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Exploring the circular bioeconomy potential in cities

36 Good Practices and more on circular bioeconomy and biowaste management

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Exploring the circular bioeconomy potential in cities

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One of the objectives of the Biocircularcities (BCC) project is to provide policy recommendations for implementing a circular bioeconomy in the three pilot territories. For that, it is important to be aware of current initiatives regarding circular bioeconomy and biowaste management. Thus, the project partners identified Good Practices currently implemented in the European Union, as well as at the national, regional and local level of the pilot territories (the Metropolitan Area of Barcelona (MAB), the Metropolitan City of Naples (MCN), and the Province of Pazardzhik (PP)). Associated to an analysis of the policy framework, this work has been compiled in a document entitled "Policy framework and Good Practices on circular bioeconomy and biowaste management", available on the Biocircularcities website.

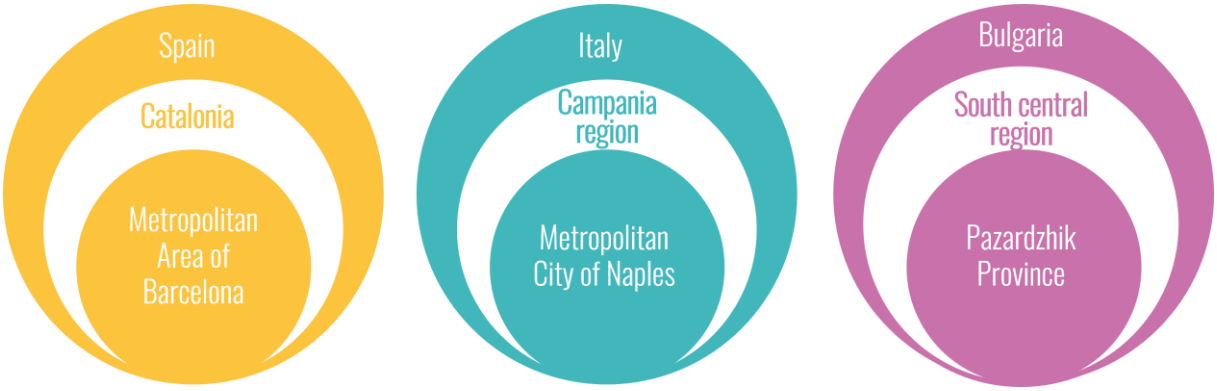

Figure 1 Geographical scope of the pilots

The current summary presents 36 Good Practices gathered by the Biocircularcities partners, complemented by a selection of additional practices and a selection of actions promoting knowledge on circular bioeconomy. The aim was not to collect an exhaustive number of references but to highlight some of the most significant ones, providing useful information for the project. The Biocircularcities partners searched also for the implementation of the most innovative circular bioeconomy practices in local biowaste management diverting biogenic waste streams from traditional biological treatments to bio-based operations for material use.

Most of the Good Practices collected aim to improve the quality and the quantity of collected biowaste through various tools such as technological innovation, including identification systems and access control.

Importance of the context

The level of implementation of some actions as separate collection of the biowaste is different in each Member State. Thus, what can be called a good practice and its associated impact differ from a context to another. For example, there are places where the plain implementation of separate biowaste collection is considered as a Good Practice while in others waste separate collection was implemented years ago and the current trends are more related to technological innovation with an access control system to the collection.

Separate collection of biowaste is still a major concern in biowaste management as it affects recycling possibilities. Even though separate collection of biowaste and other wastes has been implemented in most of EU

countries, the quantities collected and the quality of biowaste still need to be improved to optimise its recovery and increase the quality of the outputs.

The Good Practices are collected in a database and described according to nine criteria:

1. **Title** of the Good Practice
2. **Territorial identification:** country, regional level, and provincial or Local Administrative Unit where the Good Practice is located
3. **Type of waste:** main waste fraction/feedstock/material considered in the Good Practice, including organic waste from agriculture, household biowaste (separated collection of municipal biowaste), household waste (separated collection of municipal waste), food waste, mixed municipal waste, forestry residues, green waste (from households), industrial biowaste and vegetable oil from households. Good Practices related to biowaste were prioritised over other organic wastes;
4. **Type of action:** main action undertaken as part of the Good Practice are technological innovation, optimization and efficiency of collection system, communication and dissemination activities, taxation, control, surveillance, and sanctions, prevention, separate collection, preparing for re-use, decentralised treatment, system nudge, and optimization of composting plants for biodegradable waste;
5. **Objective of the measure:** main goal to be achieved by implementing the Good Practice;
6. **Initial situation/baseline:** current situation to be improved by the measure and reasons why the improvement is necessary. This description helps to assess the impact of the Good Practice;
7. **New situation:** current scenario after implementation of the Good Practice;
8. **Results:** quantitative or qualitative assessment of the impact of the Good Practice on the sector affected by it;
9. **Link** or reference: original source of the Good Practice.

For this report, five main themes tackled by the Good Practices have been identified and summarised:

- Food waste prevention;
- Biowaste collection;
- Home and decentralised composting, in-situ valorisation;
- Biowaste treatment and recycling;
- Plans and strategies.

The complete list of the Good Practices, including a detailed description for each of them, is available in the report "Policy framework and Good Practices on circular bioeconomy and biowaste management".

This document also includes an analysis of the Good Practices in relation to the Biocircularcities pilots.

The 36 Biocircularcities Good Practices

Food waste prevention

The identified food waste prevention actions cover various aspects, ranging from facilitating food donation, providing tips and tools for household to reduce food waste, or developing integrated food waste policies addressing the whole food value-chain and involving all key local stakeholders to reduce both food losses and food waste.

Related practices:

- Food waste prevention in Italy (Milan, IT)
- Prevention of food waste in Czechia (Prague, CZ)
- Web page for incentivising food waste reduction (Catalonia, ES)

Biowaste collection

Many different actions addressing food and garden waste collection have been identified, covering quite different aspects: the increase of captured quantities through improved logistic or incentives such as Pay-As-You-Throw, or the decrease of contamination through the shift from open street containers to smart containers (identifying the users with individual cards) or door-to-door systems, or the implementation of smaller opening preventing the used of biowaste containers for residual waste.

- Reduction of impurities in selectively collected biowaste in Spain (Barcelona, ES)
- Door-to-door collection (Milan, IT)
- Reduction in mouth of biowaste container (Gavà, ES)
- Separation of mixed municipal waste in the regional landfill of Pazardzhik (Pazardzhik, BG)
- Municipal Collection system (Gabrovo, BG)
- Food waste kitchen sink disposers (Malmö, SE)
- KAYT in e-containers separate collection system (Sant Just Desvern, ES)
- Increase in caption of biowaste (El Papiol, ES)
- Intelligent containers in Sant Andreu district (Sant Andreu, ES)
- Increase of separate collection through Door-to-Door and e-containers (La Conca de Barberà, ES)
- User ID cards to access smart containers (Tarragona, ES)
- Large scale implementation of household organic waste separate collection (Luxembourg)
- Implementation of separate collection of green waste (Luxembourg)
- Reducing biowaste from domestic waste (Mauges, FR)

Home and decentralised composting, in-situ valorisation

Home and decentralised composting have been identified as a sustainable way to divert garden waste and vegetal food waste from disposal or other centralised treatments reducing greenhouse gas emissions and avoiding transport impacts. Moreover, home and decentralised composting generally include low contamination, which leads to the production of quality compost that can be used as a soil improver output for residents' gardens. The implementation of decentralised compositing can also be promoted via economic incentives such as tax reduction or the support for the acquisition of the necessary equipment. The awareness campaigns deployed in parallel to the decentralised treatment are essential to promote their use and ensure their proper development. Such systems are versatile and can be implemented by citizens or larger biowaste producers.

Related practices:

- Home composting in Finland (Helsinki, FI)
- Community Composting (Nitra, SK)
- Home composting and community composting (Pla de l'Estany, ES)
- Community composting of food waste (Ciudad Real, ES)
- Valorising green waste in the garden (Mauges, FR)
- Sustrato universal: ¡cerramos el círculo! (ES)

Biowaste treatment and added value biobased products generation

Traditional biological treatments (composting and anaerobic digestion) have been identified as Good Practices depending on the area. In the case of Bulgaria, the energy valorisation of forest biowaste can be a clear Good Practice and an advantage for the local context despite its lack of innovative character, as well as composting when it means an increase in biowaste separate collection in territories where low collection rates exist.

The new trends aim to obtain added value products as bioethanol and protein from the treatment of biowaste. Although several practices are arising in this direction, scaling of the process needs to be improved to make it profitable. Other more standardised practices as biomethane production are also relevant when it comes to the possibilities of biowaste innovative treatment it offers.

Related practices:

- Integrated system of facilities for recycling, treatment and recovery of mixed municipal waste (Sofia region, BG)
- Biodegradable waste composting plant and pre-treatment for mixed household waste (Pazardzhik region, BG)
- Green Deal for the recycling of forest biowaste through energetic valorisation (FR)
- Perseo Bioethanol plant from cellulosic waste from MBT (L'Alcúdia, ES)
- Insect protein (Alicante, ES)
- Environmental benefits from the production of sustainable furniture (UK)

- Bioethanol from by-products of food industry (Lahti, FI)
- Deployment of biowaste valorisation through anaerobic digestion and biomethanisation (Luxembourg)
- Turn used oil into soap (Madrid, ES)
- CIA: putting coffee husks to good use (Ancona, IT)

Plans and strategies

There are plans and strategies that aim at reducing and better managing waste in general and biowaste in particular. Those plans are mainly focused on municipal waste. Achieving reduction goals for food waste generation is regarded as a major issue. The generation of food waste can be very high in certain areas and a particular management is needed to reduce the quantities that end up in the landfill. This can be done through programmes that include food donation, home composting or tips to reduce food waste.

Relevant practices:

- Wasted Food Programs and Resources in the United States (US)
- Plan National pour la Gestion des Déchets - PNGD (National Plan for Waste Management) (Luxembourg)

Additional Good Practices

Some additional Good Practices related to management of biowaste referring to composting, anaerobic digestion and material valorisation in the construction sector are listed below.

Good Practices related to composting and anaerobic digestion have been collected from the Interreg Europe Programme.

For additional Good Practices on **composting** please consult the following Good Practices:

- Home composting and economic incentives (Italy)
- Home composting pilot action (Greece)
- Home composting support scheme (Portugal)
- Social enterprise in composting and organic farming (Romania)
- Community composting of food waste (Spain)
- Composting municipal wastewater sludge and garden waste – pilot project (Romania)

For additional Good Practices on **biogas** production please consult the following Good Practices:

- Processing alternatives of biodegradable waste – anaerobic digestion, energy & biofuel (Finland)
- Power generation by managing organic waste (Greece)
- Biogas production through anaerobic fermentation of wastewater and whey in dairy products factory (Estonia)
- Biogas production plant based on brewery's wastewater (Estonia)
- Maccarese Agricultural company: from animal farming to energy production (Italy)
- Normandy Biogas Production Plant – technical committee for project appraisal (France)

- Biogas units for household applications (Romania)
- Green energy from municipality biowaste and wastewater sewage sludge treatment plant (Hungary)
- Biogas and fertilizer from agro-food waste (Romania)
- Biogas and compost from biowaste and sewage sludge water (Spain)
- Biogas from inoperative landfill (Poland)
- Utilisation of biowaste streams – bio-based industrial symbiosis (Finland)
- Biogas from manure and slaughter waste (Sweden)

Good Practices related to **material valorisation in the construction sector** have been obtained from popular science magazines and are listed below. These Good Practices can present certain interest for the pilot of Pazardzhik.

- ABOUT IAAC - Institute for Advanced Architecture of Catalonia
- Construction materials from biomass waste (Materiales de construcción a partir de residuos de biomasa forestal)
- Construction from untapped agriculture and forestry waste (Construcción a partir de residuos agrícolas y forestales infrautilizados)
- Transformation of off-shore shoal algae into renewable source fuel (Transformando las algas de arribazón en combustible renovable)
- Organic waste. The new construction materials? (Residuos orgánicos, ¿los nuevos materiales de construcción?)

Actions promoting knowledge on circular bioeconomy

The opportunities and solutions of the circular bioeconomy are not yet sufficiently known to the various key stakeholders. Several actions and initiatives aiming to promote the exchange of knowledge and Good Practices were identified and described here.

Europe

At European level the European Week for Waste Reduction (EWWR) and the EU Green Week are two examples of initiatives promoting such exchanges.

Started in 2009, the **EWWR**[1] was financed under the LIFE programme until 2017, year when it became financed through the European Steering Committee. The objectives of the EWWR are:

- to raise awareness about waste reduction, product reuse and material recycling strategies, and related European Union and Member States policies,
- to highlight the work accomplished by EWWR participants,

[1] https://ewwr.eu/

- to mobilise and encourage European citizens to concentrate on four key action themes,
- to reinforce EWWR stakeholders' capacities by providing them with targeted communication tools and training.

Individuals and organisations can join the EWWR as action developers, as participants in existing action or as coordinators (for public authorities only). The EWWR takes place on a different topic each year. In 2021 it was dedicated to Circular Communities.

The **Green Week**[2] is an annual opportunity to debate European environmental policy with policy makers, environmental leaders and stakeholders from across Europe and beyond, and to raise awareness and engage the maximum number of stakeholders and all those interested in environmental protection at local, regional and national levels.

Partners can organise events in a free format according to the expected audience, with the only requirement that they are environmentally friendly and sustainable. Topics and sectors range from industry and new technologies to biodiversity and climate change, and take place across Europe.

Spain

Hosted by the Ministry of Ecological Transition and Demographic Challenge (MITECO) the Workshop on Circular Economy[3] (Jornada de Debate de Economía Circular) took place in 2017. The aim was to think about key issues for the development of the Spanish Strategy on Circular Economy. In several conferences, representatives of European and local administrations discussed the role of public administrations and the identification of priority actions for the circular economy. Up to eight different questions were discussed by the participants in specific groups according to the stakeholders' interests and resulted in relevant content for the Spanish strategy. The final result was the publication of the Spanish Strategy on Circular Economy in 2020.

The Metropolitan Area of Barcelona (AMB) organises "Environmental Seminars" at least twice a year[4]. These seminars aim to promote the exchange of information, experiences and strategies on environmental issues that may be useful for local administrations. These seminars include aspects such as energy, waste, sustainability or water treatment, among others. They are mainly addressed to local administrations in order to better serve citizens and improve their participation in relevant activities.

Bulgaria

The Regional Environmental Committee of Pazardzhik Province is appointed at least once each year. It is chaired by the Pazardzhik Regional Administration (PRA - https://www.pz.government.bg), and its members are municipalities of Pazardzhik Province as well as REAP and other energy and environmental actors. The topics

[2] https://ec.europa.eu/environment/eu-green-week-2022_en

[3] https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/economia-circular/jornada-debate/

[4] https://www.amb.cat/web/ecologia/actualitat/seminaris/seminaris-ambientals

discussed by the Committee are improvement of waste management at local and regional level, increased use of local and sustainable RES (renewable energy sources), clean energy and environmental projects in the Pazardzhik Province area.

Italy

In Italy there are some good examples of actions, one of which is the Circular Economy Network[5]. It is a group of companies, organizations and entities aiming to further develop the circular economy concept in Italy. Annual conferences are held to collect and share studies, research and data on the circular economy in order to identify the key indicators and analyse national performance over the years. They also focus on the main challenges and bottlenecks to be addressed, identifying the potential solutions. The resulting strategies are then shared with policy makers who try to link industries and entities.

Another good example is the Osservatorio Recovery[6], a platform that lists the criteria for projects related to separate collection and recycling of wood, plastics and electronic waste, as indicated by the PNRR (Piano Nazionale di Ripresa e Resilienza).

Finally, the Ministry for the Ecological Transition (MITE)[7] presents the initiatives and project criteria for recycling facilities, separate collection and flagships initiatives for wood, plastics and electronic waste supply chains.

Good Practices related to the Metropolitan Area of Barcelona

The Metropolitan Area of Barcelona (MAB) pilot plans to improve its separate collection of municipal biowaste to enable high-quality recycling of biowaste and the production of better end products. The current biowaste collection in bring banks has a rather low quality and its collection rate could be further improved. The Good Practices that are more relevant to the MAB pilot relate to reducing impurities in separately collected biowaste, increasing the amount and rate of separate biowaste collection.

The Good Practices collected include technological innovations such as e-containers with identification systems, apps based on KAYT principles, and personal support as awareness-raising activities to help users check if they are separating correctly. While the key principles of separate collection, e.g., communication and convenience, have remained unchanged since their introduction, new technologies allow for better monitoring and control as well as more effective feedback mechanisms, and have enabled the development of PAYT schemes. However, direct interaction with citizens to inform and nudge them is equally important.

The Good Practices implemented in the pilot area of Barcelona are related to taxation and separate collection. The former through the Catalan Disposal Tax, which generates revenues for the introduction of separate biowaste

[5] https://circulareconomynetwork.it

[6] https://www.osservatoriorecovery.it/i-decreti-del-mite-per-leconomia-circolare-e-per-il-piano-operativo-per-il-sistema-avanzato-e-integrato-di-monitoraggio-e-previsione/

[7] https://www.mite.gov.it/pagina/pnrr-pubblicazione-decreti-economia-circolare

collection while promoting the decrease of mixed residual waste. The latter aims to increase the quantity and the quality of biowaste collected through the Zero Waste Metropolitan Agreement and supports the implementation of individual collection schemes and the reduction of waste fees for biowaste collection participants.

Good Practices related to the Metropolitan City of Naples

The Metropolitan City of Naples (MCN) pilot deals with the recycling of agro-industrial biowaste. The Good Practices that are more related to the MCN pilot focus on the conversion of agro-industrial biowaste into new fuels such as bioethanol or the production of insect protein. These practices correspond to technological innovation and industrial biowaste. Specifically related to the MCN pilot chain, a Good Practice on the management of coffee processing waste was included to be used as an alternative scenario for detailed study.

Good Practices focusing on separate collection of biowaste are also of great importance, because the higher the quality of biowaste the greater the potential uses, especially for biobased products.

Although many measures are still needed to close the waste cycle in the MCN pilot area, several private companies are already implementing good circular economy practices at local level (e.g., bioplastics, cosmetics, pharmaceuticals, biogas and biomethane from biowaste, or shopping bags from fabric scraps, etc.). The increase of innovative practices in the field of circular economy would support the bio-economy sector, which is already worth several billion euros in the Campania Region.

Good Practices related to the Province of Pazardzhik

The Province of Pazardzhik (PP) pilot will explore the possibilities to recover unused forestry waste. The most interesting Good Practices for the PP pilot are those related to green waste and forestry residues, as the selected chain for the project is forestry biowaste. The options for this material include biological treatments such as composting, energy recovery or construction material.

35% of forestry waste in the PP is currently left on the forest floor, mainly because it is difficult to transport it to other management sites. The Good Practices for energy recovery from wood waste, which might be considered less innovative in other areas, can be of particular interest in this specific case. Several public buildings heat with oil boilers, which could be replaced by recycling wood waste, reducing the fire risk due to the excessive accumulation of this waste in the forest.

The Good Practices collected related to green and forestry waste also concern the production of biofuels to reduce the consumption of fossil fuels and the recycling of wood waste to produce furniture, especially for offices.

Other uses as construction material have also been demonstrated and are less explored but could be of interest in the case of the Pazardzhik pilot. The use of forest biowaste in construction can have important benefits, as wood reduces energy consumption due to its better insulation. The REHAP project (Systemic approach to Reduce Energy demand and CO_2 emissions of processes that transform agroforestry waste into High Added Value Products) focused on the extraction of construction materials from agricultural and forestry waste.

Conclusions

Separate collection of biowaste remains an issue and there are many good practices in this field in the pilot territories. Improvements of separate collection systems, including access control technologies, are the most important type of measures.

New technologies for innovative biowaste valorisation are often very complex and still at the research stage or are in a too immature to be put into practice. For this reason, further research is needed to find solutions for the implementation of these good practices, where the economic benefits sometimes do not compensate the investment costs, and the scaling up of the industrial process needs to be pursued with a view to achieving a true circular economy.

This can be of particular interest when dealing with renewable energies or new processes to valorise biowaste. Renewable energy is promoted through regulations at different levels to reduce dependence on fossil fuels and achieve a more circular economy. In relation to waste, energetic recovery and biofuel production can promote this change. Other biowaste-based products, such as biopesticides, nutraceuticals or biochemicals, have been introduced as part of GP implementation for economic reasons or because the yield of the process is adequate and generates revenues. Nevertheless, these processes are usually constrained by regulations that require cumbersome formalities and procedures.

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