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Current Situation in Biowaste Management and Improvement Recommendations in Estonia, Lithuania, Poland and Finland

Background report

31.10.2023

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ABSTRACT

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Name of the publication: Current Situation in Biowaste Management and Improvement Recommendations in Estonia, Lithuania, Poland and Finland

39 pages

Date of the publication: October 2023

Key words: Biowaste, separate collection, biowaste treatment, home composting, recommendations

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Rates of separately collected biowaste are relatively low in many countries and there is lot to do when it comes to enhancing biowaste management to better recycle nutrients and energy and getting the potential out of biowaste. This report aims to define the current situation regarding biowaste management and find ways to enhance it in Estonia, Lithuania, Poland and Finland. The recommendations provided here are based on questionnaires, a roundtable discussion, literature and news.

According to the questionnaires and the discussion, the countries in question have quite similar challenges in biowaste management. The treatment of biowaste in aerobic composting and (in Finland mostly) anaerobic digestion plants is common in these countries. There are differences between the countries in terms of what is included in biowaste, as well as recycling rates and targets. The means used to advance biowaste sorting and collection include, depending on the country: mandatory biowaste collection or home composting mainly for every property; cheaper or free biowaste collection and a higher fee for mixed waste; free biowaste bins and paper bags; advancing home composting with free composters and composting guides and courses; the possibility for less frequent emptying of mixed waste and in so doing a lower mixed waste fee for those who separate biowaste/compost at home; the possibility of using shared biowaste collection bins or composters or multicompartment bins; education on the benefits of biowaste separation in many ways, both public and direct; investments and support for biogas and possibly composting facilities; creating demand for end-products by, for example, certification; and cooperation. Many of these practices are already in use, and the aim is to increase the use of practices that countries have had good experiences with.

Based on our findings, the recommendations to enhance biowaste management also include: preventing the production of biowaste; promoting home composting in many ways; developing the collection of biowaste and kitchen planning so that there is room for at least biowaste and mixed waste bins; enhancing the treatment of biowaste, such as by producing biogas, bioethanol, biochar, and/or fertilizers; and possibly trying to minimise incineration through taxation or other payments, which is recommended by European Commission, and bans for sending waste to landfills. In particular, spreading information about the positive outcomes of biowaste recycling is considered crucial.

FOREWORD

This background report is one of the tasks of the Baltic cooperation in nutrient recycling (FinBaltRecycling) project. The project is coordinated by the Ministry of the Environment of Finland and financed by the Ministry for Foreign Affairs of Finland. The aim of the project is a cooperation and expertise exchange between Finland and Baltic Sea region countries on biowaste management and nutrient recycling. The project partners are Finland, Estonia, Lithuania and Poland. The aim of this background report is to gather information from these countries on the current situation regarding biowaste management and create recommendations on how to improve the situation so that more biowaste is sorted and separately collected or home composted and treated. The information is this report was collected by questionnaires and a roundtable discussion.

Thanks to all the participants in the project for your valuable input!

- Ketre Kirs, Adviser, Ministry of the Environment of Estonia
- Aistė Krinickaitė, Chief Specialist, and Virginja Vingriene, Chief Officer, Ministry of the Environment of Lithuania
- Dominika Musiałowicz, Senior Specialist, Chief Inspectorate of Environmental Protection of Poland
- Sirje Stén, Ministerial Adviser, Suvi Jutila and Sveta Silvennoinen-Hiisku, Project Coordinators, Ministry of the Environment of Finland
- Jutta Laine-Ylijoki, Association for Finnish Municipal Waste Management Organizations (Suomen Kiertovoima ry KIVO)
- Anna Virolainen-Hynnä, Finnish Biocycle and Biogas Association (Suomen Biokierto ja Biokaasu ry)
- Tuulia Innala, The Association of Finnish Municipalities (Kuntaliitto)
- Sari Piippo, Finnish Environment Institute (Syke)
- Rait Pihelgas, Estonian Waste Management Center (Eesti Jäätmehoolduskeskus)
- Ott Kasuri, The Association of Estonian Cities and Municipalities (Eesti Linnade ja Valdade Liit ELVL)

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Table of Contents

Definitions

Bioethanol = A biofuel made from organic matter, such as from biowaste.

Biowaste = Can include different types of waste in different countries, such as food and kitchen waste and, in some countries, biodegradable garden and park waste.

Composting = Aerobic treatment of biowaste, where microorganisms decompose organic material into humus-like material (compost). The process requires oxygen. [1 new]

Digestion = Anaerobic treatment of biowaste, where microorganisms break down organic matter in the absence of oxygen generating biogas [1] and sludge.

HSY = Helsinki Region Environmental Services; it takes care of waste management in the Helsinki metropolitan area, among other things.

RFID = Radio-frequency identification used to automatically identify and track tags attached to objects: https://en.wikipedia.org/wiki/Radio-frequency_identification.

Valvira = National Supervisory Authority for Welfare and Health, in Finland

1 Introduction

Work on this report began in April 2023 and was finished in October 2023. It is part of the FinBaltRecycling project implemented by the Ministry of the Environment of Finland and was funded by the Ministry for Foreign Affairs of Finland. Four countries are taking part in the project: Estonia, Lithuania, Poland and Finland. The project aims to enhance experience exchange regarding biowaste, such as matters concerning sorting, collection and recycling rates of biowaste, and as principles of circular economy, to recycle better the nutrients and energy of biowaste and prevent them from ending up in landfills and incineration. The challenges faced depend on the country in question. The significance of the issue is illustrated by the fact that a considerable proportion of municipal waste, usually about one third, consists of biowaste, at least in Finland [2]. Effective recycling of biowaste and producing fertilisers from it can help to diminish the shortage of ammonia and phosphorus nutrients in agriculture. The recycling of nutrients is also important for the security of supply of the country. [3]

The EU Landfill Directive 1999/31/EC [4,5] with its amendments has been minimising the amount of biodegradable waste that ends up at landfills, and later it will also reduce the disposal of other municipal waste at landfills. In Finland, for example, stricter national landfill legislation (331/2013) has prohibited the landfilling of organic waste since 2016, resulting in about 0.4% of municipal waste in 2021 ending up at landfills [6]. Given the anaerobic circumstances of landfills, organic waste produces methane, which is about a 25 times more powerful greenhouse gas than carbon dioxide [7]. In other words, biowaste at landfills can partly intensify climate change, especially if landfill gas is not collected and, hopefully, used as energy. In addition, in incineration processes, wet biowaste lowers the heat value of the waste [8]. Therefore, it is better not to incinerate biowaste, either.

The EU Waste Framework Directive sets out the following waste hierarchy: waste prevention is the preferred option, followed by preparing for re-use, recycling as material, recovery of energy and, finally, disposal, which usually means sending waste to a landfill [9].

The EU Waste Framework Directive 2008/98/EC and its amendments sets obligations for Member States:

- by 31 December 2023, biowaste shall be collected separately or recycled at source (e.g. by composting);
- new municipal waste recycling targets shall be: 55% by 2025, 60% by 2030 and 65% by 2035 [10].

This report shall first present the methods used and then describe the current situation regarding biowaste management in the four countries, including the challenges these countries face. Following that, the results of the roundtable discussion and other means from the literature will be introduced. Chapter 6 presents conclusions and recommendations. The final chapter summarises the main findings of the report. The responses to the biowaste questionnaire from the four countries are presented in Annex 2.

Source: European Commission, Graphics Samuli Huttunen/Yle, Mapcreator, OpenStreetMap [11].

Picture 1. The nine blue countries are fulfilling the EU 2025 recycling targets, the eight yellow are partly fulfilling them (Finland and Estonia) and the ten red countries are possibly not fulfilling them at all (Lithuania and Poland – problems with municipal and plastic waste targets). Eighteen countries were issued with an early warning from the Commission, and if targets are not reached, sanctions can be imposed on those countries [11], [12], [13]. For example, in Finland, mixed waste from households, which goes to incineration, still includes 30–40 % biowaste, according to KIVO and other sources [14,15].

2 Methods

This report was prepared on the basis of responses to a questionnaire, roundtable discussion and other findings from literature and the news. It includes an analysis of all the materials and results.

Biowaste questionnaire

At the end of April 2023, the partnering countries were sent by email a short questionnaire about biowaste management . The questions are listed in Annex 1. FinBaltRecycling's contact persons answered the questions in May by email or by phone. Some extra questions were sent to clarify the answers received.

Roundtable discussion

Suvi Runsten made a presentation of the answers, and it was presented on 29 May 2023 at a Roundtable discussion at the Ministry of the Environment of Finland. She also moderated the

discussion. Some people took part in the event live and some online via Teams. In addition to the participants from the project's partner organisations, associations related to waste management from Finland, Estonia, Lithuania and Poland were also invited to participate in the discussion, and some of them took part. The participants are listed in the Foreword.

Literature review

Some studies and internet articles were reviewed, and the main points and methods are introduced here.

3 Current situation concerning biowaste management

Table 1 presents how biowaste is defined, what are the recycling rates and targets, which properties are included in separate collection and when separate collection for biowaste started in Estonia, Lithuania, Poland and Finland. There are differences in what these countries include in the definition of biowaste, which makes comparison slightly challenging. In Poland, for example, biowaste is mostly fruit and vegetables, garden and park waste, whereas in Finland biowaste is mostly food and kitchen waste. Finland has been concerned with biowaste management the longest time, and Lithuania and Poland started some years ago. In this case, biowaste management means, for example, the separate collection of biowaste, biowaste treatment facilities and the regulation of home composting (at least locally).

Biowaste management is mainly organised by the municipalities in all the countries in question, but there are some country-specific differences. In addition, private actors can have a role in waste management, at least in Finland and Poland, where private companies may also arrange, for example, the transportation and treatment of biowaste. The state's role in these countries mostly concerns legislation, which provides the foundation for waste management in the countries in question. For example, both Estonia and Finland have a Waste Act. All EU countries have to integrate EU legislation into their domestic legislation, but local legislation can also be stricter. The costs of biowaste collection are paid for by the waste producers, such as in Finland and Poland.

All four countries treat biowaste at aerobic composting plants, which produce compost, and anaerobic digestion plants, which produce liquid and solid digestate and biogas. In Estonia, some biogas plants treat both livestock manure and biowaste. In Finland, biogas plants can also be divided into co-treatment plants, farm plants and wastewater sludge treatment plants. There are also some bioethanol plants owned by private companies in Finland. Currently, and also in the future, there is a need for more biowaste treatment plants in many of these countries, such as in Estonia and Finland. In Alytus in Lithuania, there is also a mechanical treatment plant for municipal solid waste, which also separates biowaste. Home composting of biowaste is recommended in all these countries.

For a more detailed description of the current situation in biowaste management in the four countries, see Annex 2.

Table 1. Definition of biowaste, recycling rates, amounts and targets (if they exist), and information about the collection of biowaste in the four countries.

Country	Definition of biowaste	Biowaste recycling rate and target	From which properties	Starting at the latest
Estonia	Garden and park waste, food and kitchen waste from households, offices, retail premises, wholesale enterprises, caterers and food processing plants, also some biodegradable packaging ([1])	Rate 24%/ 31% ([2])(45,000 tons, incl. non-certified, in 2021), target 70% in 2028	All	31 December 2023 (Started in some places from 2011)
Lithuania	Garden waste from 2015, food waste from 2019 of households, hotels, motels, restaurants and other public catering establishments, food production and trading companies	No rate or target, only target is for municipal waste, which is the same as in the EC Waste Framework Directive	From one city with more than 50,000 inhabitants from 2019 and urbanised areas with more than 2,000 inhabitants from 2024	2024 (Started in some places from 2015/2019)
Poland	Biodegradable waste from gardens and parks, food and kitchen waste from households, catering, caterers, retail units, as well as comparable waste from food production or marketing facilities.	Rate and target unknown. Food (kitchen) waste as well as green and other biowaste constitute approx. 30% of the total municipal waste stream. ([3])	All	1 January 2021 (Started in some places from 2018 as voluntary)
Finland	Biowaste other than garden or park waste from households, companies and other organisations. It is recommended that garden waste is composted on site, or it can be taken to waste management centres.	Rate 40% in 2021 (427,000 tons), target 65% by 2027	In a locality from every property with ≥ 5 dwelling / if >10,000 inhabitants, from every property. From organizations if ≥ 10 kg/week.	1 July 2022 (Helsinki metropolitan area started at the 1990s and other areas after that)

[1] Biowaste is defined in Waste Act as: 1. Garden and park waste; 2. Food and kitchen waste from households, offices, retail premises, wholesale enterprises and caterers; 3. Waste from food processing plants, the composition and nature of which is similar to the waste specified in clause 2 of this section.

The Waste Act Section 31 (4) states that 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 may be allowed to be collected at source together with biowaste.

[2] Certified/including non-certified, see more in Annex 2.

[3] The mass of separately collected waste in 2020 accounted for approximately 29% of all waste collected from property owners. Biodegradable waste constitutes 40.8% of it.

The challenges the countries face in biowaste management are described in Table 2. They were collected on the basis of the questionnaire and the roundtable discussion.

As Table 2 shows, a common challenge among the countries is the inactive participation and the lack of interest of residents in the sorting and separate collection of biowaste. That is considered a challenge in all countries with the exception of Poland. It is a challenging task to get unmotivated people, such as those in rental buildings, to separate biowaste and other waste fractions. Another issue is the correct sorting of waste, such as in Poland. The number of Poles separating waste is increasing. As many as 96% of Poles state that they sort waste, but 48% cannot sort properly. The separation of biowaste is simpler but more burdensome, such as in terms of smell. Residents might need a personal benefit from sorting or sanctions when not doing it, such as everyone pays for their own waste. Then again, that would perhaps require a system of control, which could be complicated or need technology. For example, each apartment could have its own RFID tag for bringing waste and then there could perhaps be a scale and a code for each type of waste. Then the apartment would get a bill according to how much and which waste it has brought. Increasing the motivation to sort biowaste is a tricky problem to solve and needs new ideas. Sorting should also be made easy for people.

Apart from the challenge of unmotivated residents and the spread of incorrect information (see Table 2), the challenges are more country specific and are only mentioned by one country. For example, Estonia's challenges include insufficient capacity of biowaste treatment and other issues with the processing of biowaste, such as the poor demand for end products from biowaste management (see Annex 2). In Finland, the challenges concern the sparsely populated country with long distances and a divided collection system in some places, which create a need for better cooperation with communities and private waste transport companies for a more effective collection system. This can be achieved by, for example, the optimisation of collection routes. Another possible option is the collection of biowaste from the community and companies in the same transport, which could cut down waste transportation expenses and emissions.

There are shared but also country specific challenges. It is also worth mentioning that the challenges in Table 2 are based on the questionnaire and The roundtable discussion, so they do not include all the possible challenges, and even where a challenge is not mentioned by a country, it might still be an issue there.

Table 2. The challenges of biowaste management in Estonia, Lithuania, Poland and Finland.

Challenge	Estonia	Lithuania	Poland	Finland
1. Inactive participation and lack of interest of residents in sorting	X	X		X
2. Spread of incorrect information (myths)	X		X	X
3. Insufficient biowaste recycling capacity	X		X	
4. Issues with further processing of biowaste (missing demand for the end-products, like compost)	X			
5. Sparsely populated country (in some areas long distances and small amounts of biowaste)				X
6. The collection system is divided between municipalities (residents) and companies				X

4 Roundtable discussion

The Roundtable discussion took place on 29 May 2023 at the Ministry of the Environment of Finland and online. The participants are listed in the Foreword. The main points are summarised and highlighted here.

The aim of the roundtable discussion was to share best practices and experiences of Finland, Estonia, Lithuania and Poland on the collection and treatment of biowaste. One important insight from the discussion was that the problems within these themes are similar in all four countries. For example, one common challenge is the lack of motivation of people to separate biowaste. Also, the uneven spread of the population causes challenges. However, comparing the problems and current situations of these four countries is not easy due to, for example, the differences in legislation and terminology used by the countries. For instance, depending on the country, biowaste can include different things, such as garden waste, park waste and kitchen waste. However, the separate collection of biowaste is challenging for all four countries, and the goal is the same: to collect as much biowaste as possible.

The legislation has been updated in all four countries recently, and many of the current systems have been, in practice, only for a short period of time. In addition, some new legislation is coming into force soon. For example, in Estonia and Lithuania, some new waste management requirements will come into force in 2024. Also in Finland, there are some new requirements coming into force in 2023–2024. Time will tell how these new policies will work in practice, and this should be followed closely.

Home composting was discussed in the meeting. For example, Lithuania aims to promote home composting in the future, and lower the fees of municipal waste collection for those who compost. Home composting is encouraged in all four countries. There are some requirements that still need to be met. For example, in Finland, certain conditions must be fulfilled: home composting of food may require a composter with heat isolation, if used all year around, and it will require rodent isolation and may not leak any wastewater into the ground. In Estonia, a composter for food waste does not need to be isolated, but it does have to be closed on top and on the sides to prevent access by rodents. The composter may usually not be too near a neighbour's border. There can be more specific local orders concerning composting at home for the different regions of the different countries.

Registers of home composting came up in the discussion as well. In Finland, as a result of the new obligations, municipalities will have registers for home composting. The collection of new registers started in 2023. In Estonia, registers are also in use in parts of the country, but it has also meant an excessive workload. In addition, having registers requires motivating people to provide information about composters. The motivation to do this has been lacking, at least in Finland and Estonia.

In Poland, those who compost receive a discount on the municipal waste collection fee. Nevertheless, the discount is not usually the only incentive to compost. In Finland and in Estonia, biowaste collection is cheaper than mixed waste collection. However, in Estonia the price is not cheap enough to motivate people. The price of waste collection is determined in different ways in the four countries. For example, in Poland, the price of waste management is connected to a household's water usage. Still, lowering the fees and giving discounts to those who separate biowaste or who are composting were considered useful tools in the discussion.

Certifications were also discussed in the meeting. For example, in Estonia, biowaste can be either certified or non-certified, depending on whether it meets certain criteria. Certified compost or digestate can probably have more use destinations and is calculated into the recycling rate. Lithuania does not have certifications, but if compost and digestate meet the end-of-waste criteria, they go according to the Ministry of Agriculture as products. In Finland, Valvira is agency that has criteria for, for example, nutrient use and soil amendments, as in compost and digestate products.

The processing possibilities of biowaste are broad. For example, it is possible to make biochar, biogas, bioethanol, digestate, compost, fertilizers or soil out of biowaste. This also creates markets for businesses. According to the discussion, the most cost-effective outcome of biowaste is biogas. However, the markets are not yet working with all end-products and some prices are low. More demand for compost and digestate should be created. There is also a lack of facilities to treat biowaste, such as in Estonia. There is a lot of work to do to improve the current situation with end-products.

In the discussion, motivating people and educating them about the benefits of separating biowaste were aspects that many participants considered important in order to get more biowaste separately collected. For example, informing people about biowaste recycling's CO_2 handprint (positive outcome, reduction of emissions; different to footprint, which means

produced emissions) can help both people and decision-makers to understand the importance of separating biowaste. Also, informing people about positive public outcomes of biowaste recycling, such as the use of biogas in public transport, could be beneficial. In addition, rumours or myths seem to be a problem in many countries. For example, some people do not believe that biowaste will be recycled after it has been picked up from a property.

Other ideas, such as not producing biowaste, giving out free paper bags and creating more biodegradable packaging, were also mentioned in the discussion. Biodegradable plastic packaging for food was considered a bad idea since it is too confusing and difficult for people and requires knowledge of materials which can be disposed of as biowaste and which cannot. Also, there are problems in recycling these. In short, communication and educating people about recycling were considered crucial in the discussion.

5 Other measures from the literature

In Finland, encouraging measures for separate biowaste collection have been experimented with during the last decade by different organisations. For example, there has been an investigation into enhancing biowaste separation in rental houses (Biorent project) by HSY in 2019 [16]. The aim of the project was to encourage residents to separate their biowaste and reduce food loss. The measures used in the project were sharing biowaste bins and bags, providing guidance and increasing communication on the sorting of waste, enhancing the waste sorting systems of kitchens, enhancing the recycling points of the properties, making multi-language instruction posters, providing education on food loss, and arranging educational events. In addition, guidebooks and animation videos on the sorting of waste in several languages were provided.

According to the report [16], sharing guidance, biowaste bins and paper bags from door to door and new instruction posters in recycling points were considered effective. Sharing information about sorting biowaste was also necessary, especially with children who take the trash out. In addition, relocating mixed-waste bins close to the door of the waste collection point helped to reduce the amount of mixed waste in the biowaste bin, since those who did not sort their waste, did not throw their mixed-waste into the biowaste bin accidentally. In addition, the community, encouraging neighbours and making the waste sorting points more pleasant had a positive impact on recycling rates. The events were not particularly successful due to the poor participation of residents. In conclusion, even small actions can have effective impacts.

There was an experiment conducted in Finland in 2013–2014 in which several detached houses collected their biowaste in the same bins to decrease the environmental and economic impacts of biowaste collection, and to make biowaste collection more accessible to some properties as well as increase the collection rate. These voluntary participants increased their biowaste collection rates markedly, in comparison to the average biowaste amount. The experiment was successful, but it should be noted that the participants were motivated and the properties were located near each other. Today, it is probably more common to use a shared biowaste bin, as biowaste sorting is mandatory in many areas. A common biowaste bin was also experimented with at a local waste collection point. People used it and wanted to continue with this method

of separate collection of biowaste. However, there was a problem with who would pay for it [17].

A report on gate guards, enhancing energy saving and how to change people's behaviour and attitudes has also been published in Finland [18]. According to the report, new legislation is easier to accept if people have been influenced by a behaviour change campaign first and they have started to change their attitudes. These two should be combined. Also, the culture, how people act and talk and social norms have to change. For example, it might be helpful to get people to understand that biowaste is not only something to get rid of but also a valuable resource.

Here are some measures the report [18] suggested (with some modifications especially in 4-5):

1. **Exert influence through public figures.** Using public figures, such as actors and musicians, to promote the issue through entertainment (e.g. TV, movies, music, etc.) can be effective. It could also be, for example, a mayor or a football team that makes people change their attitudes and behaviour, such as getting them to sort. Today, social media influencers could also be used for that.
2. **Peer support.** People should know that other people sort. This means they can compare themselves to their peers and see how well they are doing and get positive feedback from others. The whole community, including companies, should take part in this and there should be a "We act" spirit, and a "We can" spirit by peer leadership.
3. **Phases to impact an individual.** A person's relationship with society is determined by the ages of 16–22 years, and values and valuations change only a little after that. Also, most people create habits by the ages of 25–40 years, which is when they most often start a family. Retired persons have more free time and may form some new habits. These are important phases and this information could be used when planning actions.
4. **Role of biowaste producers.** Big biowaste producers, such as canteens, restaurants and groceries, should start biowaste prevention, sort and teach people what biowaste is and what it is not. For example, serviettes belong in biowaste, but water does not.
5. **Estate managers and motivated residents as gate guard groups.** Estate managers are recognised as one gate guard group for waste issues. They can spread new information for residents and share brochures and waste room posters. They should be trained, for example, annually regarding new changes (e.g. HSY in Finland does that). In housing companies, there may be voluntary and motivated people who could spread information. They should also be trained and perhaps somehow rewarded for their work.

6 Conclusions and recommendations

6.1 Biowaste recycling targets

Recommendation: It is a good idea to have a target for biowaste recycling, higher than for municipal waste, because biowaste makes up around 30–40% of municipal waste (see Table 1).

6.2 Measures to promote biowaste collection and treatment

Several different measures for promoting biowaste collection, treatment and home composting emerged from the answers to the biowaste questionnaire and the roundtable discussion. These are presented in Table 3. The positive and negative issues are part of the analysis. Additional information about the measures can be found in section 6.4.

Table 3. Different kinds of measures that are used or planned for advancing the separate collection of biowaste or its treatment, and an analysis of those.

Measure	Countries that mentioned this measure and description	Positive 😊	Negative 😑
1. Mandatory biowaste collection or home composting mainly for every property	**Estonia:** Yes **Lithuania:** In urban areas with more than 2,000 inhabitants **Poland:** Yes **Finland:** In densely populated areas, if more than 10,000 inhabitants	This way more biowaste will be separated and it is easy to enforce by regulation. Home composting is a good option, too. **Recommended**	Many people would not do it voluntarily. It is not reasonable to collect biowaste from all sparsely populated areas in Finland.
2. Cheaper/subsidized/ no fee for biowaste collection (and mixed municipal waste can be the most expensive waste)	**Estonia:** Cheaper fee for separately collected biowaste compared to mixed municipal waste. Plan so that if biowaste is separately collected, the mixed waste bin can be emptied less often and will be cheaper. **Lithuania:** No fee (but companies pay) **Finland:** Separate collection of biowaste is subsidised by mixed waste fee, which is higher. Also, when biowaste is separated, the mixed waste	Recycling is rewarded by cheaper price and mixed waste punished by the most expensive price. **Recommended**	

	bin can be emptied less often and is cheaper. **Poland:** If biowaste is not separated, the fee for mixed waste is two to four times higher.		
3. Free bins for biowaste	**Estonia:** No bin rent for 5 years/ longer in some parishes, and support to local government units, also for buying biowaste bins and baskets for kitchen. **Lithuania:** Sometimes **Poland:** Sometimes **Finland:** No	Easier for people to start collecting biowaste. Not a must everywhere. **Recommended, if needed**	Additional costs for municipality / end user or need for subsidising.
4. Shared biowaste bins or composters, multicompartment services	**Estonia:** Possible to use shared bins or composters. **Finland:** Several detached houses can use a shared bin or a composter together. In some areas, there is a multi-compartment service: the same waste container has its own compartments for many types of waste, e.g. one for biowaste.	People can save money, the biowaste bin is fuller and workload with a composter can be shared. Should be an option for every house's own biowaste bin. **Recommended**	It is not easy to get people to share these and they should live close to each other. Should it be checked (from the mixed waste bin) that they do separate biowaste and not just say they do to save money?
5. Small, free paper bags for biowaste packaging at home	**Estonia:** Sometimes **Poland:** Sometimes **Finland:** In some rental houses, tested also at some municipal waste companies [19]	Easier for people to start collecting biowaste. **Recommended, if needed**	In some places in Finland, the bags are paid for by the housing company, in other cases by the property holders or the municipalities.
6. Biodegradable (plastic) bags/ package for biowaste/food	**Finland:** There is a byproduct class 3 for the packaged food waste of businesses. It is collected and/or treated separately.	The aim is to help the composting process, compared to using plastic. A higher price for companies that sort food waste with non-biodegradable packages in biowaste, or a requirement to take non-biodegradable	Biodegradable plastic does not compost fast enough in the plants' composting or digestion process and must usually be screened away, so usually they are **not recommended**. Paper is ok. Biodegradable plastic may decompose in home composting,

		packages away could be recommended. Residents should be taught to use paper packages.	because it lasts a longer time.
7. Advancing home composting	**Estonia:** Funding for municipalities to buy home composters. If biowaste is composted at home, the mixed waste bin can be emptied less often and is cheaper. **Lithuania:** Plan to reduce fee for municipal waste if home composting. Funding for municipalities to buy home composters. **Poland:** Home composting gives partial exemption from the municipal waste fee. **Finland:** In Lapland, 10% reduced fee for mixed waste if home composting [20]. Home composters are registered by municipalities. Free courses/guides about composting (in some areas). When biowaste is separated, the mixed waste bin can be emptied less often and is cheaper.	People get the soil for themselves and can use it in their gardens. Biowaste does not need transporting. People can save money for not paying for biowaste or soil. Savings in mixed waste payments. **Highly recommended, especially in sparsely populated areas.**	**Poland:** The discounts are not significant and do not correspond to the reduction in the mass – should be bigger. There can be a problem with including the mass of waste from home composters in the recycling levels. Not everyone wants to compost at home and do the work it requires. If composters are given to people, can and will they use them correctly? Composting courses and guides are needed.
8. Subsidies for biowaste treatment facilities	**Estonia:** Funding for new recycling capacity (still missing a lot of capacity), co-digestion of manure and food waste. **Lithuania:** Funding for new biowaste pretreatment and treatment facilities. **Finland:** Only for biogas plants.	Biogas (or possibly also bioethanol) plant is the best treatment economically, because of the income from the gas (or fuel), but it usually needs composting or some other process after that, such as making fertiliser or biochar. **Recommended**	Plants should be far enough from residents to avoid smell problems, but close enough for energy users. Handling of the environmental permits for biogas plants could be speeded up, if possible.

9. Finding use for end products (soil, fertilizer, energy) and certificates	**Estonia:** A regulation for certification to compost and digestate (biogas used for public transport) **Lithuania:** End-of-waste procedure for compost and digestate **Finland:** Valvira controls the quality of soil. Soil is used at least in green areas between roads, gas is used for heat and electricity generation, or as fuel for transport.	Soil quality should be checked and proved by certification, and the composted soil/ fertiliser/ biochar productised, so that it could be, for example, sold for big users, or for consumers in small bags in shops. There is always use for energy. **Recommended**	If the end user is not found, it is difficult to motivate municipalities for biowaste treatment – no nutrient recycling.
10. Information and education about biowaste collection benefits, directly to residents or by media	**Estonia:** Communication on TV, articles in newspaper, press releases, etc., but still needs to be done in future. **Lithuania:** Clear communication about benefits. **Poland:** Education of residents. **Finland:** Guiding and communication has been done for a long time already, but much more is needed. It may start even in kindergartens and schools.	People should be told about the benefits of biowaste collection, such as getting soil and energy, and nutrients recycling, and that wet biowaste lowers the heat value of the waste to be incinerated, which is not good. Also, that sorted waste is cheaper than mixed waste. **A must, recommended.**	It is an endless task; all inhabitants must be educated, and the message must be repeated. How can people be motivated? It takes time and effort, and everyone is not excited. Using the help of media to stop the spreading of myths.
11. Cooperation	**Poland:** Cooperation between local governments is needed. **Finland:** Communities and companies could have cooperation to try to make the system more effective and reasonable, e.g. by optimising transportation routes and possibly transporting household and commercial biowaste in the same car to cut down costs and emissions.	Cooperation is always good; it gives new ideas and support and possibilities to save resources. **Recommended**	It takes just a little time to arrange, but it is not always so easy.

6.1 Division of measures into economic, information, legislative and other kinds of measures

The measures described in Table 3 are divided into four different kinds by their influence mechanisms: economic, information, legislative and other kinds of measures. Economic measures include changes in fees, financial support and the sharing of free products, such as biowaste bins or composters. They could also include fines. Information measures include mostly education to enhance sorting and the separate collection of biowaste and guiding. It may require efforts to change attitudes and behaviour. Legislative measures aim to influence through legislation, such as stricter legislation about biowaste separation for every property and certifications for end-products. Other kinds of measures include measures that do not fit into the other categories, such as cooperation. This is a rough division and some of these measures could fall into more than one category.

Table 4: Division of measures into economic, information, legislative and other kinds of measures

Economic measures	**Information measures**
- Cheaper or no fee for biowaste collection, and higher fee for mixed waste - Free biowaste bins and paper bags - Advancing home composting with free composters - Possibility of less frequent emptying of mixed waste and therefore cheaper mixed waste fee for those who separate biowaste/compost at the property - Support for biogas (and composting) facilities	- Education on the benefits of biowaste collection, such as getting soil, energy and nutrients, by media and other ways (brochures, waste room posters, education at schools, etc.) - Giving free composting guides, and courses
Legislative measures	**Other kinds of measures**
- Mandatory biowaste collection or home composting mainly for every property - Creating demand for end-products (soil, fertilisers or biochar) by certification	- Possibility of using shared biowaste collection bins or composters or multicompartment bins - Cooperation between municipalities, and companies and municipalities

6.2 Additional information about the recommendations

6.2.1 Biowaste prevention, collection and home composting

Biowaste prevention

Preventing or reducing biowaste production is important, as it is the highest level in the waste hierarchy. In 2021 in Finland, there was a national biowaste campaign to reduce food loss and increase biowaste recycling. The "Love every crumb" campaign encouraged people to eat everything they prepare and not leave anything for waste [21]. Grocery stores sell products that are about to expire at a 30–60% discount. Buffet restaurants have changed to smaller plates to avoid food waste. Also, in Finland, there is new legislation to reduce food waste. Food business operators that produce or sell food must keep a record of the amount of food waste and how it is treated, and if it was consumable. They must give the unused edible food for human use if it is safe and can be done at a reasonable cost [22], [23].

Recently, the prevention of food waste has been considered also at the EU level. In the EU, it has been estimated that each person produces on average 130 kg of food waste annually, which is a large amount. The European Commission has set up a target that households, stores and restaurants must reduce their production of food waste by a third by 2030. In addition, the food waste from the food industry should be reduced by 10%. [24]

Biowaste collection

According to the European Commission, it is necessary that municipalities and companies pay special attention to the organisation of the separate collection of biowaste as legislation demands [25]. For those who do not want to compost, separate biowaste collection is a good choice. In Finland, there are new kinds of outdoor biowaste bins, which are ventilated. Biowaste can be stored in them before removal for up to four weeks. As more biowaste is collected, the amount of mixed waste should decrease, and the mixed waste bin could be emptied with less frequently, and in that way make savings. [26]

A biowaste bin can be shared between several neighbours. In a multicompartment service, the same waste truck can empty, for example, four sections at the same time and four different waste fractions can be sorted at a detached house (e.g. biowaste, cardboard, plastic and mixed waste). However, there is an extra payment for this special service and it is not available everywhere in Finland.

According to a study by HSY in the Helsinki metropolitan area, people feel that the lack of space for several waste bins in the kitchen, uncertainty over how to recycle (what exactly is biowaste), the lack of biowaste bins or paper bags, smell, the mess of sorting biowaste and the challenge of sorting are all hinderances to them separately collecting biowaste. Kitchens or dwellings should be developed so that there is enough space for waste bins, at least for biowaste and mixed waste. If there are big problems with separate collection of biowaste in the housing company, the biowaste bin could be further in the waste room and mixed waste first. The waste room should look nice and have lighting, if needed [16, 27].

Cheaper or no fee for biowaste collection

As an example, the price for emptying a 240-litre biowaste bin once a week in the Helsinki metropolitan HSY area is EUR 6.87. For a same size mixed waste bin, the price is EUR 9.46, so the biowaste price is around 73% of the mixed waste price in 2023. The biowaste collection price should be subsidised by the mixed waste fee. Also, if biowaste is not separately collected, it can be punished by higher payment for mixed waste.

Home composting

Home composting is a good choice for those who can use the soil produced in the process. It demands some work, but not too much. Some supporting media, such as leaves and woodchips or sawdust, is needed after putting food waste in a composter. The compost should be emptied about once a year, and it takes one to two years to produce soil with fertilisers from the process.

It is a good idea to conduct a study on how much biowaste is being home composted, so that it could be included in the waste statistics. Estonia plans to do this and Finland is already doing it.

In Helsinki metropolitan area, HSY gives free composting guides and courses (composting guide in Finnish [28]).

6.2.2 End products of biowaste and biodegradable packaging

Biochar

Biochar is a product made in a high temperature, under 700 ^{o} C with pyrolysis from, for example, sewage sludge or digestate, and it contains a lot of nutrients and releases them slowly into the ground.

Bioethanol

Bioethanol is, for example, fuel for cars, but it is not counted as recycling if the process produces only fuel and not also fertilisers.

Biogas from digestion

Anaerobic digestion produces biogas, which can be purified into biomethane. These can be used in the production of heat and electricity or as fuel for cars. Anaerobic digestion also produces wet digestate, which can be composted or made into fertiliser by heating to 70 ^{o}C, for example. Biogas grows the self-sufficiency of a country's energy balance. Biogas can also be liquefied. [29]

Finland has a National Biogas Programme 2020–2023, with 24 recommendations on how to promote the business [30]. There is a lot of potential for biogas energy production; it could be enlarged from one to four TWh by 2030, with around 50% coming from agriculture biomasses and food industry side streams[31].

Compost

Biowaste composting at home or at a plant produces compost, which is a sort of soil with nutrients.

Biodegradable packaging

Biodegradable plastic is not good for composting or biogas plants, and usually it must be screened away. There is a danger it might get stuck in equipment. Paper packages do not cause problems in biowaste treatment plants [32].

6.2.3 Information and extra payments

Information and education on biowaste collection benefits, directly to residents or by the media

There can be national campaigns, brochures (for residents and businesses, they can be on paper and on the internet), and education in kindergartens, schools, housing cooperatives, events, companies and so on. In Finland, municipal waste management companies give free education and guidance at many kinds of occasions. For example, one company, Vantaa Energy, which has an incineration plant, hired around ten people to work as “trash police”, and they provided recycling education, with some humour [33]. There was a lot of demand for such an initiative and it received a lot of positive feedback. [34] People should be told about the benefits of biowaste sorting and recycling and the harm of not recycling.

There should be articles and news in the media which aim to stop the myths and communicate the right information about biowaste recycling. It is important to ensure that all the separately collected biowaste is utilised and people are informed about that. Several different kinds of communication and education methods are needed, and constantly. The European Commission recommends campaigns and advice for residents [25]. Materials, such as instruction posters in the waste collection points, should include pictures, and some materials should possibly be written in several languages, so that those would be accessible for children and people from other nationalities.

Extra payments for incineration, stop for landfilling

The incineration of biowaste among mixed waste is common. The European Commission suggested adding taxes or other extra payments on incineration to reduce the amount of incinerated waste. In addition, there is no need for new incineration plants to be built, at least in Finland [25], where there is already too much incineration capacity, and possibly the prices for waste to energy have been decreasing. Lower prices for incineration might direct recyclable waste to incineration [35].

If wet biowaste is incinerated, it lowers the burning temperature, which is not optimal [8].

As a result of the 2016 Landfill Decree, about 0.4% of municipal waste ends up in landfills in Finland [6]. Landfilling organic waste should be stopped and municipal waste minimised to a maximum of 10% by 2035 according to EU Landfill Directive [4,5,36].

7 Summary

Separately collected biowaste recycling rates are relatively low in Estonia, Lithuania, Poland and Finland, and there is lot to do when it comes to enhancing biowaste recycling to better utilise biowaste nutrients and energy. The EU Waste Framework Directive 2008/98/EC, and its amendments, states that in Member States by 31 December 2023 biowaste must be collected separately or recycled at source and that the new municipal waste recycling targets are 55% by 2025, 60% by 2030 and 65% by 2035. In addition, the EU Landfill Directive 1999/31/EY, with its amendments, has been minimising biodegradable and, in the future, also municipal waste to landfills. At least in Finland the legislation has been even stricter since 2016, with about 0.4% of municipal waste ending up in landfills in 2021.

Organic waste is a problem in landfills, since it produces methane in the anaerobic circumstances of landfills. Methane is around 25 times more effective as a greenhouse gas than carbon dioxide, so biowaste in landfills is a cause of climate change, at least if landfill gas is not collected and utilised. In addition, in incineration plants, wet biowaste lowers the heat value of the waste, which is not desired.

This report aims to define the current situation regarding biowaste management and explore ways of enhancing it in the four countries studied. The recommendations provided are based on questionnaires and a roundtable discussion between the countries, some literature reviews and news.

According to the questionnaires and the discussion, the challenges in the four countries are quite similar. In addition, the treatment of biowaste in aerobic composting and anaerobic digestion plants is common in all four countries. There are differences when it comes to what is included in biowaste, recycling rates and targets.

The measures used in advancing separate biowaste collection can be divided into economic, information, legislative and other kinds of measures. Some of these measures can come under more than one category. The recommended measures used in these countries are:

Economic measures:

- Cheaper/subsidised or no fee for biowaste collection, and punishing mixed waste with higher fees
- Free biowaste bins and paper bags (if needed)
- Advancing home composting with free composters (if needed)

- Possibility of less frequent emptying of mixed waste resulting in a cheaper mixed waste fee for those who separate biowaste/compost at the property
- Support for biogas (and composting) facilities

Information measures:

- Education on the benefits of biowaste collection, such as getting soil, energy and nutrients, by media and other ways (brochures, waste room posters, education at schools, etc.)
- Giving free composting guides and courses

Legislative measures:

- Mandatory biowaste collection or home composting mainly for every property
- Creating demand for end-products (soil, fertilisers or biochar) by certification

Other kinds of measures:

- Possibility of using shared biowaste collection bins or composters, or multicompartment bins
- Cooperation between municipalities, and companies and municipalities

Many practices are already in use, and the aim is to increase the use of practices that countries have had good experiences with.

Based on our findings, the recommendations to enhance biowaste management also include:

- Prevention of producing biowaste in many ways, such as legislation for food waste producers, information campaigns, lower prices for expiring food and smaller plates in restaurants.
- Promoting home composting in many ways, since it is convenient and cost-effective.
- Developing the collection of biowaste, such as with ventilated biowaste bins if needed and kitchen planning, so that there is room at least for biowaste and mixed waste bins.
- Enhancing the treatment of biowaste by producing biogas or bioethanol, and biochar or fertiliser.
- Public and direct communication and education on the benefits of biowaste sorting and separate collection, which is considered crucial.
- Exploring measures for the minimisation of incineration, such as through taxation or other payments and waste landfilling bans.

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ANNEX 1: Biowaste questionnaire

This questionnaire was sent to Estonia, Lithuania, Poland and Finland.

1. How is the separate collection of bio-waste defined in the legislation of your country?
For example, is it all food waste and also garden waste, from households and other places?
When and under what circumstances do people/organisations have to separate it?
Do you also encourage composting?
How long has there been biowaste collection in your country (it might differ in different areas)?
How do you treat biowaste?

2. How have the roles of the state, municipalities and private actors been defined in organising and financing the collection of biowaste in your country?

3. How much of municipal biowaste is being separately collected in your country (what are the targets, have they been achieved)?

4. What policy instruments and practices are effective and good in promoting separate collection of biowaste in your country (best practices)?
For example, giving free paper bags for biowaste has been helping in rental buildings. Long-term guidance and communication has also been useful.
Also making it obligatory for all properties in some areas is effective.

5. What are the greatest challenges for the separate collection of biowaste in your country?

ANNEX 2: Answers to the Biowaste questionnaire of Estonia, Lithuania, Poland and Finland

Estonia/ Ministry of the Environment of Estonia

In Estonia, the separate collection of biowaste is defined in the Waste Act (§ 31 lg 4 and § 136[12]) and in the Minister of Environment regulation nr 12 (§ 2 and 3). The Waste Act says that local governments shall organise separate collection of biowaste at source unless it can be recycled at source. Biowaste is defined in Waste Act as: 1. Garden and park waste; 2. Food and kitchen waste from households, offices, retail premises, wholesale enterprises and caterers; and 3. Waste from food processing plants the composition and nature of which is similar to the waste specified in clause 2 of this section. 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 may be allowed to be collected at source together with biowaste. Local governments must bring the separate collection of biowaste at source or recycling at source into harmony with the provisions of subsection 4 of § 31 of this Act as of any new procurement for organised waste transport, but not later than by 31 December 2023. The waste included in the biowaste is introduced in Table 5.

It is required to collect biowaste separately in Estonia: The Waste Act says that all properties (including organisations and private properties) must collect biowaste separately from other waste and hand it over to a waste transportation company or alternatively compost on site. This includes both densely and sparsely populated areas in Estonia. There are differences between regions in biowaste collection. Biowaste collection already started in some municipalities in 2011, mostly including apartment buildings and catering establishments with a certain number of seats. Until now, the separate collection of biowaste has been organised mainly in densely populated areas. Mainly local governments have assumed that rural areas use biowaste composting on site. (More information, in Estonian [37].) In Estonia, all municipalities allow home composting instead of or in addition to biowaste collection. The conditions for composting vary in different municipalities, in some municipalities small apartment buildings are also allowed to compost. The local government determines the distance of a composter's location from a neighbour's border. If composting food and kitchen waste, the composter does not need to be isolated, but it has to be closed on the top and the sides to prevent access by rodents. The Environmental Investment Centre has provided funding to municipalities to buy home composters or biowaste bins for households.

Biowaste is used mainly as compost production in Estonia. The main treatment plant is the Tallinn Waste Recycling Center. Smaller plants are located all over Estonia, including Väätsa, Paikuse and the Torma landfill. The first biogas plant, which produces gas only from biowaste, started production in December 2022 in Maardu. It has capacity to treat 20,000 t of biowaste

annually. Biogas is mainly produced from livestock manure, but there is potential to treat biowaste with manure. Some biogas plants have already introduced such treatment.

Biowaste should be treated in such a way that it can be considered recycled. This means compost is certified according to the regulation by the Minister of Environment nr. 7 "Requirements for producing compost from biodegradable waste" and digestate from biogas production is certified according to the regulation by the Minister of Environment nr. 12 "Requirements for digestate from biowaste digestion". This means it is possible to provide certification for compost and digestate.

In Estonia, local municipalities are responsible for separate biowaste collection, doing it through organised waste collection. If necessary, local municipalities must check composting and implement various measures for this purpose. The collection of biowaste is financed through a collection fee paid by waste holders.

To increase separate biowaste collection and recycling rates, the state has support measures with several new opportunities to promote waste management and circular economy.

Biowaste recycling targets in Estonia

The current recycled amounts and targets are introduced in Table 1 and Table 5. The biowaste recycling rate has slightly increased since 2014, but the goal is still too far off to achieve. Since 2019, the biowaste recycling rate even decreased due to the recycling methodology specification and smaller garden waste recycling amounts. One of the main reasons for the low recycling rate is municipalities, which have not included separate biowaste collection as organised waste collection or have done so but insufficiently. Biowaste is only taken into account as recycled when it is certified according to the Minister of Environment regulations nr 7 and 12. Site composting is not currently considered in the statistics. It is planned to include it in the 2025 waste statistics.

Table 5. Biowaste amounts in Estonia. *

Biowaste amounts according to method IV	2014	2015	2016	2017	2018	2019	2020	2021
Separately collected (tons)	29 660	25 104	32 326	37 391	38 406	42 398	34 342	45 028
Total amount (tons)	123 971	123 091	130 905	137 003	141 174	135 255	135 269	145 460
Recycled amount (tons)	11 547	14 282	20 159	24 383	30 993	23 720	28 724	34 739
Recycling rate %	9.3%	11.6%	15.4%	17.8%	22%	17.5%	**21.2%**	**23.9%**
Separately collected rate %	23.9%	20.4%	24.7%	27.3%	27.2%	31.3%	25.4%	31.0%
Recycled + noncertified rate %	9.3%	14%	15.4%	17.8%	22%	25.4%	31.5%	31%

*Clarifications for Table 5. The table relates to the total generation of biowaste. The total amount presents all the generated biowaste annually. *Separately collected* means biowaste that is separately collected at the source. Biowaste that is included in mixed municipal waste is calculated according to the average proportion found in the sorting survey in 2020. (The average biowaste proportion in mixed municipal waste was 32% according to the survey conducted in 2020).

Recycled rate presents only certified compost and digestate, according to the recycling code R3o - biological recycling, including composting and other biological treatment processes. [38].

Recycled + noncertified rate presents the amount of biowaste that is taken into use mainly as a compost or for biogas production. This includes recycling with the codes R12o and R3o.

Since 2019, the Environmental Board, which is responsible for environmental permits, does not determine recycling code R3o to companies which have not certified their compost or digestate. That is why the data starts to change between recycled rate and recycled + noncertified rate.

To achieve the 70% recycling rate in 2028, separate collection from all properties in Estonia is needed no later than 31 December2023 and the provision of funding for development of new recycling capacity is necessary. Also, biowaste treatment plants must be built in those regions where they are currently not present, based on the principle of proximity and primarily (primacy).

Good practices and challenges in Estonia

Some practices and policy instruments have been effective in the separate collection of biowaste in Estonia. For example, in some areas, where biowaste collection is obligatory already (e.g. in the Jõelähtme municipality), the proportion of joined waste holders is very high (97%) and biowaste proportion from collected municipal waste was as much 25%. In Jõelähtme, a biowaste bin was provided for every household without a fee (the cost is included in collection fee for the next five years). If biowaste is put into the bin, the collection fee is cheaper than in the case of an empty biowaste bin.

The Environmental Investment Centre has supported local government units in the purchase of biowaste containers and composters. The support will continue this year for municipalities which have not had support before and do not have a high level of separate collection. Some municipalities have also shared paper bags and biowaste bins with residents.

The greatest challenge is inactive participation and a lack of interest among residents. Another related challenge is the spread of incorrect information, which is why there is sometimes resistance towards changes in biowaste management. Furthermore, biowaste recycling capacity is insufficient. There is a lack of motivation and poor demand for using the resulting product, so people may stop sorting biowaste or treating it. Further processing of biodegradable waste is considered expensive and too complicated. The opposition of residents and the long processing time for the required permits often hinders the establishment of new treatment solutions.

Lithuania/ Ministry of the Environment of Lithuania

In Lithuania, separate garden waste collection started in 2015, when municipalities established separate garden waste collection. Separate food waste collection from households started in 2019, when cities with more than 50,000 inhabitants should have been provided with separate food waste collection. Separate biowaste collection should be provided to households in urbanised areas with more than 2,000 inhabitants or ensured composting on site from 2024. Hotels, restaurants and other public catering establishments, food production and trading companies must sort biowaste at the place of its generation, and not mix it with other waste.

It is planned to encourage home composting by reducing the local fee for the collection of municipal waste. Separately collected biowaste is treated in composting or anaerobic digestion plants.

There is a local fee for municipal waste, but not an additional fee for the collection and/or composting of biowaste. Companies pay individually depending on the private company they are making an agreement with.

There are no targets for the separate collection of municipal biowaste, except general targets for recycled municipal waste, which are similar to the targets for recycled municipal waste in the Waste Framework Directive.

Good practices and challenges in Lithuania

In Lithuania, some practices are considered effective in promoting the separate collection of biowaste. For example, clear communication on the benefits of separate biowaste collection is considered effective.

The biggest challenge is to encourage the inhabitants of multiapartment buildings to separately collect biowaste. It takes time to adjust to new habits.

Poland/ Chief Inspectorate of Environmental Protection

On 1 July 2017, the Uniform Waste Segregation System was introduced in Poland. It includes an obligation to segregate municipal waste divided into fractions, including biowaste. Currently, it is mostly “green waste” – one of the types of biowaste. This includes, among other things, tree branches and shrubs, mowed grass, leaves and flowers, and tree bark. From 1 July 2021, there has been an obligation for the selective (separate) collection of the following waste fractions: paper, glass, metals, plastics, multi-material packaging waste and biowaste. Not all biodegradable waste can be thrown into a biowaste container. The law clearly defines what can be placed in a container. The waste included in biowaste is described in Table 1. Selectively

(separately) collected biowaste should be managed in the organic recycling process (i.e. primarily composting and/or fermentation).

In Poland, home composting is possible and recommended. For single-family residential buildings, composting biowaste in a home composter gives a partial exemption from the fee. Registers of home composters could be useful.

In Poland, only two types of biorecycling are known and recognised by BAT (Best Available Technology): aerobic composting, which produces compost that is necessary for the soil, and anaerobic digestion, which produces liquid digestate, solid digestate and biogas.

Over the last several years, legal regulations in the field of biowaste management have become more dynamic. Development of legislation in this area is at the level of both European Union law and national law. The main goal is to remodel the linear economy into a circular economy, which aims to introduce and maintain a circular supply chain in the production process.

The statutory obligation of municipal governments is to ensure an organised system for the collection of all types of municipal waste, construct and operate installations (own, joint with other municipalities or entrepreneurs) for waste recovery and disposal and ensure the conditions for limiting the weight of biodegradable municipal waste directed to landfill. The commune should cooperate with entrepreneurs operating in the field of waste collection, whose duty is to organise a system of selective (separate) waste collection and direct the implementation of a system limiting biodegradable waste for landfilling.

Polish communes may reduce waste collection fees for those residents who declare that they carry out home composting of biowaste. However, the discounts here are not significant and do not correspond to the actual reduction in the mass of waste collected from households. The weight of biowaste generated in households with large gardens may exceed even 50% of the weight of all waste. Reducing the fee may be too low a motivation to encourage residents to introduce such a solution.

The waste producer bears the costs of biowaste. The municipalities are responsible for maintaining cleanliness and order in the municipalities. They ensure the construction, maintenance and operation of installations for processing municipal waste. They cover all property owners in the commune system of municipal waste management. They supervise the management of municipal waste, including the implementation of tasks entrusted to entities collecting municipal waste from an owner's property. They ensure selective (separate) collection of municipal waste, including at least: paper, metals, plastics, glass, packaging waste multi-material and biowaste. They conduct information and educational activities in the field of correct selective (separate) collection of municipal waste.

The municipal waste management fee is the income of the commune, and it can be used only for purposes covering the costs of the municipal waste management system. The commune covers the costs of operating the municipal waste management system:

1) collection, transport, recovery and disposal of municipal waste
2) creating and maintaining points of selective (separate) collection of municipal waste
3) administration of this system
4) environmental education in the field of proper handling of municipal waste.

The commune may also cover the costs of equipping the property with containers or bags for collecting municipal waste and the costs of maintaining the containers in an appropriate sanitary, orderly and technical condition.

Recycled amounts of biowaste in Poland

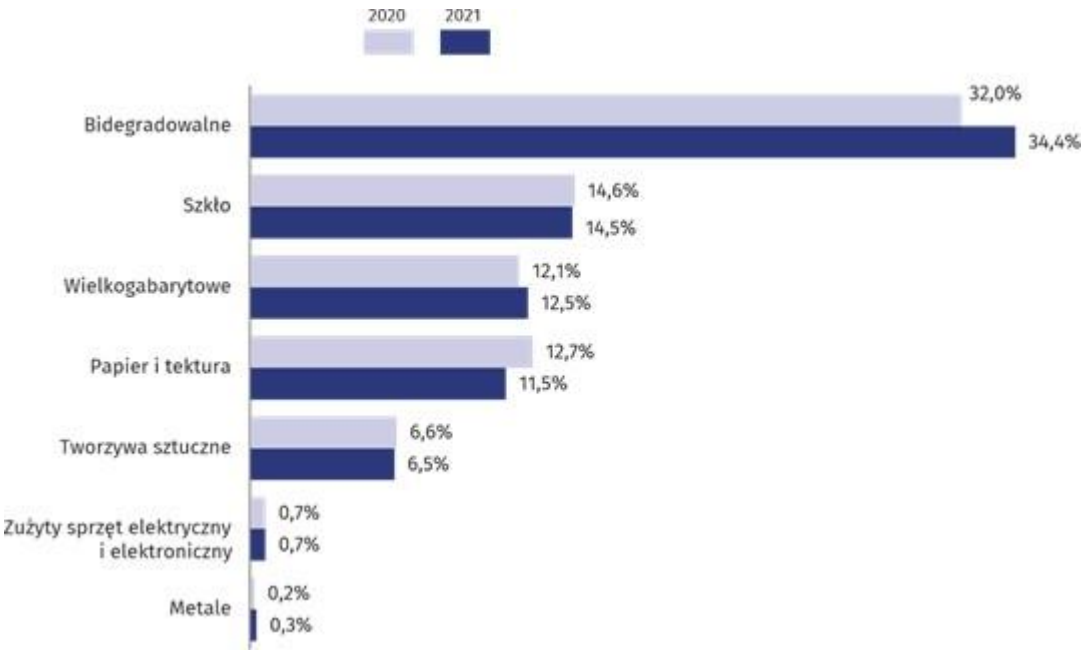
The amount of generated municipal waste depends not only on the population but also on consumption patterns. Clearly visible is the differentiation between the voivodships (communes) in the western and eastern parts of the country. In the west, much more municipal waste is generated per capita than in the east.

Over the years, the structure of selectively (separately) collected municipal waste has changed. The fractions of waste that dominated in 2005, such as paper and cardboard, glass and plastics (80% of selectively (separately) collected waste) currently account for 33 %. Currently, biodegradable waste has the largest share in selectively (separately) collected municipal waste (see Table 1). The data contained in the draft National Waste Management Plan 2028 (KPGO 2028) show that food (kitchen) waste as well as green and other biowaste constitute approximately one third of the total municipal waste stream (Picture 2).

In Poland, there is a Waste Database, administered by the Ministry of Climate and Environment. The database includes entities that: generate waste and keep records of waste; they introduce packaged products, vehicles, oils, lubricants, tyres, batteries or accumulators, as well as electrical and electronic equipment to the domestic market; producers, importers and intra-community buyers of packaging.

There is a risk that Poland will miss the EU‘s recycling targets for municipal waste and all plastic waste.

Picture 2 shows the shares of different waste fractions of selectively (separately) collected municipal waste. In the 15 million tons of municipal waste that is generated annually in Poland, more than 30% is biowaste – i.e. 5 million tons, the largest waste group.



Picture 2. Share of selected waste fractions in the total amount of selectively (separately) collected municipal waste. Biowaste comes first, 49 kg per capita (42 kg in 2020), then glass, large-size, paper and cardboard, plastics, waste electrical and electronic equipment and then metals. The information is taken from the report of Municipal waste management in the Mazowieckie Voivodship in 2021.

Good practices and challenges in Poland

In Poland, both cooperation between local governments and the education of residents are necessary for the effective implementation of effective municipal waste collection. These are considered good practices in promoting the separate collection of biowaste.

According to the answers to the questionnaire, there are many challenges concerning biowaste management in Poland. There is a lack of infrastructure for processing biowaste, so Issues with further processing of biowaste (the need for construction or modernisation of a recycling installation in accordance with the defined scope demand, including installations for the fermentation of biowaste to produce biomethane, electricity, heat and cold). There is also misinformation, such as why segregate waste when one car takes all the waste? This kind of false information discourages some people from segregating waste.

Biowaste should be treated as the most valuable raw material that can fertilise the soil and be a source of clean and renewable energy. Further systems and models for the collection of biowaste will be developed. With the increase in the awareness of inhabitants, the purity of the biowaste fraction will increase, and more and more biowaste will be collected. This must be associated with the systematic development and increase in the number of biowaste recycling installations.

Finland/ Ministry of the Environment of Finland

In Finland, most of the municipalities, accounting for 98% of country's population, have organised their waste management by communal waste management companies. They often have their own waste management treatment plants for biowaste, but transport services are tendered out from private companies. Private companies can buy waste management services directly from private waste transport companies.

According to the Government Decree on Waste (978/2021, 17 §), "the municipality shall organise the separate collection of residential biowaste other than garden or park waste at least from every property with five or more dwellings that is situated in a locality. In localities of more than 10,000 inhabitants, the municipality shall organise the separate collection (referred to in subsection 1) from every property with at least one dwelling. The obligation (laid down in subsections 1 and 2) does not apply to properties whose biowaste is treated on a small scale in accordance with the provisions of section 41a of the Waste Act." This means usually composting. These rules apply from 1 July 2022, but at the latest 1 July 2024, if biowaste collection was organised before by property owners.

In Finland, municipalities must have places where inhabitants can bring their waste, such as garden waste, for treatment. Section 12 of the decree and communal waste management orders explain how composting at the property can be done; for example, the composter should be heat-isolated and protected from rodents. According to the same decree (21 § Separate collection of waste other than residential waste, i.e. company waste), "the waste holder shall organise the separate collection of municipal waste from every property situated in a locality or in a service, tourism or workplace zone covered by a local detailed plan or a local master plan at least as follows: biowaste other than garden or park waste if the quantity generated in a week is at least ten kilograms and it is not treated on a small scale (as laid down in section 12)." Garden waste should be collected separately if possible.

The separate collection of biowaste began in the 1990s in Finland in some areas, at least in the Helsinki metropolitan area. Biowaste is treated at composting and biogas facilities. Quite many people compost biowaste themselves. If biowaste is composted at a property, the waste owner must give information about the treatment to the municipality, and the municipality must keep a record of composters. The Finnish Environment Institute SYKE is conducting a study on how much biowaste is composted at homes.

To reduce food waste, food business operators that produce or sell food must keep a record of the amount of food waste and how it is treated and if it is consumable. Also, under 29 §, food business operators must make unused edible food available for human use if it is safe and can be done at a reasonable cost (more information [12], [13]).

In Finland, the state's role in waste management is mostly in passing legislation. There are Economic Development, Transport and Environment Centres (ELY centres), which supervise

waste treatment plants. Municipalities organise waste management for households and municipal services. They also control waste management. Private actors sell waste management services to municipalities and companies.

Waste producers pay all the costs of biowaste collection. No taxpayer or state money is used for that. Only biogas facilities can get some support from the Ministry of Agriculture and Forestry in Finland.

Biowaste recycling targets in Finland

In the Finnish National Waste Management Plan, there is a target to recycle 65 % of the biowaste in municipal waste by 2027. In 2020, the separately collected amount of biowaste was around 40% (see Table 1). The most recent statistics are under revision and should come out during summer 2023.

It seems that the EU Waste Directive recycling targets for municipal waste, at least 55% by 2025, 60% by 2030 and 65% by 2035, will probably not be met. However, biowaste legislation came into force on 1 July 2022, and it will be applied according to different schedules in different parts of the country, so the development will be seen later.

Good practices and challenges in Finland

In Finland, effective practices include giving free paper bags for biowaste, which has been helping in rental buildings. Also, long-time guidance and communication have been useful, but there should be much more. Making the separation of biowaste obligatory for all properties in some areas can be effective and promote composting. People can also sort biowaste in a common bin, several detached houses together or use a common composter.

There are also issues concerning biowaste management in Finland. Finland is a sparsely populated country, especially in the north and east, with long distances and small amounts of biowaste. Also, the collection system is divided into municipal and company biowaste, which are collected separately. It is not always cost-effective and reasonable according to emissions to collect biowaste everywhere in these circumstances. Communities and companies should cooperate to make the system more effective and reasonable. It is also a challenge to get some people to separate biowaste and to change their behaviour, even when there is a lot of communication and advice available.