is remarkable, given that the overall amount of food waste produced per capita is estimated to be about 120 kg. In 2014, the city of Milan introduced residential food waste collection, with an awareness drive targeting every household and the distribution of a 10-litre vented kitchen bin and a roll of 25 compostable bags. Value is measured quarterly in comparison to quantity, and the findings indicate a low degree of pollution, about 5%. Milan was the last 'blank spot' on the map, i.e. the last municipality without bio-waste collection in an area where food waste separation had been enforced for several years in nearly all neighboring municipalities. This was one of the main factors in the effective introduction of separate collection. People were already expecting the move, welcoming the extra work of using the vented kitchen caddy and distributing food waste in compostable bags to the building's "waste disposal"

room or area. Setting out the bins and bags just a few hours before the collection and retrieving them requires a dedicated service from caretakers, but this additional expense was found to be reasonable. A door-to-door system using clear bags for leftover waste and plastic wrapping allows for visual checks by a dedicated team, who will fine a building for excessive sorting.

Economic instruments to promote independent food waste collection: Catalonia's landfill levy

Catalonia's landfill tax and rebate program is an outstanding example of how a government should facilitate the systematic and consistent recycling of bio-waste. Despite the absence of a nationwide landfill levy, Article 16 of the Spanish Waste Act requires waste agencies from autonomous communities (regions) to use economic benefits to encourage waste prevention and separation. Catalonia developed a reward program, administered by the Catalan Waste Agency (ARC), with the aim of making bio-waste removal and treatment less expensive than landfill or incineration.

The surplus revenue from the disposal tax would be dedicated to biological treatment of bio-waste and mechanical-biological treatment of residual waste, with the remaining revenue being refunded to local councils depending on their results on separate bio-waste collection. This requires coefficients to account for the quality of bio-waste collected, which necessitates the completion of a mandatory series of waste composition analyses, funded in part by the landfill levy.

To promote separate collection of bio-waste, the tax is increasing (for landfills, it is €47.1/t in 2020, with a proposed rise to €70/t in 2024); communities that do not present an action plan pay a higher tax. About all municipalities have adopted independent bio-waste management, and the aim for the near future is to focus on consistency (contamination levels of less than 10%) and quantity, as well as to try out new collection systems.

Networking in France to Encourage Food Waste Collection: Compost Plus Reseau

Reseau Compost Plus (compostplus.org) is a network of municipalities in France that promotes independent bio-waste disposal, which has been abandoned for many years due to the widespread use of mixed waste composting sites. Since 2007, the network also brought together pioneering groups to harvest bio-waste separately.

The organization was founded in 2011 by six communities who decided to raise the sector's awareness on a national level. It now consists of 28 agglomerations with a population of about 9 million people. Food waste recycling was initiated in early 2002 by some of its members, such as the agglomeration of Lorient (25 municipalities, 207,000 inhabitants), with strong success, with about 40 kg of food waste collected per capita per year. Another best practice example is the Syndicat Mixte de Thann–Cernay, which has separated 66 kg of food waste per capita. Reseau Compost Plus is involved in public information dissemination, and has recently published guides with excellent advice and cost estimates. The network administers an ASQA mark for compost to certify conformity with high expectations, as well as hosting local activities to encourage best practices in separate collection.

New approaches to the issue of food waste

Projects to combat food waste are now being funded by private and public partners. For example, food waste is at the core of many initiatives sponsored by the Bio-based Industries Joint Undertaking (BBI JU), a public-private collaboration between the European Commission and BIC.

The Agrimax project (agrimax-project.eu) does not rely on domestic food waste, but it does demonstrate how seed and food-processing agricultural waste can be turned into a variety of high-value items.

Second-generation sugars can also be found in urban solid waste (MSW), which is made up of either mixed domestic residual waste or waste that has been discarded during processing and recycling procedures and also includes large amounts of paper- or cardboard-based (lignocellulosic) materials.

The VAMOS project (vamosbbi.com) seeks to demonstrate the viability of producing and valorizing second-generation sugars from MSW's organic fraction on a demonstration scale. The sugar can be used to make three bio-based goods for non-food touch applications, allowing these low-value residual waste sugars to manufacture competitive, safe, inexpensive, and high-performance bio-based materials. By doing so, the VAMOS initiative would transform the industry by establishing a new supply chain.

The URBIOFIN project (urbiofin.eu) would show that converting the organic fraction of MSW on a semi-industrial scale is technically, commercially, and environmentally feasible. It would use an urban biorefinery concept to produce chemical building blocks, biopolymers, and additives from biowaste. URBIOFIN will eventually provide a modern, environmentally efficient solution to the conventional disposal of urban waste's organic fraction.

Best practices in project beneficiaries` countries

Turkey

Thirty communities were credited for successfully implementing the Zero Waste practice in Turkey.

The idea, championed by first lady Emine Erdoğan, spread first to public institutions, then to the private sector. The initiative has recycled thousands of recyclable materials in the four years since it began.

There are projects that gather waste from the sea, include door-to-door pickup of recyclable waste, and generate compost from recycled materials.

The idea has come a long way since 2017 and has piqued the public's attention. The ongoing coronavirus pandemic exacerbated the contamination problem, particularly due to the haphazard disposal of masks and plastic gloves used as disease control. Plastics are responsible for almost 80% of the toxins found in the world's water bodies. In comparison to other plastic contaminants, we now have masks and gloves. According to scientists, 75% of masks and gloves would float, flooding landfills and waterways if no precautions are taken.

The first lady encourages people to be more vigilant when discarding discarded masks and gloves, adding that the government had already given a notice that they should be disposed of separately from other rubbish.

All public institutions, according to Erdoğan, play a critical role in zero waste campaigns and the long-term viability of recycling. The Zero Waste initiative seeks to encourage the effective use of scarce resources, as well as to reduce and remove waste by separating it for recycling at the source. The presidential complex was the first to implement a zero-waste policy, and ministries soon followed suit. Thousands of public institutions have participated in the initiative since 2017, recycling nearly all of the waste they generate, from paper to fruit. Aside from environmental gains, the project is projected to save the nation about TL 20 billion ($2.45 billion) each year by 2023 and generate 100,000 jobs, according to estimates. The aim is to raise the country's recycling rate from 13% to 35%.

Minister of Environment and Urban Development Murat Kurum announced that public institutions in all cities and towns will complete the transition to a zero waste system by the end of 2022. According to Kurum, the scheme has been

incorporated in 49,000 buildings so far. “With our zero-waste homes, we save billions of liras. Thousands of tons of waste are recycled, and thousands of tons of marine waste are removed. We also limited the use of plastic bags by 80%, which is the most important environmental pollutant,” he said. In January 2019, a ban on free plastic bags was enacted in all stores, from supermarkets and department stores. Businesses are now charging TL 0.25 per device. Many consumers have moved to canvas bags instead of plastic bags since the ban.

Kurum stated that 9 million people, including 6 million students, were updated on recycling as a result of their efforts, and that they were pleased to see children adapting to recycling.

Turkey has begun to emphasize waste disposal over increasing environmental issues in recent years, with municipalities in charge of garbage collection updating their collection systems.

A proposed bill for the creation of an environmental body to help manage recycling activities was approved by a parliamentary committee this year. According to estimates, Turkey consumes around 20 billion cubic meters of glass, plastic, aluminium, and metal packaging per year and aims to raise the recycling rate for packaging to 90%. Fines would be levied on those caught littering in public areas, as well as companies who refuse to partake in a national recycling scheme focused on the country's zero-waste policies.

Greece

The basic practice in Greece applied is the assignment by the Central Administration of the responsibility of waste management to the Municipal services. The Municipalities are being called to apply the legislation. The lack of resources and infrastructure for implementation, the lack of a timetable and control of the implementation of the legislation by the central administration were recorded among the key problems of the effectiveness of the basic practice.

Nevertheless, there are a number of good practices in the area of application of the research and they are listed below.

- **LIFE RE-WEEE**

The LIFE RE-WEEE project laid the foundations for prevention and reuse, starting with waste electrical and electronic equipment. It was completed after 5 years of work for the development of "preparation for reuse" infrastructure and the creation of a culture of production prevention of Waste Electrical and Electronic Equipment (WEEE). This is a project co-financed by the EU funding tool, Life Environment. Partners of the project are the Recycling of Appliances, Beneficiary Coordinator, the Hellenic Recycling Organization, the Ecological Recycling Company, the Green Fund, Harokopio University, as well as the European network RREUSE.

Within the framework of the Project and in accordance with the EU Action Plan for the Circular Economy and the basic principles that govern it, for the first time in Greece, two Sorting and Sorting Centers (SST) were developed. The first SST operated in Attica in February 2019 by the company "ECORESET", which is also active in other WEEE management operations and the second in Central Macedonia in July 2019 by the company "HERMES IKE" in collaboration with the Municipality of Oreokastro, which granted the building infrastructure. The equipment and construction of SST have been procured and financed by the Green Fund.

The WEEE that is led to the SST comes mainly from the shops, where it is delivered by the citizens. The main tasks that take place in SST are the collection, sorting (visual inspection) and classification of WEEE, according to their condition, in order to follow preparation for reuse or processing. The operation of the SST takes place according to technical specifications developed by the LIFE RE-WEEE project for all stages of work.

The two SSTs operate under the same management plan, in terms of WEEE management. During their first year of operation, the management of the SSTs was 60% co-financed by the EU, while the remaining costs for the "preparation for reuse" service were covered by the Recycling of Devices.

During their first year of operation, a total of 3,100 tons of WEEE have been visually inspected for both SSTs, while over 50% (1,600 tons) have been driven to further preparatory work for reuse. 347 tons (11%) of those that have undergone visual inspection, have successfully passed all the preparations for reuse and are Reusable Electrical and Electronic Equipment (EEE), while 104 tons have already been sold in the Greek and international market. Non-EEE has been taken to the processing plants with which Device Recycling works.

It is worth noting that the highest reuse potential is presented by special equipment, such as POS, as well as laptops and tablets. Of the 1,615 pieces of laptops and tablets that successfully passed the visual inspection, 19% have already been sold (323 pieces), while of the 1,612 pieces of special equipment, such as POS, which successfully passed the visual inspection, 93% have already been sold (1,500 pcs).

After the end of the project, the infrastructure will continue to operate by the contractors "ECORESET" and "HERMES IKE" for at least 5 years in total, according to a cooperation agreement with the Recycling of Devices and with the possibility of expanding the cooperation. Device Recycling will participate in the management costs for the provided "reuse preparation" service at a price set by the bidding process. The Guide to WEEE production prevention and WEEE good management practices will be distributed to respective systems in Europe as well as in the EU.

In the context of the creation of a WEEE production prevention culture, the online platform RE-WEEE for the exchange or donation of Electrical and Electronic Devices was designed, which is on the project website www.rewee.gr. The platform can be visited by citizens and social enterprises, as it will continue to operate. The aim of the project is to become better known and promoted through publicity actions.

During the project, 7 "Repair Café" events were organized, in which citizens could repair some damage to their small appliances for free, but also learn how to repair easy and common damage to their devices themselves. According to a draft law under consultation, work similar to that of "Repair Café" will be able to take place in standard reuse centers that will be created by the local authorities. Also, as part of the project, Guides for citizens were developed with tips for extending the life of their devices, as well as ways to repair them in case of simple failures. By design, the Guides will be distributed to Municipalities and electrical stores.

The LIFE RE-WEEE project will be the basis for the implementation of the Circular Economy Strategy set by the EU since 2016 with priority in the UN. The project will also contribute to the actions of LIFE-IP CEI-Greece "Implementation of the Circular Economy in Greece", always in line with the requirements of the newly approved NWMS 2020-2030, which includes provisions for reuse and actions related to the circular economy. .

https://www.reweee.gr/el/what-is-going-on/teliki-synenteyksi-typoy-toy-ergoy-life-re-weee

- Waste and biowaste treatment plants from SWMB

The Regional Association of Solid Waste Management Bodies (SWMB) of Central Macedonia (RCM), which resulted from the merger of 14 different and smaller organizations (Legal Entities SWMB), operates as Public Entity from 01.01.2014. Shareholders in the SWMB Regional Association are all 38 municipalities of RCM and the whole geographical area of Central Macedonia is covered, which consists of the 7 prefectures (Thessaloniki, Halkidiki, Serres, Pella, Emathia, Pieria, Kilkis). The competence and responsibility of SWMB starts from the moment that the municipality, with the equipment and the human resources that it has, completes the collection of the waste. From that point on, the management of the collected waste is the responsibility of SWMB.

SWMB considers the Waste Processing Unit of the Eastern Sector of RCM, the Waste Processing Unit of the Western Sector RCM, the Waste Treatment Unit of the Prefecture of Serres and the Central Waste Plants of Serres and the Central Areas of Serres as the main projects for achieving the objectives of National Planning. There have been protests and appeals to the State Council by Municipalities and citizens against the location of some of these units and it has been criticized that they are preparing the waste to be sent to a plant incineration and for incineration in the cement industry.

- **Waste Processing Unit of the Prefecture of Serres**:

The project was co-financed by NSRF funds, was completed on 09.10.2019 and has been put into normal operation. The Public Private sector Partnership (PPP)

contract concerns the design, financing, construction, maintenance and operation of the infrastructure of the Waste Treatment Unit of the Prefecture of Serres.

The Unit serves all the municipalities of Serres, as well as the Municipality of Kilkis from the Kilkis. Its design is in line with the objectives set by the National Waste Management Plan (NWMP) and specialized in the approved Regional Waste Management Plan of Central Macedonia (RWMS Central Macedonia).

- **"Waste Treatment Unit (WTU) East Sector RCM":**

The Decision of Approval of Environmental Conditions was issued in January 2020, and then the Technical of the preliminary study was submitted. On 23.4.2020 submitted a proposal for funding the project in the Operational Program "TRANSPORTATION INFRASTRUCTURE, ENVIRONMENT & SUSTAINABLE DEVELOPMENT" Priority 14: "CONSERVATION AND ENVIRONMENTAL PROTECTION - PROMOTION OF PROFITABLE USE OF RESOURCES (COHESION)" which is co-financed by the Cohesion Fund entitled "Implementation of mature recovery projects or solid waste disposal", total operating budget € 70,445,677.65 (5 subprojects).

The position of WTU belongs administratively to the Municipality of Thermi of Thessaloniki and in particular is located in Basilica in the place "Agios Antonios". It is located between the settlements of Kato Scholari and Agios Antonios.

WTU will receive and treat two streams of solid waste, mixed waste and pre-selected organic.

The WTU Eastern Sector RCM will receive 150,200 tn / a of which:

i) 128,200 tn / a of mixed waste. 36% of the produced mixed waste of RU will be processed. Thessaloniki, the mixed waste of RU Halkidiki, the remains of CRWS RU Halkidiki and Eastern Thessaloniki (15% each), the residues of the bio-waste treatment units of RU Halkidiki and Eastern Thessaloniki (10% each),

ii) 22,000 tn / a of pre-selected waste (1st BWT Eastern Sector of Thessaloniki). This BWT will serve the Municipality of Thermi and 65% of the Municipality of Thessaloniki.

- **"Waste Treatment Unit (WTU) of Western Sector RCM":**

This is the largest infrastructure project provided by RWMS, as well as the largest project in the country. The study of the project was financed through NSRF (€ 1,315,548.58) and the study contract is currently being implemented. The proposed project under study includes the construction of:

(i) **Mixed Processing Unit** MSW with a capacity of 262,700 t / year (served Municipalities: 10 Municipalities of the Prefecture of Thessaloniki which constitute 64% of the produced mixed waste of the Prefecture of Thessaloniki, (i) Ampelokipi - Menemeni, (ii) Volvi, (iii) Delta, (iv) Thessaloniki (part of the Municipality by 60%), (v) Kordelio - Evosmos, (vi) Lagada, (vii) Neapolis - Sykeon, (viii) Pavlou Mela, (ix) Chalkidonos, (x) Oreokastro , the Municipalities of the prefectures Pieria, Imathia, Pella and the Municipality of Paionia from the prefecture of Kilkis).

(ii) **Pre-selected Bio-Waste Treatment Plant** with a capacity of 38,100 t / year that can be included in this WTU according to the RWMS KM.

The financing, construction, maintenance and operation of the project will be implemented through a PPP partnership (inclusion in the list of PPPs by decision of Intergovernmental Committee for PPPs in September 2019), with the participation of NSRF.

Bio-Waste Management Units:

On 05.04.2019 and 08.04.2019 the contracts of the two sub-projects of the study were signed. The financing for the construction of the projects will be implemented through NSRF. This is the maturation of BWT Kilkis, Pieria, Pella, Halkidiki and 2 BWT Thessaloniki. The maturation of BWT Emathia was carried out by own resources of the Regional Association SWMB of Central Macedonia.

In addition to the above infrastructures, it is worth noting that new ones are expected to be created as it has been issued by the Special Management Service of Central Macedonia calls for proposals for the Operational Program "Transport Infrastructure, Environment and Sustainable Development" Priority Axis 14 "Preservation and Protection of the Environment - Promotion of Efficient Use of Resources (CF)", which is co-financed by:

- Invitation entitled "Completion and completion of integrated waste management infrastructure". For this call, the exclusive potential beneficiary is SWMB Central Macedonia and the total co-financed public expenditure available with this call amounts to € 26,000,000. This call will include projects related to the extensions of existing projects, which are currently in operation and will cover the transitional period, as described in the RWMS. Full maturity for funding has already been secured and the submission of proposals is being prepared.

- Invitation entitled "Biowaste Management". Potential beneficiaries for this call are the municipalities on whose behalf a comprehensive proposal has been submitted for funding from the SWMB of Central Macedonia, for the Supply of bins and other WTUs of collection for the implementation of separate collection programs for biowaste (supply of coffee bins, garbage, garbage etc.). The total co-financed public expenditure available amounts to € 14,500,000.

  - Local Government and Education

On October 23, 2020, the President of SWMB of the Republic of Macedonia and the Rector of the Aristotle University of Thessaloniki proceeded to a memorandum of cooperation for the permanent and systematic connection of every new public project in the field of solid waste management.

According to the memorandum, the two bodies will work together to promote scientific research in the field of waste management through the creation of a model center for the daily synthesis of university research in the field of waste management and utilization.

The result of the cooperation will be the construction of a special facility with an amphitheater and laboratories that will be available to the university and the students for their daily education in the area of operation of the new Waste Treatment Unit (WTU) of the Western Sector.

  - Environment - Waste - Recycling Program

The Children's Library of Orestos in collaboration with SWMB and Thermi Environmental Park presented the educational program "Environment - Waste - Recycling". The aim of the program is to teach school children in the area how to properly manage waste, what are recyclable materials and how to recycle them. There was also a presentation of making a pulp that is transformed into recycled paper, an action in which the children were actively involved.

https://bit.ly/3jGY1PA

The same program took place in the children's library of Kallithea. The program aims to raise children's awareness of environmental issues through the process of waste recycling, so that they realize that they can also participate in the overall effort. It is addressed to students of elementary school, elementary school, elementary school.

https://bit.ly/37aSU54

- "No natural Christmas tree at the Mavrorrachis landfill"

From January 2019, the program of collection and utilization of natural Christmas trees is implemented throughout the metropolitan unit of Thessaloniki in collaboration with the Ministry of Foreign Affairs and the three forest departments of the region, Thessaloniki, Langadas and Stavros.

The Municipalities seek to undertake the obligation to collect all the used trees separately and then to lead them to places predetermined by the forest authorities where they have been placed with the care of SWMB special infrastructure for their cutting and utilization.

According to the data of the forestry offices in the wider area of Thessaloniki, there are about 50,000 natural trees, mainly from the facilities of Taxiarchis Halkidiki, which are being collected as green waste and used either as pellets or as soil conditioners.

The Directorate of Recycling and Municipal Waste Management of the Municipality of Thessaloniki called on citizens not to place the trees in conventional

waste bins but in special open bowls in four places (City Hall, Cultural Center of Toumpa, behind the statue of Venizelos next to the parking lot Posidonio).

https://thessaloniki.gr/programma-anakykloshs-ton-fysikon-xristougenniatikon-dentron/

- Recycling Festival by the Municipality of Thessaloniki

The Municipality of Thessaloniki has organized five Recycling Festivals until 2019, at the premises of HELEXPO, inside and outside the Kiosk 8. The main objectives of the event are the further establishment of recycling, the promotion of its importance and the awareness of students, of the citizens and visitors of the city, with the ultimate goal of upgrading its image, as well as the modernization of the collection and collection of recyclable materials.

In detail, the Recycling Festival of the Municipality of Thessaloniki is designed with content and objectives such as:

- The promotion of the program and the actions of the Municipality of Thessaloniki, so that the participants become close collaborators and helpers.
- The promotion of collaborations and synergies of the Municipality of Thessaloniki with public and private bodies, in order to improve the procedures and increase the recycling.
- The participation of all recycling systems and streams, promoting their operation and the benefits that arise.
- The participation of units of the educational community that will present their activities around recycling, either through the organization of events, or through exhibition participation and linking recycling with environmental education.
- The organization of interactive recycling presentation workshops, in which young people and adults will participate.
- The emergence of innovative recycling practices, which are applied in Greece and abroad.
- The organization of days of exchange of views and transfer of good practices between the recycling bodies and with the participation of citizens as well as cultural events.

https://thessaloniki.gr/5o-festival-anakiklosis-apo-ton-dimo-thessalonikis/

Apart from the recycling festival, there are also some events on the subject of recycling in the Municipality of Thessaloniki, but without any periodicity or correlation with other activities.

A relevant information event took place in March 2019, in collaboration with the Hellenic Recycling Utilization Company (EEAA), with the support of the Central Union of Greek Municipalities (CUGM) and the SKAI TV station, in the "Manolis Anagnostakis" hall and in its courtyard City Hall. The action with the slogan "Recycle in the blue bins of your Municipality" was addressed to primary school students, citizens and business professionals, with the aim of educating and raising awareness about the recycling of packaging, from paper, plastic, aluminum and tinplate, to "Blue buckets" and the "Glass Bells". Participants took part in educational games while gifts were given and two bicycles were drawn.

https://thessaloniki.gr/enimerotiki-ekdilosi-ekstrateia-gia-tin-anakiklosi-ston-dimo-thessalonikis/

- Small waste on land -Clean Europe Network

With the support of the Development Company "ANATOLIKI SA", the Municipality of Kalamaria became the first Municipality in Greece which voluntarily undertook to apply the first common European methodology for ensuring and monitoring micro-waste on land.

The methodology developed by the Clean Europe Network, is a useful tool for any Municipality that has no previous experience in counting the volume and type of micro-waste that occurs on land and result in ending up and polluting the sea. Utilizing the results of the methodology helps the local authorities to organize actions-programs in the direction of waste prevention on land, thus achieving cleaner cities and improving the quality of life of their inhabitants.

In the context of the voluntary participation of citizens of the Municipality of Kalamaria in the program, field tests were carried out both in the main commercial streets of the city, as well as in peripheral and less visited places.

https://www.linkedin.com/pulse/mliament-kalamaria-first-pilot-litter-monitoring-brocklehurst/?trk=prof-post

- Application for "Smart devices" - anThess anakyklosi

In the framework of the Program Contract of the Municipalities of Kalamaria, Thermi, Pylaia - Chortiatis, Thermaikos and "ANATOLIKI SA" for the complete development and support of recycling in Eastern Thessaloniki, the application for "smart devices" (smartphones, tablets), with Android operating system, has been operating since 2015, where the basic information of the website is presented www.anakyklosianthess.gr.

Through the application, users are given the opportunity to be informed about the items that can be recycled and to look for the points (within the administrative boundaries of the four participating Municipalities) where they can deposit the recyclable materials.

After the website www.anakyklosianthess.gr, the Municipalities of Eastern Thessaloniki launched the application "anakyklosi anThess" for "smart devices", mobile phones and tablets, with Android operating system. The application presents the basic information of the respective website for recycling, in the four Municipalities of Eastern Thessaloniki. In it, the user can find basic information about recycling, what we throw and what we do not throw in the blue bins, relevant news for waste management, the streams of recyclable materials that have been developed in each of the Municipalities, glass, electrical appliances, batteries, cooking oils, etc., as well as contact details per Municipality. The search for the collection points of the individual streams is particularly useful,

https://cutt.ly/jlqpJYu

- Utilization of coffee residues

The "Kafsimo" program deals with the recycling of Coffee Waste in the Municipalities of Thessaloniki and Kilkis. The project is implemented by InCommOn as part of the development and implementation of actions to enhance the recycling and sorting of municipal solid waste, including biowaste, and is funded by the Green Fund.

"Kafsimo" deals with the utilization of coffee residues in terms of social inclusion and a fair economy for the production of green biofuel. In addition, it supports the change of public behavior and mentality and the utilization of food scraps for the transition to a circular economy.

The dumping of coffee grounds in landfills in Greece is estimated to be about 40 thousand tons per year. The innovation of the program lies in the combination of the social factor with science, actively involving the producers of the residue with a parallel emphasis on the technical part and the reduction of CO2 emissions. Through the sale of biofuel, the project aims in the long run to be partially self-financed and the revenue to support the social housing of vulnerable groups.
https://www.voria.gr/article/o-kafes-sti-thessaloniki-ke-to-kilkis-ginete-kafsimo

- Pop-Machina and co-production

The operation of the first collaborative makerspace in Thessaloniki is planned by the Municipality of Thessaloniki in collaboration with OK! Thess through the European program "Pop Machina". The project aims to strengthen the circular economy, create new employment opportunities and promote social innovation.

It is a project of the HORIZON 2020 Program that seeks to demonstrate and strengthen the potential of the maker movement and co-production for the circular economy in the EU, in order to promote environmental sustainability and create socio-economic benefits in European cities. The project brings people in contact with circular production communities in 7 European cities and supports them with tools, training programs and specialized business services.

The design of makerspace has started in Thessaloniki, which will operate at the facilities of OK! Thess. Using a series of technologies ("factory of the future", blockchain, etc.) and utilizing scientific disciplines such as urban design and architecture, will create the cognitive background that will provide the necessary support to address the escalation problems faced by collaborative production. The laboratory will be equipped with modern and traditional technologies, such as 3D

printers, CNC cutting machines, electronics and robotics laboratory and more, while it will offer all the necessary supplies to cultivate and develop skills and knowledge through educational activities and mentoring.

https://okthess.gr/el/blog/makerspace-popmachina-okthess/

- "Tropa Verde" reciprocal recycling program

The "Tropa Verde" (green army) program addresses the issue of increasing the recycling rate and reuse of materials at the municipal level and is, based on European, national and regional directives and regulations, a priority of the Municipality of Pavlos Melas, which cooperates with the Municipality of Santiago de Compostela in Spain and the Municipality of Zuglo in Budapest.

It is a multi-level system of rewarding citizens with reciprocal benefits in order to develop incentives for more intensive recycling and reuse of materials. It is supported by a multimedia platform that aims to promote recycling and environmental responsibility among citizens, directly rewarding good environmental action. The platform's pivotal role is to interactively connect sites where citizens can deposit recyclable materials and partner companies by providing gifts or discounts to citizens (or municipal benefits such as swimming pool and municipal gym subscriptions, theater and concert tickets).

https://pavlosmelas.tropaverde.org/

- Recycling of clothing and footwear

It is made by the company EASTWEST GREECE, which has been active since 2015 in the prefecture of Thessaloniki. The clothes and shoes have a second chance to be used, as some are available to the needy from the Municipalities, while the rest take the road of recycling. Even the clothes that no longer have life are recycled and after processing cleaning cloths, insulation material, lint, work uniforms, filling for car seats, etc. are made. In the Municipalities of Thessaloniki there are hundreds of special clothes recycling bins in various places while it has been expanded and in other cities.

http://eastwest-greece.com/h-etaireia-mas/

- Collection of frying oils

The Consortium of SSE organizations of Thessaloniki "Everything Everything" has started cooperation with the Municipality of Neapolis-Sykeon as well as the Municipality of Delta, collecting cooking oils from households. It is already discussing expansion to other Municipalities by concluding Program Contracts for the implementation of a pilot program for the safe collection, transport and recycling of frying oil waste from domestic and professional use.

The Consortium uses methods that involve members of the target social groups actively in jointly organized activities such as Environmental and Experiential Education, their guiding principles, the UNESCO Roadmap for the Global Education Action Plan for Sustainable Development, the training implemented by the Offices and the Center for Environmental Education of Western Thessaloniki and relevant educational and informative material.

https://www.pressenza.com/el/2019/08/ta-panta-re-anakiklosi-epanaxrisimopoiisi-apovlita-anakiklosi/

Ukraine

The Institute of Market Problems and Economic & Ecological Research of the National Academy of Science of Ukraine was a beneficiary of the “Marine and river litter elimination new approach-MARLENA eMS BSB 139” project, which was implemented in framework Joint Operational Programme “Black Sea Basin 2014-2020” during 2018-2020. Project was funded by EU.

MARLENA was established to tie together anti-pollution powers along the Black Sea, waterways, protected areas, and nature reserves, as well as those in the Black

Sea basin. For target groups such as teenagers, visitors, businesses, local communities and councils, and educational organisations, the project aimed to raise public consciousness and education about river and aquatic litter issues, the importance of biodiversity, and environmental conservation. Environmental and responsible-citizenship development, as well as ecological actions, were given special consideration.

MARLENA sought to strengthen environmental action and engage local residents in the promotion and execution of cross-border Black Sea Basin coastal and river clean-up campaigns, as well as discuss best practices in waste reduction and elimination.

In Ukraine the existing policies and legislation, network and cooperation initiatives to reduce river and sea pollution in BSB are studied; the manual "Being a responsible citizen" was created and published; 2 children in Ukraine participated in the international eco-camp in Kitten (Bulgaria);two one-day eco-camps in Ukraine were organized and held; organized and held a thematic conference with project stakeholders; an international round table was organized and held with the project partner countries and their stakeholders;developed and published manuals with best practices in waste management in the project partner countries; 50 containers for PET collection were installed on the territory of the village of Youth (Velikodolinsk territorial community) and an information campaign on the cleanup of the sea and rivers in Ukraine with the project's stakeholders was conducted.

Within the framework of the Program EaPTC Moldova – Ukraine project "Enhanced capacity for an efficient waste management in "Lower Danube" Euroregion area (CleanTown)" is implemented.
Locations of the action- Lower Danube areas of Moldova and Ukraine. Total duration-12 (twelve) months. Name of the applicant- Cross-border Cooperation and European Integration Agency. Co-applicants:

- NGO Agricola, Ukraine;
- Valeni Town Hall, Republic of Moldova

Overall objective of the project is to contribute to the creation of an integrated and efficient system of waste management and consequently better environmental protection of the Lower Prut and Lower Danube areas of Moldova and Ukraine.

Specific objectives:

- To enlarge the existing cross-border partnerships and intensify the cooperation among local public authorities, environmental protection institutions, NGOs and other stakeholders from Moldova and Ukraine in the field of waste manag[8]ement;
- Extend the waste collecting system in the partner municipalities and procure necessary equipment;
- Awareness raising of the population inhabiting the region regarding the necessity to protect the environment and selective waste collection.

Main activities:

- Ensuring procurement of specific endowments for target municipalities aiming to improve waste management;
- Conducting information/awareness activities to promote waste management systems with reduced environmental impact;
- Promoting selective waste collecting in Valeni and Reni communities

Institute of Market Problems and Economic&Ecological Research of the National Academy of Science of Ukraine works under technological aspects of wine waste processing.

A significant part of the territory of Ukraine has unique opportunities for the successful functioning of viticulture, which exists and develops, mainly in accordance with the needs of winemaking:

• only about 10% of the grapes produced in the world are consumed fresh;

[8] https://www.24chasa.bg/novini/article/7693468

- about 6% is used for drying (raisins, raisins);
- about 84% are processed into wine materials.

When processing grapes for wine materials, waste is generated (ridges, pomace, seeds), the proportion of which is 15 ... 20%. The objective prerequisites for development are: favorable soil and climatic conditions; capacity potential of the domestic and foreign wine market; availability of intellectual and production capital for the implementation of innovative technologies; ecological, socio-economic advantages of the organization of waste-free processing of grapes. The concept of waste-free production is based on the principles of consistency, the complexity of the use of resources, the cyclical nature of material flows, limiting the impact of production on the natural and social environment.

The greatest share and significance among the waste of winemaking is represented by grape pomace.

By the nature of the applied technology of winemaking, various types of pomace are obtained: pomace obtained during the processing of grapes according to the white method (sweet); pomace obtained during the processing of grapes using the red method (sweet and fermented).

Scientific research carried out in different countries made it possible to develop various schemes for the complex processing of wine-making waste.

The main products of the complex processing of grape pomace are raw alcohol, tartaric acid, food eno dye, seeds, grape oil, feed flour, pectin, soft drinks, fertilizers.

VOLUMES OF CONVERSION GRAPES FOR WINE BASE IN UKRAINE IN 2020

Name of raw materials		
Main raw material		
Grapes for winemaking, thousand tons	76,0	
Secondary products of winemaking		
Grape stalks , thousand tons	3,0	
Pomace, thousand tons	10,2	
Seeds, thousand tons	2,6	
Skin, thousand tons	7,6	

Bulgaria

Green islands for separate waste collection are being built in Sofia.

The aim is to increase the separate collection of waste with the active participation of citizens. We plan to include new neighborhoods in the pilot projects for separate collection. 2300 households from „Nadezhda“, „Ovcha Kupel“ and „Kremikovtsi“ take part in such projects. This was announced by the mayor of Sofia and a candidate for a new term from the GEDB and UDF coalition, Yordanka Fandakova, at a meeting with citizens in „Nadezhda“.

There, at blocks 151, 152 and 160, there are 5 green islands with containers for separate waste collection, to which 300 households have access. Citizens separate 4 types of waste - from packaging, glass, paper and food waste All containers are equipped with volume filling sensors.

Waste separation at „Nadezhda“ has been created to stimulate citizen participation in the process of recycling. So look for successful models for separate collection in neighborhoods with multi-family residential buildings.

85% of Sofia's waste is already recovered, thanks to the integrated waste processing system. It produces electricity and compost, and recycles materials. Since the operation of the waste plant, the capital has saved over BGN 52 million in landfill fees. Over BGN 2.6 million. are the revenues from the sale of recyclable materials.

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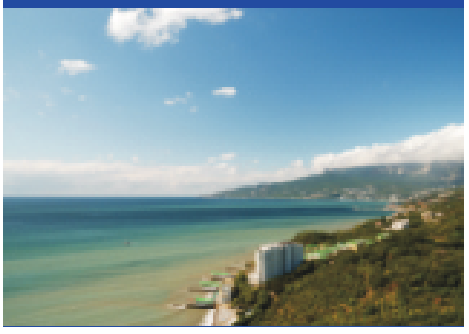

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