LIFE BIOBEST

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LIFE BIOBEST

GUIDING THE MAINSTREAMING OF BEST BIO-WASTE RECYCLING PRACTICES IN EUROPE

D5.2: Policy brief including the regulatory barriers

WP5: Policy and Regulatory Recommendations for bio-waste

T5.1: Identifying and analysing policy and regulatory barriers for the production of high-quality compost and digestate from bio-waste

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1 Document attributes

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1.1 Document Management Control Sheet

Table 1. Document Management Control Sheet

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1.2 Document Revision History

Table 2. Document Revision History

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0.3	05/12/23	3rd Draft	Document created as 3rd version to be distributed	ENT – Mike Stinavage, Gemma Nohales
0.4	15/12/23	4th Draft	Peer reviewers' contributions in track changes	CIC and ECN ENT-Ignasi Puig-Ventosa
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0.7	31/1/24	Definitive/ Approved	Final linguistic and format revision Definitive and approved version to be submitted	ENT – Mike Stinavage, Gemma Nohales
0.8	1/2/24	Submitted	Submitted to Participant Portal in PDF	ENT - Gemma Nohales

1.3 Report Overview

While EU waste legislation is commendable in its scope and comprehension, bio-waste policies are not actively or uniformly being implemented within and across Member States (MS). Based on existing research, policy initiatives set forth in the Waste Framework Directive (WFD) and Landfill Directive (LD) are not reaching the objectives and the intended results.

Ahead of the EU recycling mandates expected in January 2024, LIFE BIOBEST identifies the systemic barriers affecting bio-waste separate collection and treatment with the goal of providing know-how and increasing transparency of the struggles entities face when implementing EU waste policy.

To this end, section 2 introduces and analyses the existing legal framework. Sections 2.1.1 and 2.1.2 analyse the WFD and LD and support the finding that bio-waste recycling and landfill target compliance is lacking across the MS. In section 2.1.3, a detailed summary of the cross-cutting legislation demonstrates that bio-waste management has wide reaching implications and can be a driver of many sectorial policies. As explained in section 2.2, the European Commission is following the level of compliance in the Early Warning Reports and Environmental Implementation Reviews.

In sections 3 and 4, LIFE BIOBEST identifies the gaps in the regulatory framework and barriers obstructing efficient bio-waste management. By showing the frequency and distribution of barriers categorised by topic (Legal/Administrative, Economic, Organizational, Technical), level of governance (EU, National, Regional, Municipal), and step in the bio-waste cycle (Collection (C), Treatment (T), Use of outputs (U) and Quality (Q)), the goal has been to disaggregate the barriers to provide a wide and comprehensive view of the constraints and bottlenecks—a necessary step towards the design of corrective measures. Using various information capturing tools and a sample size of 14 MS, LIFE BIOBEST detected a wide range of barriers distributed across MS.

In section 5, the calls to action leverage findings to minimize the impact of the detected barriers, thereby providing detailed and practical recommendations.

The final goal of this study is to facilitate the closure of the bio-waste loop by implementing efficient bio-waste management solutions that make progress towards the EU objectives and maximize the return of quality compost and digestate to the soil.

1.4 Table of Acronyms

Table 3. Table of Acronyms

Acronym	Term
AD	Anaerobic digestion
ABPR	Animal By-product Regulation
BP	Best practice
CR	European Commission Country Report(s)
D	Deliverable
DtD	Door-to-door
EC	European Commission
EU	European Union
EWR	Early warning report(s)
FPR	Fertilising Product Regulation
GW	Garden waste
KPI	Key performance Indicator
KW	Kitchen waste
LD	Landfill Directive
MBT	Mechanical biological treatment
MS	Member State(s)
RW	Residual waste
Tpa	Tonnes per annum
WFD	Waste Framework Directive
WP	Work Package

1.5 LIFE BIOBEST Project Summary

EU obligations on the selective collection of bio-waste will come into force at the end of 2023, increasing the availability of source-separated bio-waste for composting and anaerobic digestion. To ensure the development of bio-waste management best practices and the production of quality compost and digestate for soil applications, while minimizing any negative effect and closing effectively the loop, a comprehensive analysis is required regarding bio-waste management strategies, instruments and management schemes and their results given that large disparities exist among experiences in the EU.

The LIFE BIOBEST project aims to identify and validate the current Best Practices (BP) and management instruments along the bio-waste management chain (from generation to treatment) that allow the production of quality compost and digestate and establish a series of reference Key Performance Indicators (KPI), based on the analysis of existing databases and experiences. Through interconnected co-creation meetings with relevant expert stakeholders of the sector, solutions will be provided to overcome the identified technical, regulatory, economic and environmental barriers to widely adopt the proposed BPs.

A comprehensive EU-wide guide will be created, together with two decision-support tree guides for local and regional authorities to adapt bio-waste management models to their specific context, offering feasible BP and management instruments to promote efficient collection and subsequent recycling of bio-waste into quality compost and digestate.

By means of an analysis of the input materials, treatment practices, resulting compost and digestate quality, a proposal for premium European standards for biological waste entering composting and anaerobic digestion will be developed with the ultimate goal of promoting the certification of these materials and treatments, guaranteeing optimal management processes and a safe return to the soil.

The outcomes of LIFE BIOBEST will promote a significant improvement of the collection and treatment systems, and consequently of the quantity and purity of the input material, reducing process losses and favouring the conversion of bio-waste into high-quality compost and digestate.

The LIFE BIOBEST consortium is led by Fundació ENT (ENT) in partnership with Consorzio Italiano Compostatori (CIC), ACR+ (Association of Cities and Regions for Sustainable Resource Management), European Compost Network (ECN) and Zero Waste Europe (ZWE). It is a 2.5-years LIFE Preparatory Project funded by the European Commission.

Project Total Eligible Costs: €1,664,600.07, Funding Rate: 90%, Maximum Grant Amount: €1,498,140.05.

2 Introduction

On the eve of the European Union mandate expected in January 2024 for bio-waste separate collection, the vast majority of EU MS, regrettably, do not fully comply with the 2024 obligation of separate collection across all its municipalities. While collection systems may exist, the capture and the quality of separately collected material must be improved, especially for food waste.

Despite bio-waste's numerous possible benefits, its management exists with inconsistencies that prevent it from reaching full potential. The identification and analysis of barriers are therefore in order.

The evaluation of barriers is a critical step towards dismantling them. This work will assist local, regional, national and EU authorities and stakeholders in introducing changes needed to produce high-quality compost and digestate products, remove bottlenecks, solve loopholes, and improve harmonised implementation.

To make progress towards such goals, this study investigates the status of transposition of the EU legal framework and the barriers obstructing successful implementation and objective compliance. A wide range of barriers thwarting the practical application and implementation of waste policy have been identified and categorised.

LIFE BIOBEST's goal is to supplement Article 22 of the WFD, as well as the complementary articles about bio-waste management, which call for the mandatory implementation of bio-waste separate collection, with comprehensive calls to action.

2.1 Existing Legal Framework in the EU

Municipal waste includes waste generated by households and waste from other sources that is similar in nature and composition to household waste, such as from small commercial businesses and public institutions (Directive EU/2018/851). Due to its material composition, the pervasiveness of its generation, and connectedness to society and public and environmental health, municipal waste is a complex waste stream.

Bio-waste accounts for 34% of municipal waste, making it the largest single component of the municipal waste stream in the EU (van der Linden and Reichel, 2020). Food waste accounts for about 60% of bio-waste, yard waste being the other major fraction. Given its quantity, biodegradability and composition, bio-waste management is a critical issue.

The EU has passed cross-cutting legislation that targets bio-waste implementation from multiple angles, which are not limited to the following policy areas: agriculture, emissions, fertilisers, pollution, packaging, soil health (see section 2.1.3). Among them, the European Commission adopted the Circular Economy Action Plan (CEAP) in March 2020, which is one of the main building blocks of the European Green Deal.

The Circular Economy Package in 2018 is the core of EU laws targeting waste prevention, management and material cycles. It includes the following EU updated directives:

- amending Directive 2008/98/EC on waste (WFD),
- amending Directive 1999/31/EC on the landfill of waste (LD),
- amending Directive 94/62/EC on packaging and packaging waste (PPWD),
- amending Directives 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic,
- complementarily, it was drafted the Directive (EU 2019/904) on the reduction of the impact of certain plastic products on the environment, better known as Single-Use Plastics Directive, or SUP, was passed in June 2019 and came into force on 3 July 2021.

Transposition and implementation, however, have been achieved with varying levels of success, both across MS and within them. The discrepancies in transposition and implementation reveal the regulatory gaps of these EU directives and the existence of governmental weaknesses.

Most relevant provisions related to bio-waste management are in the WFD (The European Parliament and the European Council and Directive 2008/98/EC, 2008) and in the LD (Directive (EU) 2018/850, 2018). The PPWD and SUP are limitedly related to bio-waste in the discussion of compostable packaging and plastics materials. The coming sections will present in-depth discussion of the WFD and LD and the regulatory gaps revealed through their implementation.

2.1.1 Waste Framework Directive

The revised WFD sets forth obligations and objectives that push forward a new performance standard for municipal waste management in the EU. The framework obligates separate collection of bio-waste, aims at achieving higher levels of material recycling and mandates MS to adopt the measures and objectives set therein. The WFD passed in 2018 is a revision of the 2008 WFD.

Figure 1. Priority topics of the Waste Framework Directive

Table 4. Contents of the revised WFD referring to bio-waste management

Priority Topic	Revised WFD
Separate collection	Member States shall collect bio-waste separately by 31 December 2023 (Article 22 (1)). Derogations for environmental, technical, and economic reasons are included in the text (Article 10 (3)). By 31 December 2021, Member States shall submit a report to the Commission on the implementation of Article 10 as regards bio-waste, including on the material and territorial coverage of separate collection and any derogations under paragraph 3 (Article 10 (6)).
Bio-waste not separated at origin	As of 1 January 2027, municipal bio-waste entering aerobic or anaerobic treatment may only be counted as recycled if it has been separately collected or separated at source (Article 11a (4)) - MBT will no longer count towards recycling targets.
Recycling targets	• by 2025, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 55 % by weight; • by 2030, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 60 % by weight; • by 2035, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 65 % by weight. (Article 10).
Calculation of recycling targets	The amount of municipal biodegradable waste that enters aerobic or anaerobic treatment may be counted as recycled where that treatment generates compost, digestate, or other output with similar quantity of recycled content in relation to input, which is to be used as a recycled product, material or substance. Where the output is used on land, it may

Priority Topic	Revised WFD
	only be considered as recycled if resulting in agriculture or ecological improvement (Article 11a (4)). End-of-waste materials to be used as fuels or other means to generate energy, be incinerated, backfilled or landfilled, cannot be counted towards the recycling targets (Article 11a (5)). Implementing acts establishing rules for the calculation, verification and reporting of data, in particular as regards bio-waste separated and recycled at source shall be adopted by 31 March 2019 (Article 11a (9)). For additional information, see section 2.1.1.4.
Inputs into final recycling process	The Commission will monitor national criteria and will, when necessary, adopt implementing acts that specify the permissible waste inputs for the recovery operation (Article 6 (2a)).
Specific recycling target for bio-waste	By 31 December 2024 the Commission shall consider the setting of recycling targets for municipal bio-waste (Article 11 (6)).
Collection target for industrial bio-waste	By 31 December 2024, the Commission shall consider the setting of recycling targets for commercial waste and non-hazardous industrial waste (including bio-waste) (Article 11 (6)).
Incentive schemes dedicated to bio-waste	Member States shall make use of economic instruments and other measures to provide incentives for the application of the waste hierarchy such as those indicated in Annex IV or other appropriate instruments and measures (Article 4 (3)). Member States will promote the use of materials produced from bio-waste (Article 22 (2c)).
Bio-waste definition allowing for biodegradable or compostable bioplastics in collection of bio-waste	Member States may allow waste with similar biodegradability and compostability properties to be collected together with bio-waste if it complies with European or equivalent national standards (Article 22 (1)).
Standard for organic recycling	Mandate for the development of a European standard for bio-waste entering organic recycling processes (Article 22 (3)) (not yet available).
Home composting	Member States shall encourage home composting (Article 22 (2b)).
Food waste reduction	An indicative Union-wide food waste reduction target of 30% by 2025 and 50% by 2030 is included (Recital 12).
Non incineration of bio-waste	Bio-waste shall not be incinerated (Article 10 (4)).

Source: based on the revised WFD summary made by ECN (European Compost Network, 2018)

The following sections evaluate the key elements of the WFD related to bio-waste: its overarching framework umbrella, the Waste Hierarchy and prevention obligations, as well as the main pillars that uphold the policy measures.

2.1.1.1 Umbrella: Waste Hierarchy and priority prevention obligations

The Waste Hierarchy sets the following priority order when shaping waste policy and managing waste at the operational level: prevention, preparing for reuse, recycling, recovery and, as the least preferred option, disposal (which includes landfilling and incineration without energy recovery).

Figure 2. WFD and Waste Hierarchy applied to bio-waste

Source: Figure left, European Commission WFD webpage (web). Figure right, hierarchy applied to bio-waste, ISLR (Institute for Local Self-Reliance, 2017)

As a matter of priority, MS shall prevent and reduce the generation of food waste[1] (Art. 9 of WFD) as a contribution to the United Nations Sustainable Development Goal to reduce by 50 % the per capita global food waste by 2030. Food donation and other redistribution for human consumption shall be encouraged by MS, prioritising human use over animal feed and the reprocessing into non-food products.

To define and deploy these strategies, MS must adopt specific food waste prevention and reduction measures within their waste prevention programs (Art. 29 of WFD).

[1] The article specifies the application of prevention measures in primary production, in processing and manufacturing, in retail and other distribution of food, in restaurants and food services as well as in households.

2.1.1.2 Pillar 1: Separate Collection of bio-waste

MS are legally obligated to separately collect bio-waste by 31 December 2023 (Art. 22 of WFD) and, at that point, as a parallel obligation, bio-waste shall not be burned (Art. 10 (4) of WFD) or landfilled (see section 2.1.2).

The call for bio-waste separate collection and recycling must be translated into efficient management models, which should be aligned with incentives and governance mechanisms. For more information, please refer to section 4.1.3 and section 4.2.3. Other intermediate approaches that result in low implementation, coverage, participation or quality will be considered a misinterpretation of the legal framework, especially Art. 22 and 11 of WFD and Art. 5 of LD, and the desired scenario.

Bio-waste is a backbone of MSW management as it is key to achieving recycling (see section 2.1.1.3) and landfilling objectives (see section 2.1.2) and preventing contamination of other recycling waste streams.

2.1.1.2.1 Quantity and quality

As shown in Figure 3, there are varying levels of implementation and outcomes in terms of bio-waste capture (especially for kitchen waste) in Europe. The current data and experience investigated in LIFE BIOBEST project (see D3.1 Guideline on separate collection and BPs report annexed), demonstrate that the levels of capture and quality of bio-waste depends on the following key elements:

- The organic sub flows[2] collected and the extent to which they are comingled[3,4].
- The type of collection system used.
- The frequency of bio-waste collection and its value related to the frequency of residual waste. It is important to adjust the bio-waste frequency to cover the necessities of delivery according to the storage possibilities and the climate conditions.

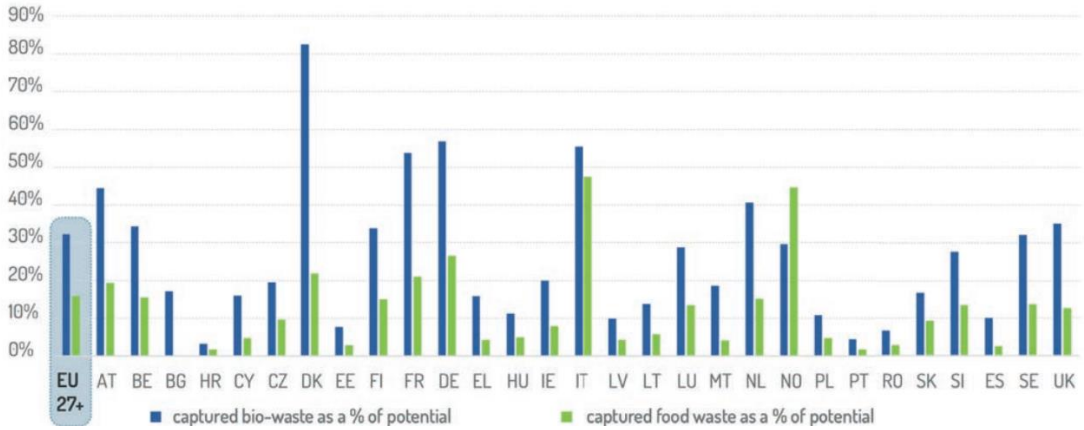
[2] Collection model sub flows refer to specific streams like food waste (with or without cooked materials), green waste, pruning waste, vegetal and garden fraction, etc.

[3] As per the report from BIC & ZWE, "*Adapted from Bio-waste generation in the EU: Current capture levels and future potential",* comingled and separate food and garden waste lead to different results. When separated, higher capture levels of kitchen waste are achieved.

[4] For the specific case of commercial activities that distribute packaged foods such as supermarkets and groceries, it is important to establish protocols to manage the discarded packaged foods that are expired or in poor condition. Protocols must define the procedures to deliver these products to specific intermediate unpacking facilities, to biological treatment facilities with pre-treatment lines designed to open and extract the packaging or to carry out the unpacking task in the same facilities of the activity before the delivery to the assigned collection service.

- The reduction of the residual fraction delivery frequency to the collection system (access to the collection service), which results in a higher diversion of the recycled flows.
- The implementation of individualised models that identify the user and allow the control of the quality, such door-to-door (DtD) schemes.
- The communication actions that accompany the model implementation and operation.

Figure 3. Captures of bio-waste and food waste in the EU 27, in proportion to the theoretical potential



Source: BIC & ZWE, Adapted from Bio-waste generation in the EU: Current capture levels and future potential (Favoino and Giavini, 2020)

Achieving high quantities of separately collected material does not signify that it will return to the soil as compost or digestate. This is only possible in case of compliance with the EU or national regulations on fertilisers or soil amendments and/or with the demand of the agricultural sector (type of compost/digestate, quantities and quality).

Thus, one of the essential conditions for effective bio-waste recycling is the presence of low levels of impurities (physical contaminants) and other types of contaminants[5] since this guarantees the production of quality compost and digestate, thereby closing the bio-waste loop.

[5] According to the report from ISWA "A Practitioner's Guide to Preventing and Managing Contaminants in Organic Waste Recycling", bio-waste contaminants are "an undesirable item, chemical substance or biological material in organic waste and/or its recycled product that has the potential to adversely affect the recycling process and/or the recycled end product(s) (i.e., compost or anaerobic digestate). There are 3 types of contaminants: a) Physical – these are generally large, visible items such as plastics, metal items, glass and stones. b) Chemical – these are organic and inorganic chemicals derived from natural and man-made sources. Examples include pesticides, persistent organic pollutants and heavy metals. c) Biological – these occur naturally and are often intrinsic parts of some organic wastes. They include, for example bacterial and fungal pathogens, weeds seeds, plant propagules and toxins (Gilbert and Ricci-Jürgensen, 2023).

Currently, Article 22 of WFD requires that MS set up separate collection schemes for bio-waste without specifying the quality standards, mainly in terms of the level of impurities, but some MS are introducing their own regulations. The new EU calculation method (see section 2.1.1.4) establishes that, after subtracting any rejects, the collected flows can only be counted as recycled if the compost and digestate output is effectively returned to the soil.

Therefore, the quality of collected bio-waste must always be considered alongside quantity. The first steps towards high-quality recycling and closing the loop are proper separation at the source and models that allow the direct control of the quality.

Models should be designed and deployed to obtain the lowest level of impurities in the collected bio-waste. Ideal values are less than 2% of impurities, expressed by weight, but always with a recommended threshold of 5% (MAGRAMA, 2013). Bio-waste with more than 10% of impurities makes valorisation hardly feasible as this degrades the value of the produced fertilisers (Dubois *et al.*, 2020).

Based on an extensive database available in Catalonia (Spain) on the level and type of impurities within separately collected bio-waste, it was statistically proven that two explanatory factors were urban density and the requirement to use compostable bags. As well, a crucial influence of the collection system was observed: low impurity levels coincided with DtD collection schemes (Puig-Ventosa et al., 2013).

The consequences of separately collected bio-waste with low quality are as follows:

- High levels of impurities cause problems during composting processes such as the loss of treatment capacity and additional costs related to improving pre-treatment of bio-waste and managing more reject flows. They have a direct impact on the quality of the compost, notably the concentration of heavy metals (Cu, Pb, and Zn)(Rodrigues *et al.*, 2020). In some cases, variable gate fees based on the percentage of impurities are applied to reflect the additional treatment costs related to low-quality bio-waste.
- The presence of conventional plastics is a particular concern, given the need to divert them from the composted and digested output suitable for application in farmlands. Plastics have an inherent tendency to fragment into microplastics, which leads to the increase of microplastics in soils. Screening and refining processes imply the diversion of bio-waste and compost along with rejects, reducing the total tonnages of composted and digested outputs, while increasing the volume and cost of reject disposal. The ratio of rejects/impurities, also known as the "dragging factor," shows the importance of having the cleanest input feedstocks possible and reducing costs while maximising the agricultural, environmental, and economic benefits of compost/biogas schemes and strategies. In a comprehensive analysis with sampling and mass balances at 27 sites in Italy, the average dragging factor calculated was at 275%, i.e. 2.75 t of rejects per each ton of impurities (Favoino and Giavini, 2022) based on (Centemero, Bizzoni and Ciotti, 2020).

2.1.1.3 Pillar 2: Recycling Targets

The efficient and sustainable management of bio-waste through separate collection and subsequent biological treatment will contribute to numerous EU waste policy targets, including the following:

- 2020 Circular Economy Action Plan: Halving the amount of residual (non-recycled) municipal waste by 2030.
- WFD: MS should reach 50% recycling rate by 2020, 55% by 2025, 60% by 2030, and 65% has been recently approved for 2035.
- LD targets (see section 2.1.2).

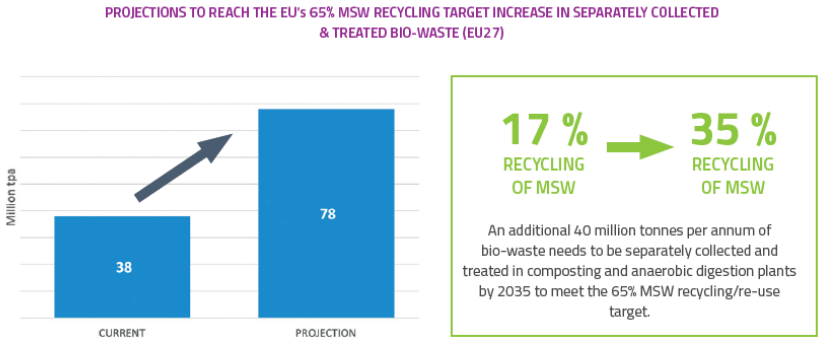
Since bio-waste is the largest single stream of municipal waste, efficient and sustainable management is necessary to reach these targets[6].

Composting and anaerobic digestion of separately collected bio-waste are essential to reach 65% of municipal waste recycling target by 2035. As illustrated in Figure 4, bio-waste separate collection must increase from 38 to 78 million tpa, with an additional 40 million tpa of bio-waste captured and treated in biological facilities per year in EU27. These calculated increases exclude non-municipal commercial and industrial bio-wastes (Gilbert and Siebert, 2022).

As the proportion of bio-waste in high and upper-middle income countries ranges from 34% and 46% of total municipal waste, it is estimated that 35% of the EU's MSW would need to be separately collected as bio-waste to meet the 65% recycling target (Gilbert and Siebert, 2022).

[6] This conclusion is also supported in the "Analysis of Nordic regulatory framework and its effect on waste prevention and recycling in the region" (Papineschi *et al.*, 2019) that states: "The use of separate biowaste collection is clearly an effective way to increase recycling rates given the proportion of the waste stream comprising of biowaste, shown wherever waste composition is available for countries. […] The strong indication is that there is significant potential to increase the recycling of biowaste and it will clearly be crucial to achieving much higher overall recycling rates for separate collection and capture of biowaste to increase dramatically," and, "Capture of biowaste, especially food waste, will be vitally important due to the large amount still in mixed residual waste at present."

Figure 4. ECN projections to reach the EU's 65% of MSW recycling target by increasing bio-waste capture



Source: ECN, Data Report 2022 (Gilbert and Siebert, 2022)

2.1.1.4 Recycling calculation method

The calculation rules for bio-waste are provided as follows in Commission Implementing Decision 2019/1004 and the Eurostat manual:

Figure 5. Existing calculation rules for bio-waste recycling

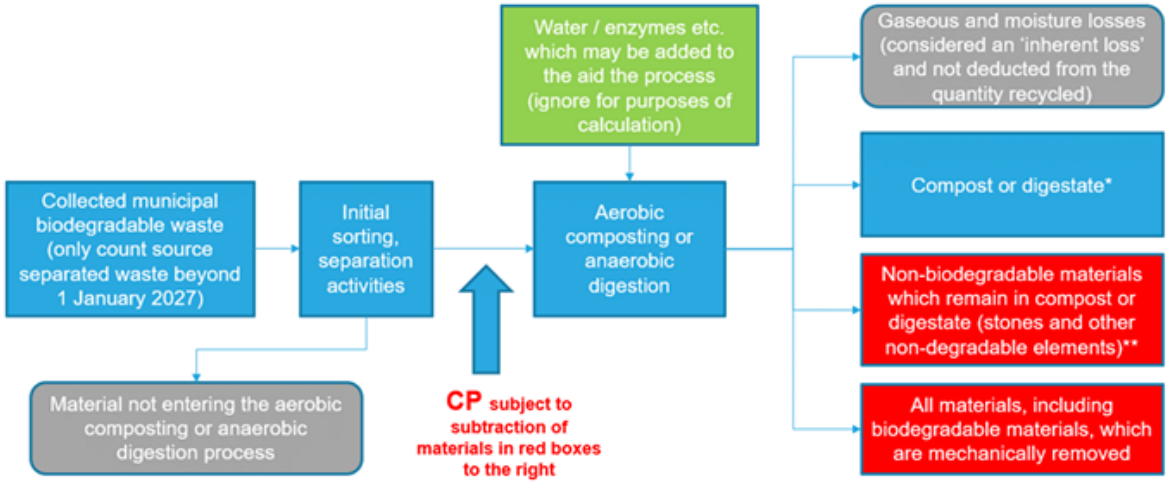


Figure note: Calculation point and calculation rules for bio-waste. As for the calculation rules: grey boxes indicate flows that are not considered in the calculation with the exception of gaseous and moisture losses; blue boxes indicate flows that are included in the calculation; red boxes indicate flows that are subtracted from the input quantity at the calculation point; finally, green boxes indicate flows that are ignored in the calculation.

Source: EC, Guidance for the compilation and reporting of data on municipal waste (Eurostat, 2023)

The point of recycling calculation is reached just before entering the aerobic/anaerobic process, after the initial sorting and separation activities, and is subject to subtraction of either non-biodegradable materials which remain in the output, as well as all materials (including biodegradable) removed mechanically at the input or from the outputs (see Figure 5).

Where outputs are used on land, ecological or agricultural benefits must be documented for the process to be considered recycling (based on WFD Article 11a (4)). Considering this condition, a compost obtained from bio-waste—that does not comply with fertiliser regulations and is not used as soil improver should not be considered a recycled material.

In conclusion, since the calculation only considers net flows and output effectively returned to the soil, this opens new monitoring challenges in ensuring that MS and bio-waste managers are collecting the data and accurately following the methodology.

2.1.1.5 WFD Revision

The EC has been called to revise the Waste Hierarchy to increase binding waste prevention and recycling targets and improve recycling quality in order to close the circular cycle and to create safe and usable compost and digestate.

In advance of the coming WFD revision, the EC called for feedback and statistics to gather evidence for an impact assessment. The entries, provided by NGOs, governmental institutions, corporations, and private interest groups, mark the practical and theoretical gaps and barriers identified in the WFD (see here). The most common comments and calls to action include:

- Revision of waste definitions,
- Amendments of the WFD to establish targets to reduce waste (kg/inhabitant),
- Setting legally binding objectives and targets for bio-waste,
- Prioritization of waste prevention,
- Consideration of quality in addition to quantity of material separately collected,
- Realignment of incentives to reduce landfilling and incineration and
- Further development of economic instruments such as pay-as-you-throw (PAYT) and landfill taxes to stimulate investment in recycling and bio-waste recycling systems.

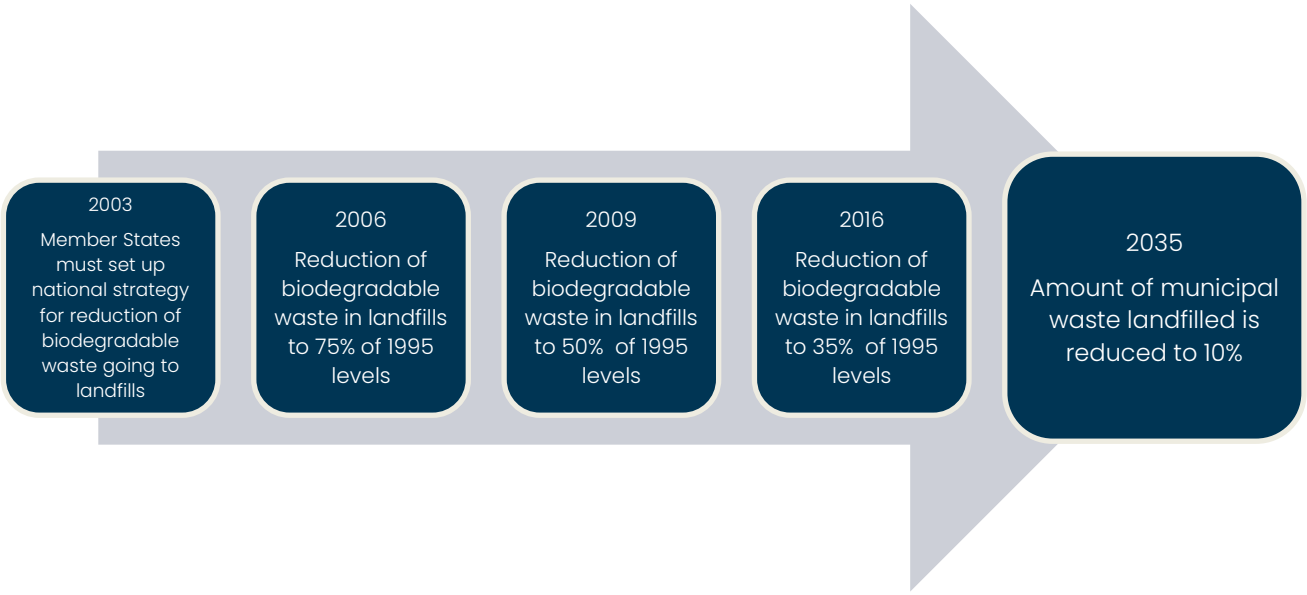
After this consultation process, on July 5th 2023, the EC launched a proposal to amend the WFD and only focus on two resource intensive sectors: textile and food waste.

In terms of bio-waste, the proposal sets out targets to reduce food waste generation by 10% in processing and manufacturing, and by 30% in retail, restaurants, food services and households, compared to 2020 levels and per capita. MS oversee creating food waste prevention programmes.

2.1.2 Landfill Directive

In accordance with the Waste Hierarchy, the LD acts as a driver to prevent, or reduce as much as possible, the negative impacts of landfilling. Diverting bio-waste from landfills is central to these efforts.

Figure 6. Priority topics of the Landfill Directive



The main contents of the LD text referring to bio-waste or directly affecting the management of this flow are detailed in the following table:

Table 5. Priority topics of the LD related to bio-waste

Priority Topic	Landfill Directive
Categorisation of landfills	Landfills for hazardous waste; Landfills for non-hazardous waste; Landfills for inert waste (Art. 4 Directive 1999/31):
Creation of National Strategies	MS had to set up a national strategy for the implementation of the reduction of biodegradable waste going to landfills not later than 16 July 2003 and notify the Commission of this strategy (Commission of the European Communities, 2005). The strategies had to include measures to achieve the targets set out in Article 5(2) by means of, in particular, recycling, composting, biogas production or materials/energy recovery (Art. 5(1) and (2) Directive 1999/31).
Reduction of landfill-bound biodegradable waste	Reduction of biodegradable municipal waste going to landfills (Art. 5 (2) Directive 1999/31). • 75% of 1995 levels by 16 July 2006 • 50% of 1995 levels by 16 July 2009 • 35% of 1995 levels by 16 July 2016

Priority Topic	Landfill Directive
	Calculations are based on the total amount of biodegradable municipal produced in 1995 or the latest year before 1995 for which standardised Eurostat data is available.
Treatment before landfilling	All waste capable of undergoing treatment has to be treated before it is landfilled. Compliance may be achieved through (Art. 5 Directive 1999/31): • A combination of legal rules (e.g. requiring separate waste collection, or banning the landfilling of organic waste, etc.). • Waste management planning (e.g. high levels of incineration entail that only small amounts of waste are landfilled without treatment).
Prioritization of recycling	MS shall take measures to prevent waste that has separately collected for re-use and recycling from entering landfills (Art. 5. Par. 3 - introduced by Directive 2018/850). MS shall ensure that as of 2030, all waste suitable for recycling or other recovery, in particular in municipal waste, shall not be accepted in a landfill with the exception of waste for which landfilling delivers the best environmental outcome (Art.5 Par. 3a -introduced by Directive 2018/850).
Limits on landfilled waste	MS shall take the necessary measures to ensure that by 2035 the amount of municipal waste landfilled is reduced to 10% or less of the total amount of municipal waste generated by weight (Art.5 Par.5 - introduced by Directive 2018/850).

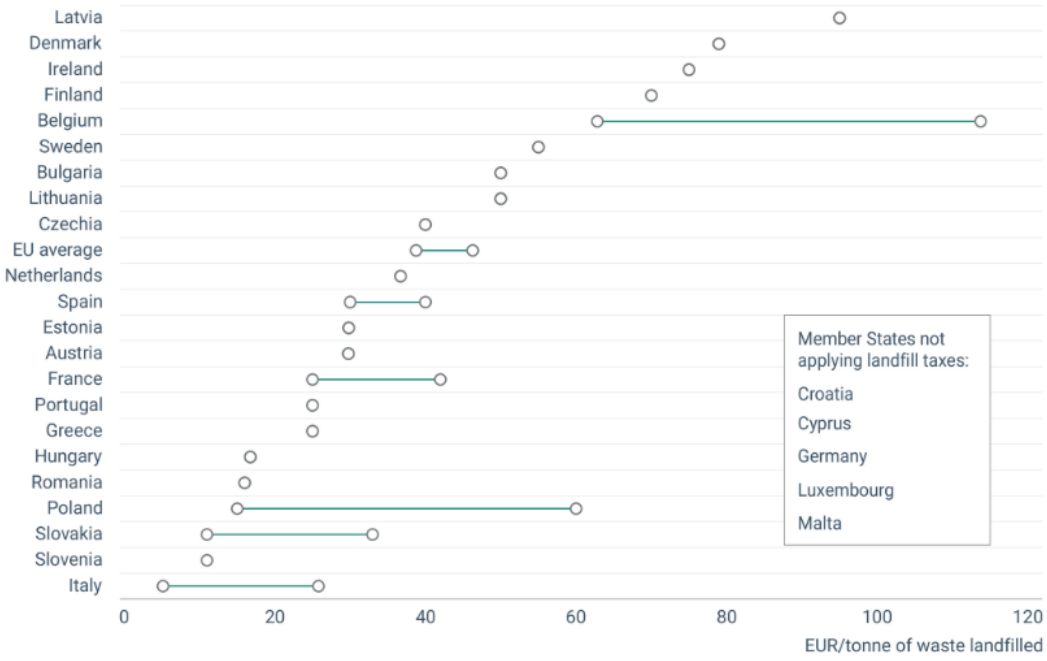
2.1.2.1 Landfill Directive application and results in MS

Crucial progress in the application of the LD from 2010 and 2020 has been made (European Environment Agency, 2022):

- The total quantity of waste sent to landfill decreased by 27.5%, from 173 million tonnes to 125 million tonnes.
- The overall landfill rate — waste sent to landfill as a proportion of waste generated — decreased from 23% to 16%.
- The landfilling of household and similar waste decreased by 57% (-40.9 million tonnes), combustion waste by 30% (-14.9 million tonnes) and other waste by 28% (-9.3 million tonnes).

When it comes to economic drivers to reduce landfilling, a recent assessment shows that landfill taxes are currently applied in 22 MS. The EU (simple) average is approximately EUR39-46 per tonne of waste landfilled, with significant variation between countries, from less than EUR20 per tonne to over EUR100 per tonne (European Environment Agency, 2023).

Figure 7. Overview of taxes on the landfilling of municipal waste in EU MS, 2023



Source: EEA, Economic instruments and separate collection systems — key strategies to increase recycling (European Environment Agency, 2023)

Landfill taxes are often combined with bans on certain types of wastes from landfills, and some MS apply bans but not taxes. These bans are applied for some specific flows or groups of flows, affecting the bio-waste stream and, as shown in Table 6, varying among MS:

Table 6. Specific landfill bans applied in MS

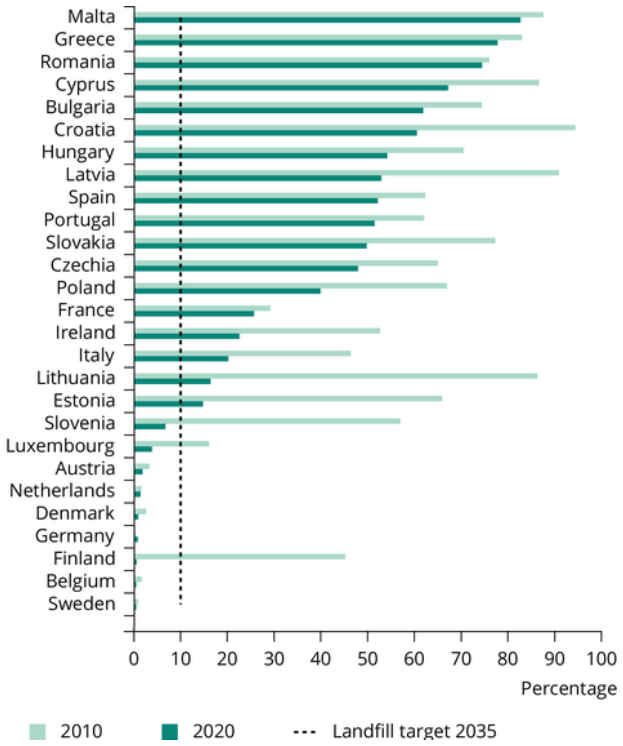
Flow affected by landfilling ban	MS applying the bans
Untreated municipal waste	Belgium, Estonia, Hungary, Lithuania, Luxembourg, the Netherlands, Slovakia (from 2024) and Slovenia
Biodegradable waste	Belgium, Czechia, Denmark, Finland, Slovenia and Sweden
Waste exceeding a certain total organic carbon value.	Austria, Germany, Luxembourg and Slovenia
Combustible waste	Poland and Sweden Czechia (from 2030) bans the landfilling of waste exceeding a certain calorific value.
Separately collected recyclables	Cyprus, Czechia, France, Malta and Slovenia Latvia (from 2030) bans the landfilling of recyclable waste.
Separately collected bio-waste	Poland

Source: EEA, Economic instruments and separate collection systems — key strategies to increase recycling (European Environment Agency, 2023)

There are many MS facing issues of LD non-compliance[7], which can be seen in the high landfilling rates as shown in Figure 8. Among the common landfilling issues identified across the EU are:

- Illegal or substandard landfilling still operative.
- Persistent practice of landfilling significant amounts of untreated MSW.
- Improper treatment provisions.
- Lack of compliance with appropriate treatment and removal of the organic fraction.
- Inadequate separate collection systems that do not divert large amounts of recyclables from residual waste.
- Disposal costs that do not incentivize diversion: low landfill disposal fees (not considering externalities) or low/lack of disposal taxes not able to effectively compensate separate collection costs.
- Strategies replacing heavy reliance on landfill with heavy reliance on incinerators/WTE facilities.

Figure 8. Municipal waste landfill rates by country: 2010, 2020 and objective by 2035



Source: EEA, Diversion of waste from landfill in Europe (European Environment Agency, 2022)

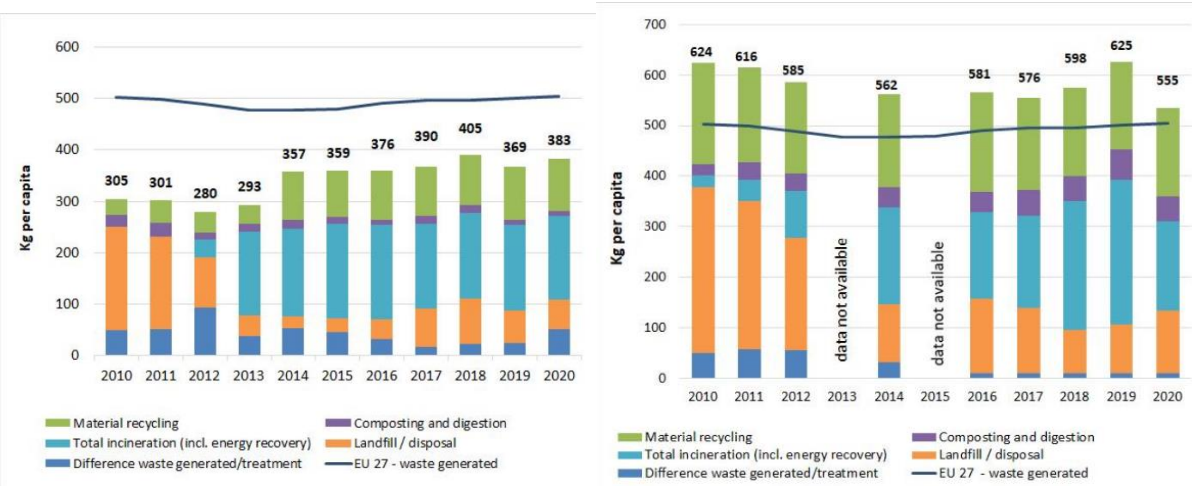
[7] The EC is currently pursuing infringement proceedings against 12 MS that do not comply with the LD.

2.1.2.2 Strategies diverting waste from landfills to incinerators

Some MS currently complying or on track to fulfil LD targets because they pursue strategies that base their management scheme on incineration. In 2020, 9 MS and 2 non-EU countries sent 10% or less of municipal waste to landfills (Austria, Belgium, Denmark, Finland, Germany, Luxembourg, Netherlands, Norway, Slovenia, Sweden and Switzerland), with several of these countries incinerating a considerable amount of municipal waste (European Environment Agency, 2022).

MS replacing landfills with incineration may miss the recycling objectives, and this negatively impacts bio-waste management. As shown in Figure 9, Estonia and Ireland, for example, significantly reduced landfill disposal in the period from 2010-2020 only to increase incineration.

Figure 9. Evolution of the municipal waste mgmt. in Estonia (left) and Ireland (right), 2010-2020



Source: EC, Environmental Implementation Review Country Reports, Estonia and Ireland (European Commission, 2022)

When it comes to the economic drivers to divert residues from incineration facilities, the figure below shows that taxes on the incineration of municipal waste are imposed by only nine MS and with lower values than landfill taxes. Belgium, France, Italy, Portugal and Spain apply lower taxes for incineration with energy recovery than for incineration without energy recovery, but higher tax rates are no longer relevant in these countries, as nearly all waste incineration is categorised as energy recovery (97% in Italy and 100% in the other four MS, calculated based on Eurostat (2023)). Overall, there seems to be no clear link between the application and level of incineration taxes and the share of waste incinerated (European Environment Agency, 2023).

Figure 10. Overview of taxes on the incineration of municipal waste in EU MS, 2023

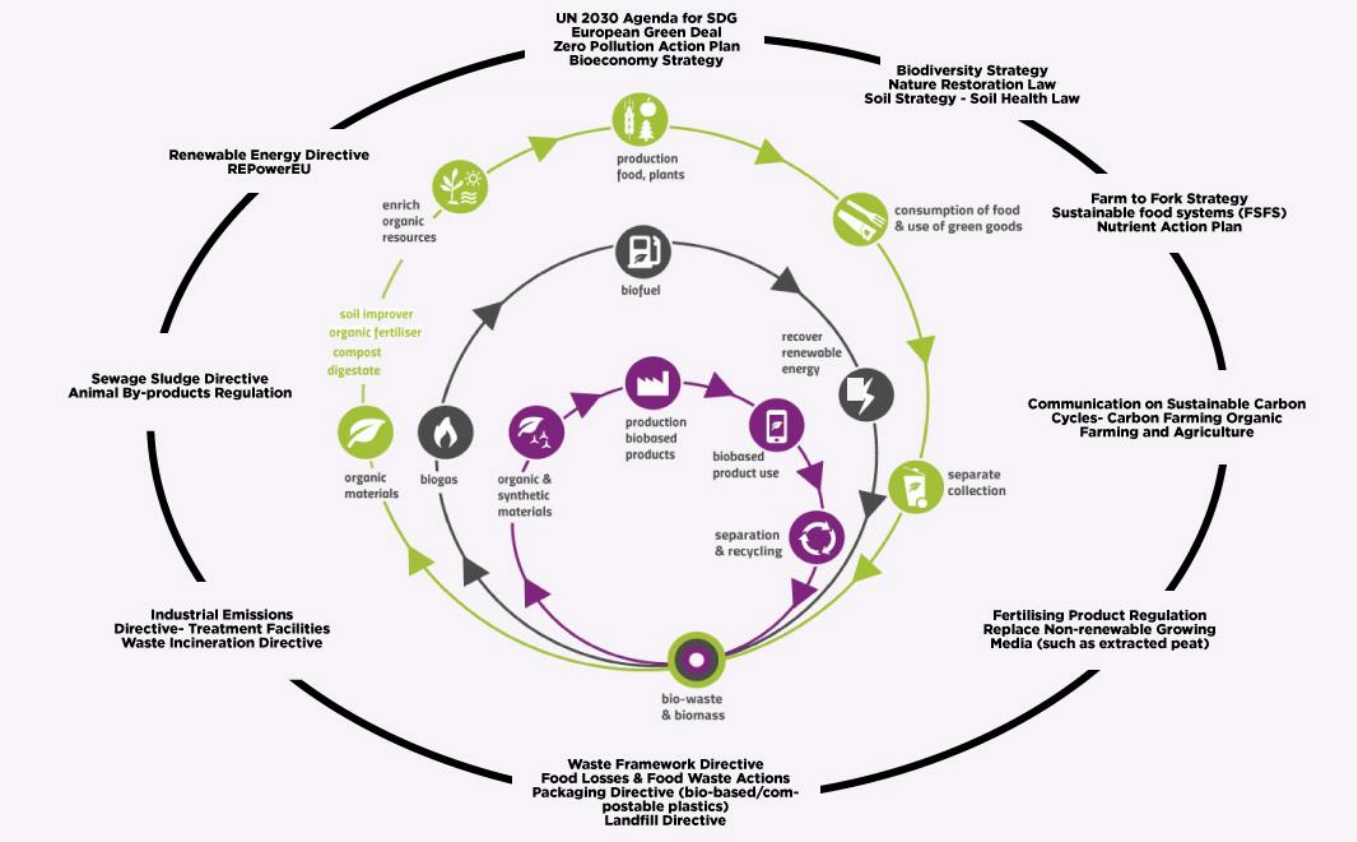
Source: EEA, Economic instruments and separate collection systems — key strategies to increase recycling (European Environment Agency, 2023)

In conclusion, the results of these strategies and instruments demonstrate the low effectiveness of the current waste management models. High landfill and incineration rates are directly linked to low separate collection levels. To reach the 2035 recycling target will necessitate a prioritization of the bio-waste stream in conjunction with the diversion of bio-waste from landfills and incinerators.

2.1.3 Additional EU Cross-Cutting Legislation

The bio-waste is a transversal resource with relations and impacts in many areas, as defined in the following cross-cutting legislation scheme.

Figure 11. Cross-cutting legislation scheme



Source: BIOBEST elaboration. The bio-waste cycle scheme located inside the scheme is from ECN.

Table 7. Cross-cutting legislation assessment

Legislation/Strategy	Objective and Relevant Text	Potential Drivers
Circular Economy Action Plan (CEAP) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A new Circular Economy Action Plan for a Cleaner and more Competitive Europe	**Objective** Make sustainable products the norm in the EU and empower consumers and public buyers. Focus on resource-heavy sectors and where the potential for circularity is high such as: electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, **food**, water and **nutrients**. Make circularity work for people, regions and cities lead global efforts on circular economy. **Related text** "The circular economy can significantly reduce the negative impacts of resource extraction and use on the environment and contribute to restoring biodiversity and natural capital in Europe. **Biological resources are a key input to the economy of the EU** and will play an even more important role in the future. The Commission will aim at **ensuring the sustainability of renewable bio-based materials**, including through actions following the Bioeconomy Strategy and Action Plan." "**High quality recycling relies on effective separate collection of waste**. To help citizens, businesses and public authorities better separate waste, the Commission will propose to harmonise separate waste collection systems." "[…] safety of secondary raw materials can still be compromised, for instance, where banned substances persist in recycled feedstock. **High-quality sorting and removing contaminants from waste to increase confidence in the use of secondary raw materials**". "Secondary raw materials face a number of challenges in competing with primary raw materials for reasons not only related to their safety, but also to their performance, availability and cost. The Commission foresees a number of actions to ensure the expansion of the recycling sector in the EU and **establish a well-functioning internal market for secondary raw materials.**" "Continue to encourage the broader application of well-designed economic instruments, **such as environmental taxation, including landfill and incineration taxes."**	Driver to collect and treat bio-waste to obtain compost, biogas/ biomethane, other bio-products. Also guarantees the quality of outputs and the markets
Bioeconomy Strategy and Action Plan COM/2018/673 final. Communication on a Sustainable Bioeconomy for Europe: Strengthening the Connection between Economy, Society, and the Environment	**Objective** Bioeconomy aims at promoting sustainable production of natural resources from biomass rather than fossil and mineral-based resources (Kardung et al., 2021). To strengthen and expand **EU bio-based sectors and unlock investments and markets at all stages** of the innovation cycle. **Related text** "The transformation towards sustainable, healthy, nutrition-sensitive, resource-efficient, resilient, circular, and inclusive food and farming systems needs to accelerate. This includes **turning organic waste, residues, and food discards into valuable and safe bio-based products,** for instance by deploying small-scale biorefineries, helping farmers, foresters, and fishermen to diversify their revenue sources and better manage market risks, all while achieving the goals of the Circular Economy." (Paragraph 3 - Unlocking the potential of the bioeconomy) The third objective - **reducing dependence on non-renewable**, unsustainable resources whether sourced domestically or from abroad - is vital to deliver the **EU's energy and climate targets, as bioenergy**, currently the EU's largest renewable energy source, is expected to remain a vital component of the energy mix in 2030. […] industrial symbiosis and innovative industrial biobased processes contribute to the **greening of industries and development of circular bioeconomies and products, for instance by innovating the way cities add value to their significant share of bio-waste**." Action 2.2: Pilot actions to support local bioeconomy development (rural, coastal, urban) via Commission instruments and programmes. "The Urban bioeconomies pilot will enable 10 European cities to turn organic waste from a societal problem into a valuable resource for the production of bio-based products."	Driver to treat bio-waste to obtain compost, biogas/ biomethane, other bio-products. Driver to invest in new technologies

Legislation/Strategy	Objective and Relevant Text	Potential Drivers
Zero pollution action plan Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions. Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil' COM/2021/400 final	**Objective** The zero pollution vision for 2050 is for **air, water and soil pollution** to be reduced to levels no longer considered harmful to health and natural ecosystems, that respect the boundaries with which our planet can cope, thereby creating a toxic-free environment. This is translated into key 2030 targets to speed up reducing pollution at source. **Related text** Targets include: • Improving **water quality by reducing waste, plastic litter at** sea (by 50%) and **microplastics** released into the environment (by 30%); • **Improving soil quality by reducing nutrient losses** and chemical pesticides' use by 50%; • Reducing by 25% the EU ecosystems where air pollution threatens biodiversity; • **Significantly reducing waste generation and by 50% residual municipal waste.**	Driver to close the cycle of bio-waste and promote the quality of compost/digestate.
Packaging and Packaging Waste Regulation (Proposal) Proposal for a Regulation on packaging and packaging waste, amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and repealing Directive 94/62/EC	**Objective** The overarching objectives of this legislative proposal are to reduce the negative environmental impacts of packaging and packaging waste, while improving the functioning of the internal market. The specific objectives are: (i) to reduce the generation of packaging waste; (ii) to promote a circular economy for packaging in a cost-effective manner; and (iii) to promote the use of recycled content in packaging. The bio-waste stream is often contaminated with conventional plastics, and the material recycling streams are often contaminated with compostable plastics. The proposal includes **common rules on the use of compostable plastic packaging,** defines conditions for packaging to be considered compostable and prescribes that filter coffee pods, sticky labels attached to fruit and vegetables and very lightweight plastic carrier bags shall be compostable.	Driver to improve the quality of bio-waste and proper use of biodegradable/compostable bioplastics
Policy framework for bio-based plastics and biodegradable or compostable plastics Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions EU policy framework on biobased, biodegradable and compostable plastics. COM/2022/682 final	**Objective** Policy framework for the use of bio-based, biodegradable and compostable plastics. **Related text** "Materials of all feedstocks, including biobased feedstocks, are kept in the loop for as long as possible, and that **secondary raw materials are preferred to primary raw materials**." "There is a European standard for industrially compostable packaging, but **not for home composting** as the conditions for the latter can differ significantly". "As of 31 December 2023, bio-waste must be separately collected or recycled at and the **introduction of industrially compostable plastic bags for the separate collection of bio-waste** in countries such as Italy and Spain has **led to less pollution in bio-waste and increased capture of bio-waste**. However, not all Member States or regions support the use of such bags as specific composting methods are required and cross-contamination of waste streams may occur."	Driver to improve the quality of bio-waste and proper use/recyclability of bioplastics
Animal By Products Regulation Regulation (EC) No 1069/2009 of the European Parliament and of The Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not	**Objective** Set a **framework on the handling, collecting, processing and trading of animal by-products.** The main principles are **safe sourcing, safe treatment and safe end uses**. The legislation sets, among the different provisions, end point in the manufacturing chain for processed and packaged pet food, biodiesel, tanned hides and skins and other products. Reaching the end point means that these products no longer are subject to ABP-regulation and can be traded without hints in the EU. Also, it establishes official controls of laboratories of processing and biogas plants handling ABPs (composting plants fall under the name of biogas plants in the ABP).	Driver to safely process and manage ABP

Legislation/Strategy	Objective and Relevant Text	Potential Drivers
intended for human consumption and repealing Regulation (EC) No 1774/2002	**Related text** Standard transformation parameters: Category 3, material which is used as raw material in a biogas plant equipped with a pasteurisation/hygienisation unit must be submitted to the following minimum requirements: (a) maximum particle size before entering the unit: 12 mm; (b) minimum temperature in all material in the unit: 70 °C; and (c) minimum time in the unit without interruption: 60 minutes. Section 2: **Alternative transformation parameters for biogas and composting plant** The competent authority may authorise the use of parameters other than the parameters set out in point 1 of Section 1 of Chapter I and other than the standard transformation parameters, provided that the applicant for such use demonstrates that such parameters ensure adequate reduction of biological risks.	
Ensuring availability and affordability of fertilisers Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions Ensuring availability and affordability of fertilisers. COM (2022) 590 final	**Objective** The Communication outlines several best practices and ways to help farmers **optimise their fertiliser use and reduce their dependencies** while securing yields. **Related text** "[…] the Commission will promote the following measures as regards fertilisers: **better access to organic fertilisers and nutrients from recycled waste streams.**" "CAP Strategic Plans support partial **replacements of mineral fertilisers by organic fertilisers like manure, sewage sludge and bio-waste**, from methanisation processes or biological and thermal treatments, while ensuring that this does not result in higher nutrient losses". "The substitution of mineral fertilisers by organic fertilisers is part of the solution to **reduce the EU's dependence on gas and is also promoted via the EU's organic target. It will help reduce the carbon footprint of fertilisers.**" "Since July 2022, the Fertilising Products Regulation (FPR) has opened the single market in particular to fertilisers made from recovered waste and by-products available in the EU. It promotes **green and circular alternatives to natural gas and mined raw materials for fertiliser production.**" "**Developing methods to extend efficient nutrient recycling of organic waste** (e.g. livestock manure, anaerobic digestion, sludge and other organic waste streams) **into renewable bio-based fertilising products** contributes to the objectives of the Farm to Fork Strategy. An important element in this is the **separation and collection of bio-waste.**" "The circular use of bio-waste as fertiliser will be discussed in the Commission's Integrated Nutrient Management Action Plan." "**Boosting sustainable biomethane production** to 35 bcm by 2030 is a cost-efficient path to achieving the EU's ambition to reduce imports of natural gas from Russia. Not only will this supply renewable energy and boost farmers' income, but it will also **create a new supply stream of organic fertilisers.**"	Driver to close the cycle of bio-waste and promote the use of quality compost in agriculture
Fertilising Product Regulation Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending. Regulations (EC) No 1069/2009 and (EC) No	**Objective** The regulation sets out **rules for EU fertilising products** carrying the CE marking, including requirements for: maximum levels of contaminants and pathogens (disease-causing microorganisms); minimum content of nutrients and other relevant characteristics depending on the category of the product; labelling. It opens the EU **single market for fertilising products** which previously had not been covered by harmonisation rules, such as organic and organo-mineral fertilisers, soil improvers, inhibitors, plant biostimulants or growing media. It lays down common rules on **safety, quality and labelling requirements for fertilising products**. It introduces limits for toxic contaminants for the first time. This guarantees a high level of soil protection and reduces health and environmental risks, while allowing producers to adapt their manufacturing process to comply with the new limits.	Driver to close the cycle of bio-waste and promote the quality of compost and digestate and their market

Legislation/Strategy	Objective and Relevant Text	Potential Drivers
1107/2009 and repealing Regulation (EC) No 2003/2003	**Related text** An **EU fertilising product may contain compost obtained through aerobic composting** of exclusively one or more of the following input materials: (a) bio-waste within the meaning of Directive 2008/98/EC resulting from **separate bio-waste collection at source**; (c) living or dead organisms or parts thereof, which are unprocessed or processed only by manual, mechanical or gravitational means, by dissolution in water, by flotation, by extraction with water, by steam distillation or by heating solely to remove water, or which are extracted from air **by any means, except:** (i) materials originating from **mixed municipal waste;** (ii) sewage sludge, industrial sludge or dredging sludge, and (iii) **animal by-products or derived products** within the scope of Regulation (EC) No 1069/2009. The aerobic composting shall consist of **controlled decomposition of biodegradable materials**, which is predominantly aerobic and which allows the development of **temperatures suitable for thermophilic bacteria as a result of biologically produced heat.** All parts of each batch shall be either regularly and thoroughly moved and turned or subject to forced ventilation in order to ensure the correct sanitation and homogeneity of the material.	
Common Agricultural Policy CAP Documents	**Objective** The new CAP (2021-2027) seeks to ensure a sustainable future for European farmers, provide more targeted support to smaller farms, and allow greater flexibility for EU countries to adapt measures to local conditions. The 10 objectives of the new CAP are: • to ensure a fair income for farmers; • to increase competitiveness; • to improve the position of farmers in the food chain; • climate change action; • environmental care; • to preserve landscapes and biodiversity; • to support generational renewal; • vibrant rural areas; • to protect food and health quality; • fostering knowledge and innovation. In the **IMAP** (the EU Commission Wikipedia of impacts of farming practices on the environment, climate and agricultural productivity), **organic fertilisation has the following positive impacts**: decrease air pollutants emissions, decrease GHG emissions, decrease nutrient leaching and run-off, increase plant nutrient uptake, increase soil biological quality, increase soil nutrients, increase carbon sequestration and crop yields.	Driver that promotes sustainable agriculture and circular bio-economy
Farm to Fork Strategy Communication from the Commission to The European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Farm to Fork Strategy for a fair, healthy and environmentally friendly food system	**Objective** The Farm to Fork Strategy aims to accelerate our transition to a **sustainable food system** that should: • have a neutral or positive environmental impact; • help to mitigate climate change and adapt to its impacts; • reverse the loss of biodiversity; • ensure food security, nutrition and public health, making sure that everyone has access to sufficient, safe, nutritious, sustainable food; • preserve affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade.	Driver to close the cycle of bio-waste, return carbon and recycled nutrients to the soil and improve its quality/agricultural production

Legislation/Strategy	Objective and Relevant Text	Potential Drivers
	Related text "There is an urgent need to **reduce dependency on pesticides and antimicrobials, reduce excess fertilisation, increase organic farming**, improve animal welfare, and reverse biodiversity loss." "The circular bio-based economy is still a largely untapped potential for farmers and their cooperatives. For example, advanced bio-refineries that **produce bio-fertilisers**, protein feed, bioenergy, and bio-chemicals offer opportunities for the transition to a climate-neutral European economy and the creation of new jobs in primary production. **Farmers should grasp opportunities to reduce methane emissions from livestock by developing the production of renewable energy and investing in anaerobic digesters** for biogas production from agriculture waste and residues, such as manure. Farms also have the potential **to produce biogas from other sources of waste and residues**, such as from the food and beverage industry, sewage, wastewater **and municipal waste."** "The Commission will also work with Member States to extend the application of **precise fertilisation techniques** and sustainable agricultural practices, notably in hotspot areas of intensive livestock farming and of **recycling of organic waste into renewable fertilisers**.	
Organic Farming Regulation Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007	**Objective** Organic production is an overall system of farm management and food production that combines **best environmental and climate action practices**, a high level of biodiversity, the preservation of natural resources and the application of high animal welfare standards and high production standards in line with the demand of a growing number of consumers for products **produced using natural substances** and processes - playing a dual societal role. **Related text** Commission Implementing Regulation (EU) 2021/1165 of 15 July 2021 authorising certain products and substances for use in organic production and establishing their lists: **Composted or fermented bio-waste**: product obtained from **source separated bio-waste as** defined in Article 3(4) of Directive 2008/98/EC, **which has been submitted to composting or to anaerobic fermentation** for biogas production only vegetable and animal **bio-waste only when produced in a closed and monitored collection system**.	Driver to close the cycle of bio-waste, return carbon and recycled nutrients to the soil and improve its quality/agricultural production
Integrated Nutrient Management Plan (*Communication not yet published*)	The **integrated nutrient management action plan** will look at the entire nitrogen and phosphorus cycles. It will cover all environmental media (air, water, marine and soil) and all relevant sources of pollution (e.g. agriculture, industry, urban, waste, energy, transport). This will include looking at how to ensure **a more sustainable application of nutrients** (identifying nutrient load reductions with Member States, applying balanced fertilisation and sustainable nutrient management), tackling nutrient pollution at source, increasing **the sustainability of agriculture** and other sectors, and **stimulating the markets for recovered or recycled nutrients.**	Driver to close the cycle of bio-waste and return recycled nutrients to the soil
Soil Strategy for 2030 Communication From The Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee Of The Regions EU Soil Strategy for 2030 Reaping the benefits of healthy soils for people, food, nature and climate	**Objective** The EU soil strategy aims to ensure that, by 2050 all EU soil ecosystems are healthy and more resilient and can therefore continue to provide their crucial services; there is no net land take and soil pollution is reduced to levels that are no longer harmful to people's health or ecosystems; and that to protect soils, managing them sustainably and restoring degraded soils becomes a common standard. **Related text** "**Recycling organic matter such as compost, digestate**, sewage sludge, processed manure and other agricultural residues has many advantages: the material after appropriate treatment **serves as organic fertiliser**, helps to **replenish depleted soil carbon pools**, and **improves water retention capacity and soil structure**, and thus enables **closing of the nutrient and carbon cycle**. However, this should always be carried out in a safe and sustainable way **to prevent soil pollution.**" "Building on the obligation to collect organic waste separately, the Commission will seek to finance a new LIFE project that addresses as an ad hoc priority the **use of high-quality compost from bio-waste on soil.** The Commission will also continue funding research to address the **environmentally sound recovery of organic fertilisers from bio-waste.**" "Other sustainable practices include cover cropping, crop rotation, the incorporation of crop residues, contour farming in slopes, avoid heavy machinery, **the safe use of compost** […]"	Driver to close the cycle of bio-waste, return carbon and recycled nutrients to the soil and improve its quality

Legislation/Strategy	Objective and Relevant Text	Potential Drivers
Soil Monitoring and Resilience Directive Proposal for a Directive of the European Parliament and of the Council on Soil Monitoring and Resilience (Soil Monitoring Law)	**Objective** This measure aims to build a durable and homogenous **monitoring system for all soils** in the EU territory, defining soil health certifications and sustainable soil management practices, and prioritizing circular solutions that enrich the organic content. It includes, as risk reduction measures, biological remediation techniques and **composting and soil amendments.**	Driver to close the cycle of bio-waste, return recycled nutrients to the soil and improve its quality
Biodiversity Strategy for 2030 Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and The Committee Of The Regions EU Biodiversity Strategy for 2030 Bringing nature back into our lives	**Objective** The EU's biodiversity strategy for 2030 is a comprehensive, ambitious and long-term plan to **protect nature and reverse the degradation of ecosystems**. The strategy aims to put Europe's biodiversity on a path to recovery by 2030 and to build our societies' resilience to future threats such as the impacts of climate change, forest fires, food insecurity, and disease outbreaks. **Related text** "Nature-based solutions such as protecting and restoring wetlands, peatlands and coastal ecosystems, or sustainably managing marine areas, forests, grasslands and **agricultural soils**, will be essential for emission reduction and climate adaptation." "Agroecology can […] **increase soil fertility and biodiversity**, and reduce the footprint of food production." "The EC will also promote the goal of **zero pollution from nitrogen and phosphorus** flows from fertilisers through **reducing nutrient losses** by at least 50%, while ensuring that there is no deterioration in soil fertility. This will result in the **reduction of use of fertilisers by at least 20%.** […]" "The effects of erosion and **losses of soil organic carbon** are becoming increasingly apparent. Desertification is also a growing threat in the EU. It is therefore essential to step up efforts to **protect soil fertility, reduce soil erosion and increase soil organic matter**. This should be done by adopting sustainable soil management practices, including as part of the CAP. Significant progress is also needed on **identifying contaminated soil sites, restoring degraded soils, defining the conditions for their good ecological status, introducing restoration objectives, and improving the monitoring of soil quality.**"	Driver to close the cycle of bio-waste and increase organic matter in soils
Communication on Sustainable Carbon Cycles Communication from the Commission to the European Parliament and the Council Sustainable Carbon Cycles	**Objective** Drastically **reduce EU reliance on carbon, recycle carbon and upscale carbon removal solutions** that capture CO2 from the atmosphere and store it for the long term to reach climate neutrality goal in 2050. **Related text** "One of the three actions that are key to establish sustainable and climate-resilient carbon cycles is the **recycling of carbon from waste streams** and sustainable sources of biomass. The circular economy and the sustainable bioeconomy sectors can address this objective." "[…] we need to upscale carbon removal solutions that **capture CO2 from the atmosphere and store it for the long term,** either in ecosystems through nature protection and **carbon farming solutions** or in other storage forms through industrial solutions while **ensuring no negative impact on biodiversity or ecosystem** deterioration in line with the precautionary and Do No Significant Harm principles." "Sustainable land management will be critical in achieving the EU's 2050 climate neutrality objective as it will **increase the amount of carbon captured and stored in plants and soils.**	Driver to close the cycle of bio-waste and use the soil as carbon sinks
Union Certification Framework for Carbon Removals (Proposal) Regulation Of The European Parliament And Of The Council establishing a Union certification framework for carbon removals	**Objective** Ensure **high-quality EU certified carbon removals**, through a transparent and credible governance framework. Increase amounts of carbon dioxide will have to be **captured and removed each year from the atmosphere by carbon farming** and industrial removal activities or projects to compensate hard-to-abate emissions from sectors **like agriculture**, cement, steel, aviation or maritime transport, with the view to reach climate neutrality.	Driver to close the cycle of bio-waste and use the soil as carbon sinks

Legislation/Strategy	Objective and Relevant Text	Potential Drivers
Emissions trading system Directive Directive 2003/87/EC Of The European Parliament And Of The Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC	**Objective** Permits to increase the cost of incineration, thereby reducing greenhouse gas emissions. It includes WTE in the ETS in order to monitor and reduce emissions. **Related text** Article 30 (7): "By 31 July 2026, the Commission shall present a report to the European Parliament and to the Council in which it shall assess the feasibility of **including municipal waste incineration installations** in the EU ETS, including with a view to their inclusion from 2028 and with an assessment of the potential need for an option for a Member State to opt out until 31 December 2030." In the report referred to in the first subparagraph, the Commission shall also assess the possibility of including in the EU ETS other waste management processes, in particular **landfills** which create methane and nitrous oxide emissions in the Union.	Driver to reduce the quantity of bio-waste sent to incineration
RepowerEU SWD (2022) 230 Commission staff working document implementing the repower EU action plan: investment needs, hydrogen accelerator and achieving the biomethane targets	**Objective** Renewable gases such as **biogas and biomethane play a crucial role in reaching the EU's decarbonisation** goals and have been incorporated into initiatives such as the REPowerEU Action plan to promote biomethane production across Europe. **Bio-waste poses a key opportunity to obtain biogas and biomethane.** Biomethane is a more refined form of crude biogas and can be used as a substitute for natural gas. Compared to biogas, whose methane content typically ranges from 45% to 75% by volume, with the remaining part mainly CO2, biomethane is an almost pure source of methane and has a higher and more stable energy content. In addition, it is easier to distribute and does not require ad hoc infrastructure since it can be injected directly into the natural gas network. This "renewable natural gas" is produced by refining biogas from anaerobic digestion of organic matter or by gasification of solid biomass followed by methanization. **Increasing the production and use of biomethane is key** to addressing the climate crisis, diversifying gas supplies and limiting issues due to the instability of natural gas prices. **Related text** "The production of **sustainable biomethane should be waste-based,** avoiding the use of food and feed feedstocks that would lead to land use change problems. In addition, by **2024, Member States have to collect separately organic waste, which can be valorised in anaerobic digestors.**" (Section 5 - Achieving the biomethane targets) Table of section 5 – Area of action: "Promote the **sustainable production and use of biogas and biomethane at EU and national/ regional level and the injection of biomethane into the gas grid.**" […] 2. Type of action "Develop **national strategies on sustainable biogas and biomethane production** and use or integrate a biogas and biomethane component in the National Energy and Climate Plans (NECPs)". "The development of the **national strategies should focus on the most sustainable paths, based on waste-based production** (e.g. agricultural and agro-industry waste and residues, forest and forest-industry waste and residues, food industry waste, energy and chemical industry biogenic CO2 effluents and waste, industrial wastewater, **domestic organic waste),** and the evaluation of the preconditions to further promote the potential of sustainable biomass coming from sequential or cover cropping or other innovative sources of biomass including from marginal lands and contaminated lands through phytoremediation and the related technology development needs."	Driver to treat bio-waste in anaerobic digestion facilities to obtain biogas and biomethane. Driver to invest in this technology and guarantee the proper feedstocks.
Renewable energy directive (Revision ongoing – provisional agreement) Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on	**Objective** Sets the overarching European **renewable energy target of 32%** and includes rules to ensure the uptake of renewables in the transport sector and in heating and cooling, as well as common principles and rules for renewables support schemes, the rights to produce and consume renewable energy and to establish renewable energy communities, and sustainability criteria for biomass. It also establishes rules to **remove barriers, stimulate investments and drive cost reductions in renewable energy technologies**, and empowers citizens, consumers and businesses to participate in the clean energy transformation. In 2023 negotiations, EU member states and the European Parliament agreed that by 2030, the bloc will get 42.5% of its energy from renewable sources such as wind and solar.	Driver to treat bio-waste in anaerobic digestion facilities to obtain biogas and biomethane. Driver to invest in this technology and guarantee the proper feedstocks.

Legislation/Strategy	Objective and Relevant Text	Potential Drivers
the promotion of the use of energy from renewable sources (recast) (Text with EEA relevance.)	**Related text** (21) When developing support schemes for renewable sources of energy, Member States should consider the available sustainable supply of biomass and take due account of the principles of the circular economy and of the waste hierarchy established in Directive 2008/98/EC of the European Parliament and of the Council (10) **in order to avoid unnecessary distortions of raw materials markets. Waste prevention and recycling of waste should be the priority option. Member States should avoid creating support schemes which would be counter to targets on treatment of waste and which would lead to the inefficient use of recyclable waste**. (37) In order to ensure that the list of **feedstock** to produce advanced biofuels, other biofuels and biogas, as set out in an annex to this Directive, **takes into account the principles of the waste hierarchy established in Directive 2008/98/EC, the Union sustainability criteria, and the need to ensure that that annex does not create additional demand for land while promoting the use of wastes and residues**, the Commission, when regularly evaluating that annex, should consider the inclusion of additional feedstock that does not cause significant distortive effects on markets for (by-)products, wastes or residues.	
EU Taxonomy Regulation and delegated acts Commission Delegated Regulation (EU) of 27.6.2023 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council	**Objective** EU **taxonomy criteria for economic activities** making a substantial contribution to one or more of the non-climate environmental objectives, namely: sustainable use and protection of water and marine resources, **transition to a circular economy**, pollution prevention and control and protection and restoration of biodiversity and ecosystems. **Related text** Annex II: Transition to a circular economy 2.3. **Collection and transport of non-hazardous** and hazardous waste 2.5. Recovery of **bio-waste by anaerobic digestion or composting**	Driver to collect and treat bio-waste and to focus the investments

Source: Elaborated by ECN and ENT

2.2 Early Warning Reports

Following the adoption of the WFD, MS were provided a period of 5 years to modify waste management in accordance with the established objectives and obligations. At the outset of the 2018 revision, the EC issued the first Early Warning Reports (EWRs) to those MS at risk of missing the objectives. In June 2023, a second round of EWRs were issued.

2.2.1 1st Early Warning Reports

The EC provided in 2018 a first report on the implementation of EU waste legislation in MS, which includes an EWR measuring MS progress towards the goals set therein (European Commission, 2018). Among the recommended actions was a call for MS to introduce mandatory requirements to sort bio-waste and ensure that infrastructure matched the collection systems. Of the 27 EU MS, the EC identified 14 MS already at risk of missing objectives, namely the 2020 goal of 50% preparation for reuse/recycling of municipal waste. In the end, only 7 MS, from the 27, fully accomplished the 2020 recycling targets.

1st EWRs were issued to Bulgaria, Croatia, Cyprus, Estonia, Finland, Greece, Hungary, Latvia, Malta, Poland, Portugal, Romania, Slovakia and Spain.

2.2.2 Environmental Implementation Review (EIR)

The EC provided a 2022 Environmental Implementation Review (EIR) that is a regular reporting tool designed to improve the implementation of EU environmental laws and policies. It includes individual MS reports addressing all relevant environmental thematic areas, including bio-waste management. They highlight the main challenges and achievements of each MS in implementing key EU environmental laws and policies. The reports also suggest priority actions to improve implementation.

2.2.3 2nd Early Warning Reports

The EC provided a 2023 second report on the implementation of EU waste legislation in MS, which includes another EWR. The majority of MS are at risk of missing the municipal waste preparing for re-use and recycling targets for 2025. In the individual MS reports, indicators include service coverage and treatment capacity. More specifically, the report considers the target of 55% preparing for re-use and recycling of municipal waste and 65% recycling of all packaging waste to be achieved by 2025 (European Commission, 2023). The following overview provides context for Figure 12:

- 9 MS are on track to meet both targets – Austria, Belgium, Czechia, Denmark, Germany, Italy, Luxembourg, the Netherlands and Slovenia;
- 8 MS are at risk of missing the municipal waste target only, but not at risk for the target on all packaging waste – Estonia, Finland, France, Ireland, Latvia, Portugal, Spain and Sweden;

- 10 MS are at risk of missing both the targets for municipal and all packaging waste for 2025 – Bulgaria, Croatia, Cyprus, Greece, Hungary, Lithuania, Malta, Poland, Romania and Slovakia;
- All 14 MS listed in the 1st report were also listed in the 2nd, alongside 4 additional countries: France, Ireland, Lithuania, and Sweden.

Figure 12. MS at risk of missing municipal waste and packaging waste targets for 2025

Source: EC, 2nd Early Warning Report (European Commission, 2023)

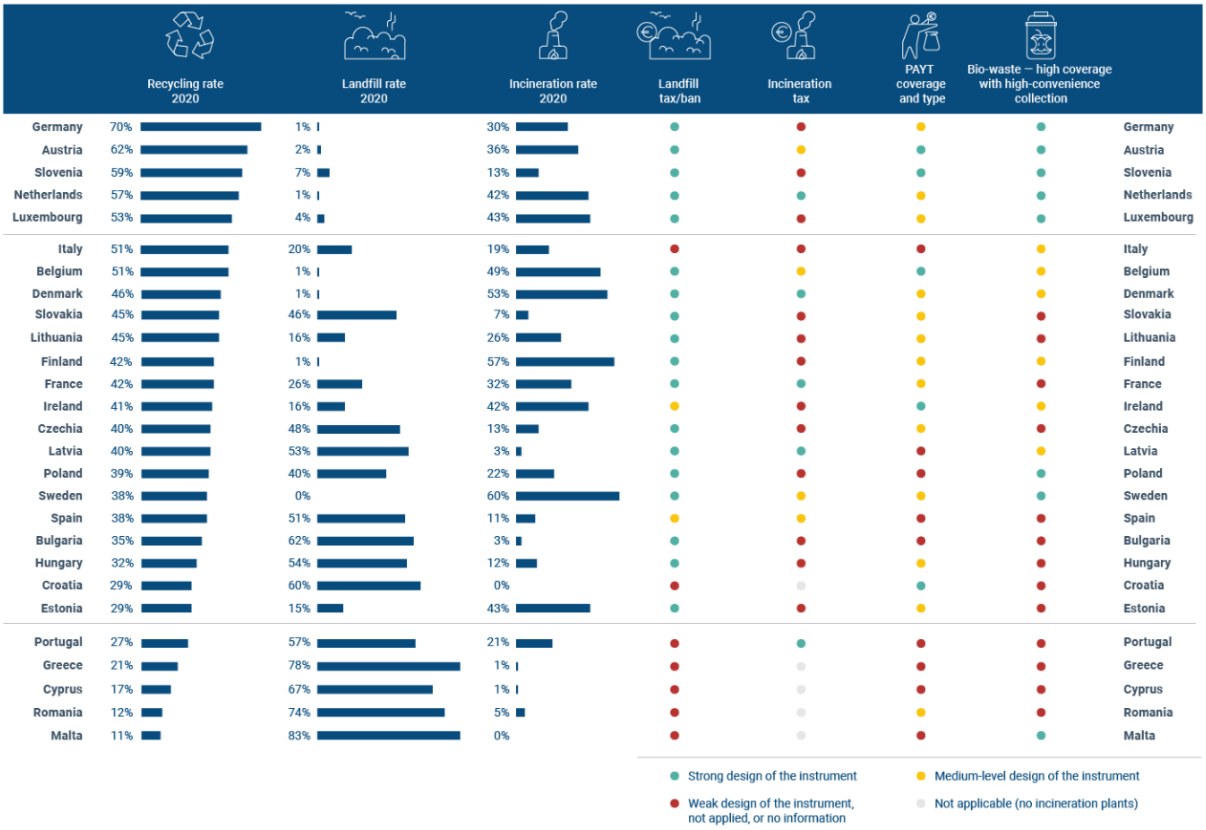
As shown in Table 8, variation exists across the 9 MS that are on track to meet both targets. MS are categorised by convenience and coverage of bio-waste collection systems as follows[8]:

- Bio-waste with high coverage-high convenience collection: Austria, Germany, Luxembourg, the Netherlands and Slovenia.
- Bio-waste with medium coverage-medium convenience collection: Italy, Belgium and Denmark.
- Bio-waste with low coverage-low convenience collection: Czechia.

[8] According to technical note accompanying the EEA briefing 'Economic instruments and separate collection – key instruments to increase recycling', convenience collection systems for Bio-waste are referred to doo-to-door collection schemes. The levels of coverage are defined as follows: >= 80 % of the population is characterised as 'high share of the population', 50-80 % is characterised as 'medium share of the population' and < 50 % is characterised as 'low share of the population'. See more details here.

On the contrary, Poland and Sweden are not on track to meet the targets (in 2020 under 40% of recycling), but they are included in the group of bio-waste with high coverage-high convenience collection.

Table 8. Overview of applied instruments and waste management results



Source: EEA, Economic instruments and separate collection systems — key strategies to increase recycling (European Environment Agency, 2023)

It must be remembered that 2020 and 2025 recycling objectives still include bio-stabilized waste obtained from the residual fraction. Once the recycling calculation excludes this flow beginning in 2027, the final rates will be significantly affected. This points to a gap between the strategies permitted to achieve the recycling targets and the obligatory 2024 enforcement mechanism for bio-waste collection. An additional indicator showing the future calculation results is necessary to foresee compliance with upcoming recycling objectives.

3 Methodology

For the purposes of D5.2, LIFE BIOBEST compiled pre-existing data with particular focus on the Early Warning Reports (EWR) and the European Commission Country Reports (CR). This information was systematically leveraged.

The goal has been to provide a wide portrait of the status and stopping blocks of bio-waste management in the EU. This qualitative study has depended on the availability of information, expert insight, and our know-how.

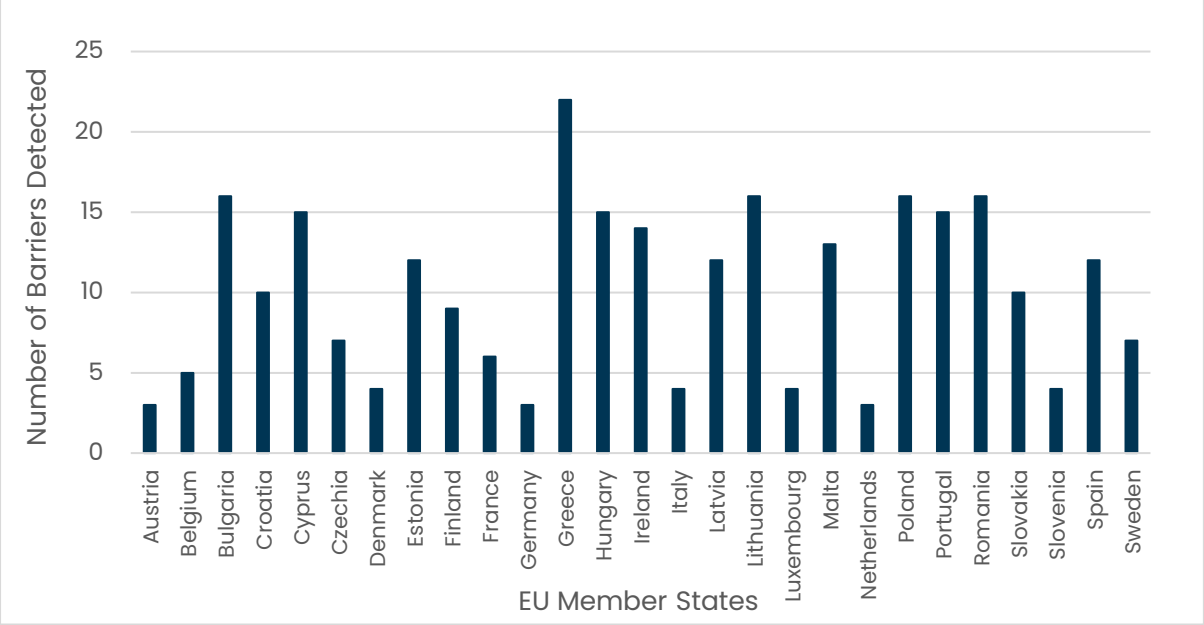
LIFE BIOBEST novel data on bio-waste regulatory and policy barriers comes from the following sources:

- Open response barriers and incentives survey to ECN members,
- Co-creation events led by ACR+ in LIFE BIOBEST WP4 (see section 10-Annex 2: Co-creation Event Results),
- ENT pre-interview survey for ranking barriers sent to MS expert stakeholders,
- Personal interviews with MS expert stakeholders conducted by ENT (see section 9-Annex 1: Interview Summaries).

3.1 Detection of Regulatory and Policy Barriers by pre-existing sources

Prior to LIFE BIOBEST's research, the EWRs and CRs detected regulatory/policy barriers across MS.

Figure 13. Number of barriers detected by CR and EWR per MS



According to the Eunomia study "Study to Identify Member States at Risk of Non-Compliance with the 2020 Target of the Waste Framework Directive and to Follow-up Phase 1 and 2 of the Compliance Promotion Exercise", common difficulties in reaching the WFD directive can be categorised based on their impact on the national, municipal or citizen level (Hogg *et al.*, 2018).

Table 9. Summary of priority issues concerning bio-waste regulatory framework and management on the national level

Priority Issue	Context
National targets not cascaded to regional / municipal level or minimal consequence of failure.	**The presence of national targets does not necessarily mean that action will take place on the ground**. It is the regions and, mainly, municipalities that are the implementing agents of waste services, and national policy must ensure they are incentivised to act. Where targets are maintained only at the national level, **there is likely to be little effect without other strong policies in place**.
Low costs of disposal.	In many MS the **landfill taxes or fees are still too low to provide a clear economic justification** for investment in alternative reuse, recycling and composting systems. **High costs of landfill can simply lead to a switch to energy recovery** of mixed wastes, rather than to recycling.
National policies requiring food waste separation too loosely worded and will not result in significant changes.	Incentives and service changes, such as reducing the capacity of residual waste containment, would be required to ensure the policies are successful. This **level of detail is often omitted from such obligations**.
Lack of enforcement of policies.	Several MS have good policies in place, but they are **not being fully effective as they are not being enforced**. This is in the main due to a **lack of political will to prioritise changes to local government services**, particularly if municipalities have significant political power within the country.
Regulatory uncertainty/continuous small changes.	**In the absence of clear regulation, or if regulation is changing frequently due to changing political conditions, municipalities and waste companies are unwilling to make significant investments** in infrastructure and services. **National and local administrations often lack the resourcing and knowledge** to produce robust administrative and regulatory frameworks for the country.
Inadequate appraisal of best practice options in policy design.	It seems clear in many MS that **national policy often seems to be implemented without a thorough understanding of the full range of best practice options** that might be suitable for use in the country. Consequently, lower performing, albeit more common, systems are often introduced.
No/insufficient frameworks for consistency, leading to highly variable, sometimes poorly implemented systems.	Many countries need to balance central versus local government control of services, and regularly **many of the decisions about implementation are left solely to the municipalities**. Whilst decentralisation can help manage differences in local contexts, there are generally many common themes in how well performing services operate, and common pitfalls.
Outdated data capture systems providing uncertainty about existing performance.	Some MS have invested in modern digital waste information systems, but the majority have not, and find it a **considerable challenge to report accurate data** related to the calculation of the household and similar waste recycling rate under the WFD.

Source: Eunomia, *Synthesis of Study to Identify Member States at Risk of Non-Compliance with the 2020 Target of WFD […]* (Hogg et al., 2018)

Table 10. Summary of priority issues concerning bio-waste regulatory framework and management on the municipal level

Priority Issue	Context
Minimal / no capacity to design and deliver selective collection systems.	**Reaching high recycling targets can require much more complex and extensive service changes**, taking into account a range of factors; such as consumer behaviour, the value of secondary materials market, effective communications campaigns, robust procurement and contract management. **The capacity and skills of local government are often underdeveloped**.
High proportion of housing stock as apartments / challenges in collection of recycling.	Providing **DtD services is very challenging, and usually bring schemes are used to collect waste**. This, however, removes the ability to change behaviour at the household level, particularly as sharing the benefits of reduced mixed waste arisings is difficult.
Overreliance on EU Funds.	For several MS there has been an **overreliance on using EU Funds for development of infrastructure**, leaving no longer term funding plan in place. This is most relevant for collection and recycling infrastructure.
Lack of effective communication campaigns.	Some countries require packaging producers to fund communication campaigns under EPR regulations, however, the **delivered campaigns can be very limited**. If citizens are being asked to pay higher fees for services, it is important to **properly communicate the benefits of increased convenience and better overall waste management for the country.**
Waste industry can lack required skills and competences.	It was noted above that the **municipalities can lack the knowledge to implement the required services, the same is true of the waste industry** itself which may not have the experience to design and operate them to a high standard.

Source: Eunomia, Synthesis of Study to Identify Member States at Risk of Non-Compliance with the 2020 Target of WFD […] (Hogg et al., 2018)

Table 11. Summary of priority issues concerning bio-waste regulatory framework and management on the citizen level

Priority Issue	Context
No financial or other incentive to separate recyclables (lack of participation).	Often there are no measures that provide **specific incentives to citizens to participate in the recycling services** that are being offered, so for those not simply motivated by environmental goals, separation of recyclables does not occur.
Inconvenient selective collection systems (i.e. not DtD or near entry).	Setting up communal based collection services, with recycling containers at the end of the local street is a low-cost way of meeting low recycling targets. Nevertheless, **many countries believe that these inconvenient systems can still deliver high levels of recycling**.
Lack of public understanding of systems and need to minimise contamination.	In many cases the public are **unaware of the issues with contamination of recycling streams** particularly, contamination of food waste from plastics or segregated plastics stream with incorrect polymers or other contaminants. Moreover, **many citizens are sceptical of the final destination of segregated recycling streams.**

Source: Eunomia, *Synthesis of Study to Identify Member States at Risk of Non-Compliance with the 2020 Target of WFD […]* (Hogg et al., 2018)

3.2 Interview Process with Key Stakeholders

LIFE BIOBEST selected interview subjects based on their expertise and geographic location in the EU, totaling to 14 MS. The 14 MS represent all geographical regions of the EU, and many have the largest populations. Interviews depended on the availability of the subject experts.

Following the interviews, audio transcripts were generated. A full list of interview subjects and interview summaries can be found in Annex 1: Interview Summaries.

3.3 Classifications of Regulatory and Policy Barriers

Considering barriers identified in pre-existing studies and LIFE BIOBEST expertise, ENT, ACR+ and ECN compiled a list of over 100 barriers.

Barriers were categorised as the following:

- Regulatory/policy barriers: systemic barriers having widespread effect across levels of management and government.
- Local/strategy challenges: difficulties linked to local context or circumstance.

Regulatory/policy barriers were subsequently filtered by frequency and categorised based on:

- Key topic:
  - Legal/Administrative,
  - Economic,
  - Organizational and
  - Technical.
- Step in bio-waste cycle:
  - Collection (C),
  - Treatment (T) and
  - Use of Outputs (U).
- Governance level:
  - EU,
  - National,
  - Regional and
  - Municipal.

Table 12 provides a full list of the regulatory/policy barriers and their categorisations. It must be noted that primary categorisations are not mutually exclusive. Categorisations were defined by LIFE BIOBEST expertise, perspective and know-how.

Table 12. Barriers categorised by topic and governance level

	EU	National	Regional	Municipal
Legal/Administrative	Environmental and/or agricultural policies and management protocols lack synergies (T) Lack of quality and service standards for input (T) Lack of effective binding policy or enforced legal obligations to reach minimum standards (C & T) Absence of EoW criteria leads to lack of harmonization between MS (T)	Regulatory uncertainty and modifications lead to highly variable systems (C & T) Competition between recycling of and energy recovery from bio-waste (T) EU targets not cascaded to national/regional/municipal government (C & T) Lack of local, regional, or national strategy for the separate collection of bio-waste (C)	Inadequate appraisal of best practice options in policy design (C & T) Administrative and bureaucratic barriers to implement / improve the treatment units (T)	
Economic		Low costs of incineration or low/lack of taxes (T) Low costs of landfilling or low/lack of taxes (T) Insufficient resources/finances (C & T) No market or insufficient market incentives for compost, digestate, or biogas (U) Improper/lack of guidance on use of EU funds and taxonomy (C)	Bio-waste treatment is more expensive than mechanical biological treatment (MBT) (T) Lack of financial incentive for local authorities to separately collect bio-waste (C) Lack of resources to build or outfit waste treatment facilities for bio-waste (T) Lack or uncertainties regarding financing/subsidies for treatment (T)	Bio-waste collection is more expensive than residual waste collection (C) Lack of financial incentives for the citizen (PAYT, discounts, etc.) (C) Lack of resources to conduct waste analysis and monitor bio-waste quality and quantity (U)
Organizational		Lack of interest/support from decision-makers/elected representatives (C & T) Lack of or inefficient penalties for non-compliance (C) Poor institutional organization and limited capacity to implement legislation (C & T)	Lack of economic scale efficiency schemes to develop cooperative management (C & T) Lack of synchronisation across public and private entities in charge (C & T) Limited or lack of infrastructure for collection and treatment (C & T) Institutions lack clarity regarding mandatory separate collection (C)	Lack of effective communication/educational campaigns (C)

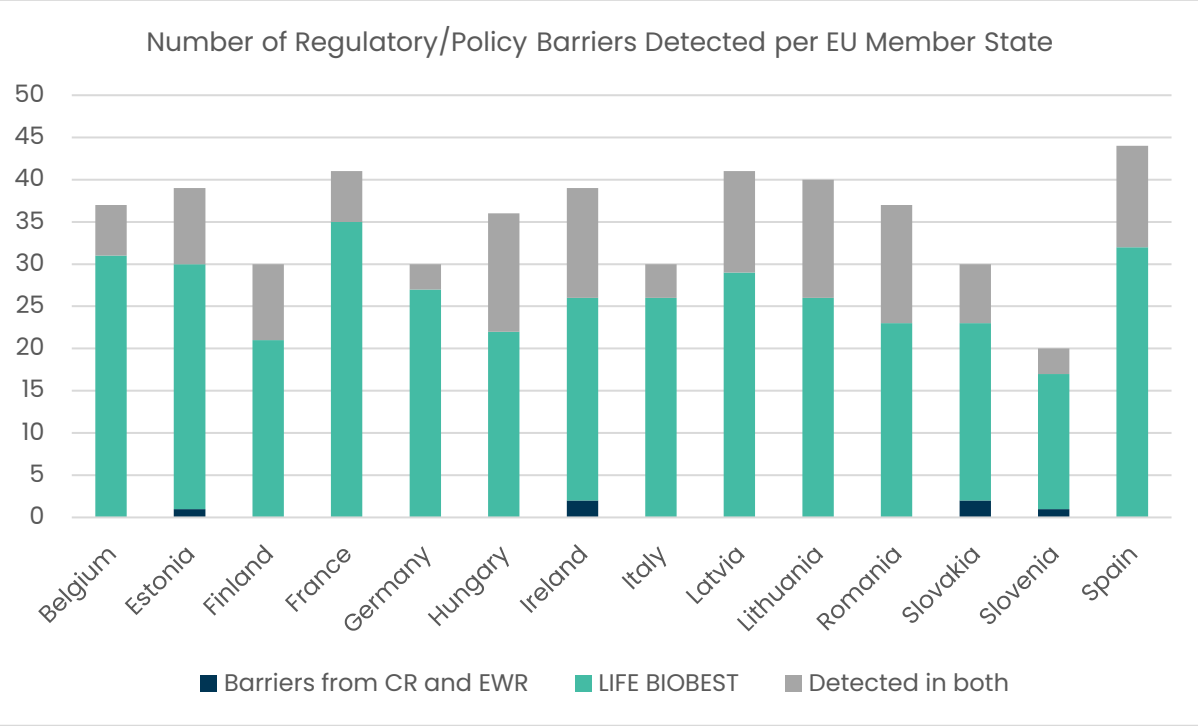
	EU	National	Regional	Municipal
Technical		Lack of technical know-how (C & T) Waste industry lacks required skills and competencies (C & T) Insufficient data monitoring systems to track implementation, performance and evolution (C & T) Lack of guidance or technical support for bio-waste management (C)	Lack of or low geographical coverage of the separate collection system (C)	Lack of materials provided for proper at-home separation (C) Inadequate appraisal of local circumstances in system set-up (C & T) Absence of monitoring of quality for collected bio-waste (C) Inconveniently instituted separate collection system (C) Distrust from the public regarding the performance of the separate collection system (C) Collection models don't account for contamination reduction/quality assurance (C) Difficulties to comply with the Animal By-Product Regulation (ABPR) (C) Difficulty to identify the actual challenges and barriers limiting the capture rate and the quality (C) High population density challenges for collection systems (C) Limited collection monitoring information for application of corrective actions (C) Production of compost not sufficient in quality/quantity or consistent enough to enter the market (U)

4 Results

LIFE BIOBEST validated over 95% of barriers detected in the EC CRs and EWRs and increased barriers detection by almost threefold. On average, 35 barriers were detected per MS.

In total, 8% of barriers have been categorised as primarily affecting the EU level; 33% of barriers as primarily affecting the national level; 22% of barriers as primarily affecting regions; 37% of barriers as primarily effecting municipalities.

Figure 14. Total number of barriers detected per surveyed EU MS



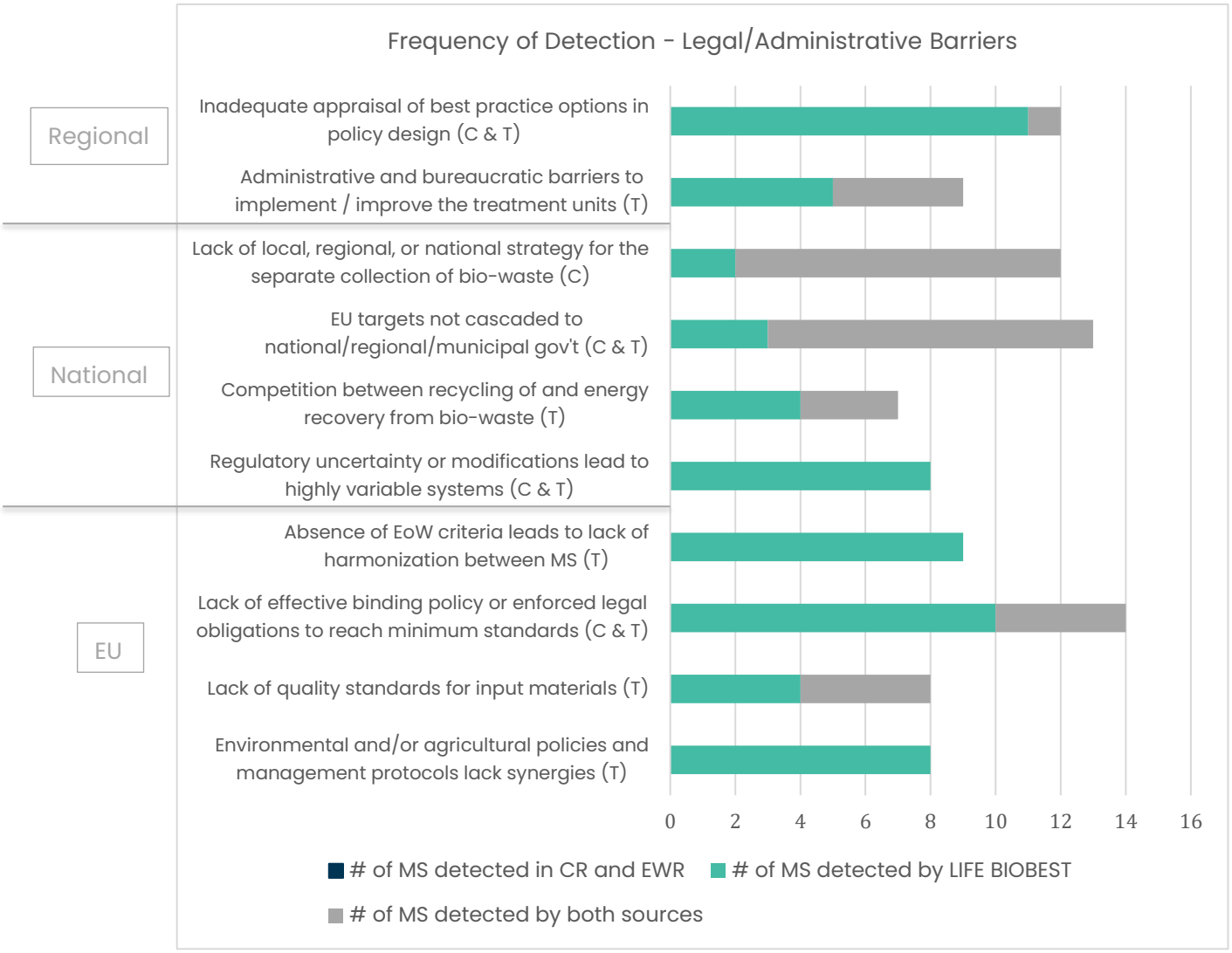
4.1 Legal/Administrative Barriers

The legal framework of bio-waste policy is primarily centered on upper levels of policymaking by no coincidence: institutions on the EU and national levels provide laws and objectives that cascade down to institutional bodies on lower levels of the legal framework.

The legal framework functions as a general compass, guiding regional and local governments and organizations to adhere to the law and progress towards the identified goal. Legal/Administrative barriers are under the predominate control of upper-level policy making, and, for adherence to the law to be maintained, enforcement is crucial.

4.1.1 Frequency of Legal/Administrative Barriers

Figure 15. Frequency of MS legal/administrative barriers' detection categorised by governance level



4.1.2 Distribution of Legal/Administrative Barriers

Table 13. Distribution of MS legal/administrative barriers' detection categorised by geographical area

Regions/MS detected	Northern Europe				Western Europe				Central and Eastern Europe				Southern Europe	
Legal/Administrative	Estonia	Finland	Latvia	Lithuania	Belgium	France	Germany	Ireland	Hungary	Romania	Slovakia	Slovenia	Italy	Spain
Environmental and/or agricultural policies and management protocols lack synergies (T)	✓	✓	✓		✓	✓		✓					✓	✓
Lack of quality standards for input material (T)			✓	✓	✓	✓		✓		✓	✓			✓
Lack of effective binding policy or enforced legal obligations to reach minimum standards (C & T)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Administrative and bureaucratic barriers to implement / improve the treatment units (T)	✓		✓	✓	✓	✓		✓	✓		✓			✓
Absence of EoW criteria leads to lack of harmonization between MS (T)	✓	✓	✓				✓	✓	✓	✓		✓		✓
Regulatory uncertainty or modifications lead to		✓	✓		✓	✓		✓	✓				✓	✓

Regions/MS detected	Northern Europe				Western Europe				Central and Eastern Europe				Southern Europe	
Legal/Administrative	Estonia	Finland	Latvia	Lithuania	Belgium	France	Germany	Ireland	Hungary	Romania	Slovakia	Slovenia	Italy	Spain
highly variable systems (C & T)														
Competition between recycling of and energy recovery from bio-waste (T)	✓	✓			✓		✓	✓	✓					✓
EU targets not cascaded to national/regional/municipal gov't (C & T)[9]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Lack of local, regional, or national strategy for the separate collection of bio-waste (C)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Inadequate appraisal of best practice options in policy design (C & T)	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓

[9] This barrier was mentioned in the CRs and EWRs. MS experts identified this as a barrier in the BIOBEST pre-interview survey. Although some countries have cascaded policy to lower levels of government and reached the targets, they may not be fully applying the Waste Hierarchy, and territorial gaps may be present.

4.1.3 Discussion of Legal/Administrative Barriers

Compared to pre-existing sources, LIFE BIOBEST increased the detection of legal/administrative barriers by nearly twofold.

The following table shows the four most common legal/administrative barriers with 85-100% detection in surveyed MS, alongside the End-of-Waste barrier.

Barriers	Analysis
Lack of effective binding policy or enforced legal obligations to reach minimum standards (C & T)	Without binding policies and effective mechanisms for monitoring and enforcement of the bio-waste separate collection mandate scheduled for 2024, the EU runs the risk of setting a problematic legal precedent. Current binding policies that focus on recycling targets and landfill targets are not strong or effective enough to catalyze the intended change.
EU targets not cascaded to national/regional/municipal government (C)	To devolve power to the lower levels of government and promote locally appropriate solutions, legal/administrative policy measures should be based on objective mandates, benchmarks, and targets. The way to guarantee this is to use continuous and effective monitoring as well as appropriate and timely penalties.
Lack of local, regional, or national strategy for the separate collection of bio-waste (C)	Local governments implement bio-waste collection and treatment, and their willingness to do so may be less an isolated event than it is a response to policy measures (regional regulations and guidelines) on upper levels of government. Policy must be translated into strategic plans accompanied by sound financial strategies.
Inadequate appraisal of best practice options in policy design (C & T)	Existing best practices show the advantages and limitations of certain bio-waste collection and treatment schemes. This information is a tool for policy design, objectives, and recommendations as it provides practical insight in achieving efficiency. Currently there is a lack of technical recommendations and guidelines.
Absence of EoW criteria leads to lack of harmonization between MS (T)	In the absence of EU-level End-of-Waste (EoW) criteria, national governments can define, if at all, their EoW criteria, leading to the persistence of fragmentation within the EU internal market and resulting in hampered market access for products originating from recycling and other recovery operations due to legal uncertainties. The latest version of the FPR introduced in its scope organic materials, previously left out. The revised regulation aims at creating a harmonised market and sets requirement for placing compost and digestate with the CE label into the market, which automatically grants the EoW status to these products that can then be freely traded intra-EU. In this regard, the FPR is a partial solution since it is optional. Operators must abide by obligations only if they want to introduce their fertilising product on the EU market. This could render the EoW criteria defined in the FPR ineffective since products that are usually traded locally or regionally are only obligated to comply with national rules. Furthermore, the FPR presents technical pitfalls when dealing with input material that includes animal by-products (e.g., kitchen waste from households and canteens). For these input materials, the FPR refers to standard transformation parameters for composting and anaerobic digestion as laid down in the ABPR,

Barriers	Analysis
	which are difficult to be met by bio-waste recycling facilities. This results in compost and digestate from animal by-products not meeting the standards of the EU market, unless alternative parameters will be accepted and included in EU legislation.

To begin bio-waste separate collection and subsequent recycling, there must be treatment plants available to process the material. This is one of the first obstacles that must be resolved in many European regions and requires legal/administrative time and resources.

Table 14 provides analysis of the complementary articles and mandates that apply to bio-waste collection phase and accompany the separate collection obligation established in Art. 22 of WFD. Table 15 provides the analysis of the complementary articles and contents that apply to bio-waste recycling phase.

Table 14. Complementary contents from the WFD's collection mandate alongside an analysis of relevant weaknesses

WFD collection mandate complementary contents	Weaknesses of the mandate configuration
• No specification of the technical features of the implementation.	• No minimum requirement or result indicators for service coverage and performance (in terms of quantity and quality).
• Member States shall make use of economic instruments and other measures to provide incentives for the application of the waste hierarchy such as those indicated in Annex IV or other appropriate instruments and measures (Art. 4 (3)). • Member States shall encourage home composting (Art. 22 (2b)).	• The promotion of economic instruments and home composting are positive drivers but, in any case, there is no real obligation ("shall" wording of the text) for their introduction so the effect of these instruments is limited.
• Derogations for environmental, technical, and economic reasons are included in the text (Art. 10 (3)).	• No specific situations for the derogations are defined; this can increase the number and type of entities that would be able to justify the non-compliance. The availability of treatment facilities could be one of the main justifications in case they are no foreseen in advance with sufficient time (very long period of permit emission and implementation along with high investment are required)
Verification mechanisms: By 31 December 2021, Member States shall submit a report to the Commission on the implementation of this Article as regards bio-waste, including on the material and territorial coverage of separate collection and any derogations under paragraph 3 (Art. 10 (6)).	• Specific checkpoint included, listing a few details that will be required: material and territorial coverage, derogations. • No specification of the indicator on the type of collection model or service and the performance. No specification of the indicator of territorial coverage that can be in terms of population served, municipalities with collection implemented, etc. • No additional checkpoints are established after the collection obligation deadline so this will not facilitate the compliance follow-up.

Table 15. Contents from the WFD's recycling mandate alongside an analysis of relevant weaknesses

WFD recycling mandate contents	Weaknesses of the mandate configuration
• The amount of municipal biodegradable waste that enters aerobic or anaerobic treatment may be counted as recycled where that treatment generates compost, digestate, or other output with similar quantity of recycled content in relation to input, which is to be used as a recycled product, material or substance. Where the output is used on land, it may only be considered as recycled if resulting in agriculture or ecological improvement (Art. 11a (4)). End-of-waste materials to be used as fuels or other means to generate energy, be incinerated, backfilled or landfilled, cannot be counted towards the recycling targets (Art. 11a (5)).	• The specification of the included flows and destinations is an important mechanism to avoid incorrect target calculation and a driver to divert the flows to those treatment and uses that are considered as recycling options. The requirement to consider only the flows that are applied to agriculture or as soil amendments is a key element that will be met by bio-waste flows with high quality.
• By 31 December 2024 the Commission shall consider the setting of recycling targets for municipal and commercial bio-waste (Art. 11 (6)).	• The specific targets for bio-waste may be assessed by the end of 2024, one year after the separation obligation, in any case, the article text does not make the target introduction compulsory for the EC. Bio-waste recycling targets can work as a crucial driver to develop efficient collection models and services focusing on high capture rates. The important issue is the agreement on ambitious targets and complementarily the introduction of a minimum collected bio-waste quality to ensure that the recycled output flow can be effectively applied to the soil.
• Mandate for the development of a European standard for bio-waste entering organic recycling processes by 31 December 2018 (Art. 22 (3)).	• No specification of bio-waste quality from separate collection is included in the WFD, but standardization for bio-waste entering organic recycling treatment and the timeline were foreseen. Since this standard is not yet in place, the driver is not active.
• Member states will promote the use of materials produced from bio-waste (Art. 22 (2c)).	• The promotion of the use of materials is essential since the possible incomes or other benefits from the outputs (compost, biogas, etc.) can balance the treatment costs and increase economic viability. The creation of proper output markets is necessary to guarantee the final use of the product and thereby to count those flows as recycled according to the new calculation method (see Table 4). In any case, there is no related obligation in this article, so the effect of this instrument is limited.
Verification mechanism: • Implementing acts establishing rules for the calculation, verification and reporting of data, in particular as regards bio-waste separated and recycled at source shall be adopted by 31 March 2019 (Art. 11a (9b)). • The Commission will monitor national criteria and will, when necessary, adopt implementing acts that specify the permissible waste inputs for the recovery operation (Art. 6(2))	The rules for the calculation are defined in Article 11a. and in Commission Implementing Decision 2019/1004. Referring to the condition: "where the output is used on land, it may only be considered as recycled if resulting in agriculture or ecological improvement (Art. 11a (4))" • The final use of outputs should be monitored by the facilities and local/regional administration to ensure the effective application. • It is important to trace the batches of compost related to the entrance flows to the responsible parties. • Acceptance or accountability specifications for the entrance flows and minimum requirements to discard

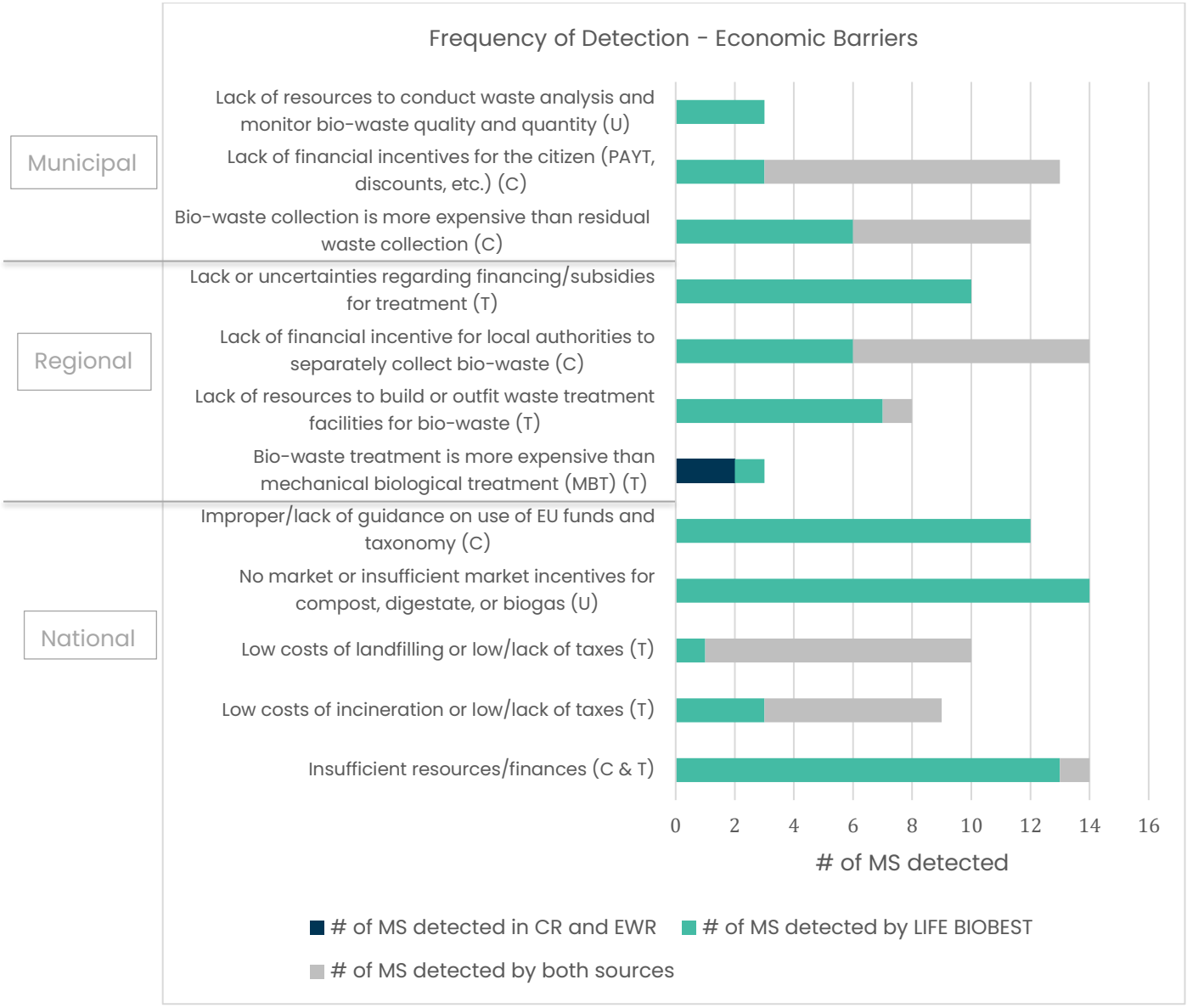
WFD recycling mandate contents	Weaknesses of the mandate configuration
	low quality flows (and not mix them with other quality streams) should be introduced and widely applied. Detailed operational procedures and input quality standards will be proposed in the LIFE BIOBEST Deliverable 5.3.

4.2 Economic Barriers

Economic barriers are those that disrupt the conduits of capital and finances both between and within government levels, institutions, and non-governmental organizations. Considering the investments and operational costs needed to implement/update waste management procedures and make bio-waste management durable for municipalities, reducing the impact of economic barriers is crucial. Economic instruments must be aligned to motivate levels of governance and citizens.

4.2.1 Frequency of Economic Barriers

Figure 16. Frequency of MS economic barriers' detection categorised by governance level



4.2.2 Distribution of Economic Barriers

Table 16. Distribution of MS economic barriers' detection categorised by geographical area

Regions/MS detected	Northern Europe				Western Europe				Central and Eastern Europe				Southern Europe	
Economic	Estonia	Finland	Latvia	Lithuania	Belgium	France	Germany	Ireland	Hungary	Romania	Slovakia	Slovenia	Italy	Spain
Bio-waste collection is more expensive than residual waste collection (C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Low costs of landfilling or low/lack of taxes (T)	✓	✓	✓	✓				✓	✓	✓	✓		✓	✓
Low costs of incineration or low/lack of taxes (T)	✓	✓		✓	✓	✓	✓	✓					✓	✓
Improper/lack of guidance on use of EU funds and taxonomy (C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
Insufficient resources/finances (C & T)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lack of financial incentive for local authorities to separately collect bio-waste (C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Regions/MS detected	Northern Europe				Western Europe				Central and Eastern Europe				Southern Europe	
Economic	Estonia	Finland	Latvia	Lithuania	Belgium	France	Germany	Ireland	Hungary	Romania	Slovakia	Slovenia	Italy	Spain
Lack of financial incentives for the citizen (PAYT, discounts, etc.) (C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Lack of resources to conduct waste analysis and monitor bio-waste quality and quantity (U)			✓			✓			✓					
Lack of resources to build or outfit waste treatment facilities for bio-waste (T)	✓		✓	✓		✓			✓	✓	✓			✓
Lack or uncertainties regarding financing/subsidies for treatment (T)	✓	✓	✓	✓	✓	✓		✓	✓	✓				✓
No market or insufficient market incentives for compost, digestate, or biogas (U)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bio-waste treatment is more expensive than mechanical biological treatment (MBT) (T)	✓			✓							✓			

4.2.3 Discussion of Economic Barriers

Compared to pre-existing sources, LIFE BIOBEST increased the detection of economic barriers by nearly twofold. Two economic barriers on the national level and one barrier on the regional and municipal levels were detected in 90-100% of surveyed MS:

Barrier	Analysis
Lack of financial incentive for local authorities to separately collect bio-waste (C)	The overhead and operational costs deter local authorities from adopting measures needed to implement durable and high-performance bio-waste separate collection scheme, public outreach, and treatment. Without the elements discussed below in "Insufficient resources/finances", local governments are unlikely to prioritize bio-waste management.
Lack of financial incentives for the citizen (PAYT, discounts, etc.) (C)	Since the separation of bio-waste is often perceived as a habit change in households, economic incentives or penalties are one instrument to onboard the public and ensure their ongoing participation.
Insufficient resources/finances (C & T)	Although EU funds (such as NextGeneration Funds) may be applied to bio-waste collection and treatment systems, low managerial capacity or other priorities may affect their application. These constraints can also be found on the regional and municipal levels, especially where EU funds are not utilized. In the case of limited resources/finances, politicians and public administrators are not motivated to increase fees to institute updates or modifications to bio-waste management. Disposal taxes are another mechanism to balance costs in favor of bio-waste management. If the tax is earmarked (e.g. refund to municipalities according to their results), bio-waste management is more economically viable. Many countries have disposal taxes on incinerators and landfills, but often they are insufficient at motivating high performance bio-waste schemes.
No market or insufficient market incentives for compost, digestate, or biogas (U)	Proper incentives in the form of taxes for competitive products and subsidies should be implemented to support the use of the outputs of the bio-waste recycling process. A stable market for outputs would defray bio-waste operational costs and incentivise the outputs' quality improvements. Farmers and agricultural producers must be included in this strategy to synchronise fertiliser demand and supply. Regions with high-quality soils where there is no demand for fertilisers must devise alternative strategies for the uses of compost and digestate. Given the increasing cost of chemical fertilisers, the need for soil amelioration and for renewable energy production (see section 2.1.3), it is likely that the output will increase in demand. Under these circumstances, so long as quality and quantity levels are achieved, a market for these commodities could rebalance the finances, thereby promoting effective management on all steps of the bio-waste cycle.

If the economic component is not adequately resolved, local governments are unlikely to take even the preliminary steps towards the institution of bio-waste collection and treatment. Without proper economic strategies for bio-waste separate collection models and treatment facilities, EU objectives and mandates will not be reached.

Priority actions to overcome economic barriers necessitate the realignment of incentives primarily on the regional and municipal levels for both private and public concerns.

4.3 Organizational Barriers

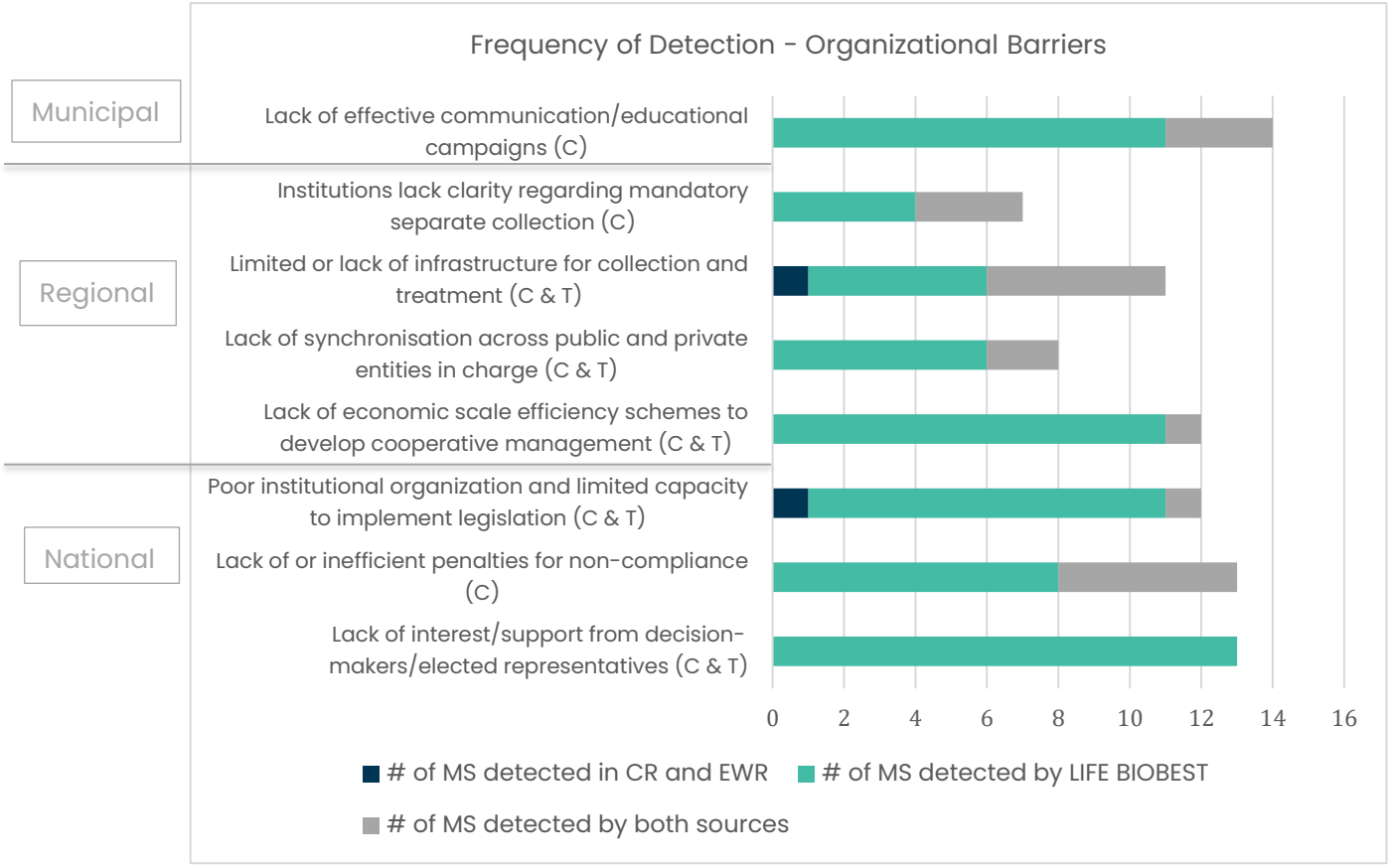
Organizational capacity speaks to the strength of institutions in carrying out policy and implementing effective solutions in bio-waste management. This requires collective activity to assemble fitting structures equipped with skilled personnel, processes, and practices that lead to well-functioning bio-waste systems. Central to these efforts are the institutions' capacities to interact transversally.

Citizens are part of the organizational structure as they are key actors for separate collection and participation. The mechanism to reach society in waste management is through communications and public education activities that are synchronized with instruments from the other categories.

In this way, politicians, leaders, and other elected staff are key actors since they set and enact the political agenda.

4.3.1 Frequency of Organizational Barriers

Figure 17. Frequency of MS organizational barriers' detection categorised by governance level



4.3.2 Distribution of Organizational Barriers

Table 17. Distribution of MS organizational barriers' detection categorised by geographical area

Regions/MS detected	Northern Europe				Western Europe				Central and Eastern Europe				Southern Europe	
Organizational	Estonia	Finland	Latvia	Lithuania	Belgium	France	Germany	Ireland	Hungary	Romania	Slovakia	Slovenia	Italy	Spain
Lack of interest/support from decision-makers / elected representatives (C & T)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Lack of or inefficient penalties for non-compliance (C)	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Poor institutional organization and limited capacity to implement legislation (C & T)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Lack of economic scale efficiency schemes to develop cooperative management (C & T)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Lack of synchronisation across public and private entities in charge (C & T)	✓		✓	✓		✓		✓	✓	✓				✓

Regions/MS detected	Northern Europe				Western Europe				Central and Eastern Europe				Southern Europe	
Organizational	Estonia	Finland	Latvia	Lithuania	Belgium	France	Germany	Ireland	Hungary	Romania	Slovakia	Slovenia	Italy	Spain
Limited or lack of infrastructure for collection and treatment (C & T)														
Institutions lack clarity regarding mandatory separate collection (C)														
Lack of effective communication/educational campaigns (C)														

4.3.3 Discussion of Organizational Barriers

Compared to pre-existing sources, LIFE BIOBEST increased the detection of organizational barriers by more than threefold. Organizational barriers identified are dispersed across the national, regional, and municipal levels, with the largest fraction found at regional level, which is fitting given the regional governments' role as intermediary between national and municipal governments as monitors and facilitators.

Five organizational barriers were detected in 85-100% of surveyed MS:

Barrier	Analysis
Poor institutional organization and limited capacity to implement legislation (C & T)	To overcome this organizational barrier requires concerted interaction across institutions and stakeholders. The success of organizational strategies depends on the mobilization of waste policy into comprehensive operational processes, both durable and extensively applied. Efficient institutional structures, skilled human resources, and management oversight are necessary. A bottleneck present in the FPR is the conformity assessment procedure for waste-derived input materials such as compost and digestate, which requires the external control carried out by an accredited notified body of the quality assurance scheme set up by the producer. While a third-party assessment is in principle a correct requirement, at the moment no notified body is dealing with bio-waste derived fertilising products, and existing quality assurance organizations (QAOs) for compost and digestate are excluded from accreditation at EU level under the FPR, adding a further layer of administrative burden. Allowing these QAOs to assess the conformity of compost and digestate would bring many benefits. Well-established national and pan-European quality assurance schemes have proven to be effective and should be further considered in EU policy concerning bio-waste.
Lack of or inefficient penalties for non-compliance (C)	Enforcement is a key instrument to advance the quality and quantity of bio-waste collected and output produced. Penalties should be timely, appropriate, and effective. In order to homogenize performance and reach objectives, in the case of non-compliance, credible authorities must distribute penalties that stimulate progress on bio-waste management.
Lack of interest/support from decision-makers/elected representatives (C & T)	The role of politicians and elected officials has gone under recognized in pre-existing studies. When bio-waste management is subjected to the whims of politicians and election cycles, it will only progress if it is politically advantageous. Electoral cycles affect the implementation of or modifications to the bio-waste system. In general terms, bio-waste is not a popular issue for the public or politicians, though at times it is used as a political pawn.
Lack of economic scale efficiency schemes to develop cooperative management (C & T)	For heightened efficiency, adjacent municipalities or regions may enter into agreements about shared bio-waste collection services or treatment facilities under economic scale efficiency models. However, this necessitates levels of inter-governmental and inter-organizational interaction that some surveyed MS have identified as scarce. These complex agreements between political parties and entities impact the willingness to enter or manage cooperative management schemes.

Barrier	Analysis
	Across all categorisations, as detected in all surveyed MS, one of the most crucial barriers is the lack of effective communication/educational campaigns since the public is a key actor in bio-waste management systems. For the development and economic solvency of bio-waste management, high levels of participation are a requisite. In general, initial campaigns are not sufficient. There is a lack continuous outreach services and a lack of financing for them. To maintain levels of participation requires advanced methodology to communicate and understand behavior.
Lack of effective communication/educational campaigns (C)	Successful educational activities reach and convince the public are often bolstered by legal mandates and economic instruments to motivate and maintain participation. Public communications and social media have a crucial role in providing information and guiding public opinion. Under optimal circumstances, this reduces the societal stigmatisation of waste management. Farmers, agricultural producers and landscapers are key stakeholders to close the cycle of bio-waste. Therefore, communication efforts should focus on their understanding of the positive benefits of compost/digestate and their willingness to buy or use them. To that end, awareness activities must nudge the public to participate and provide information about proper participation habits that lead to low impurity and contamination levels.

While in some local entities bio-waste separate collection and treatment is managed and maintained by public institutions, in many cases private companies provide the service.

In suboptimal circumstances, key responsibilities such as public communication and enforcement are lost in the rift between the two sectors, thereby problematizing the bio-waste scheme. In the local entities where this is the case, it is a defining impediment. To prevent this, private-public partnerships and sub-contracting must ensure all necessary processes by clearly defining roles, responsibilities and quantity/quality objectives. The control and the monitoring should be developed by the public administration, and there must be mechanisms to update or modify contracts, if necessary, in favor of service improvements.

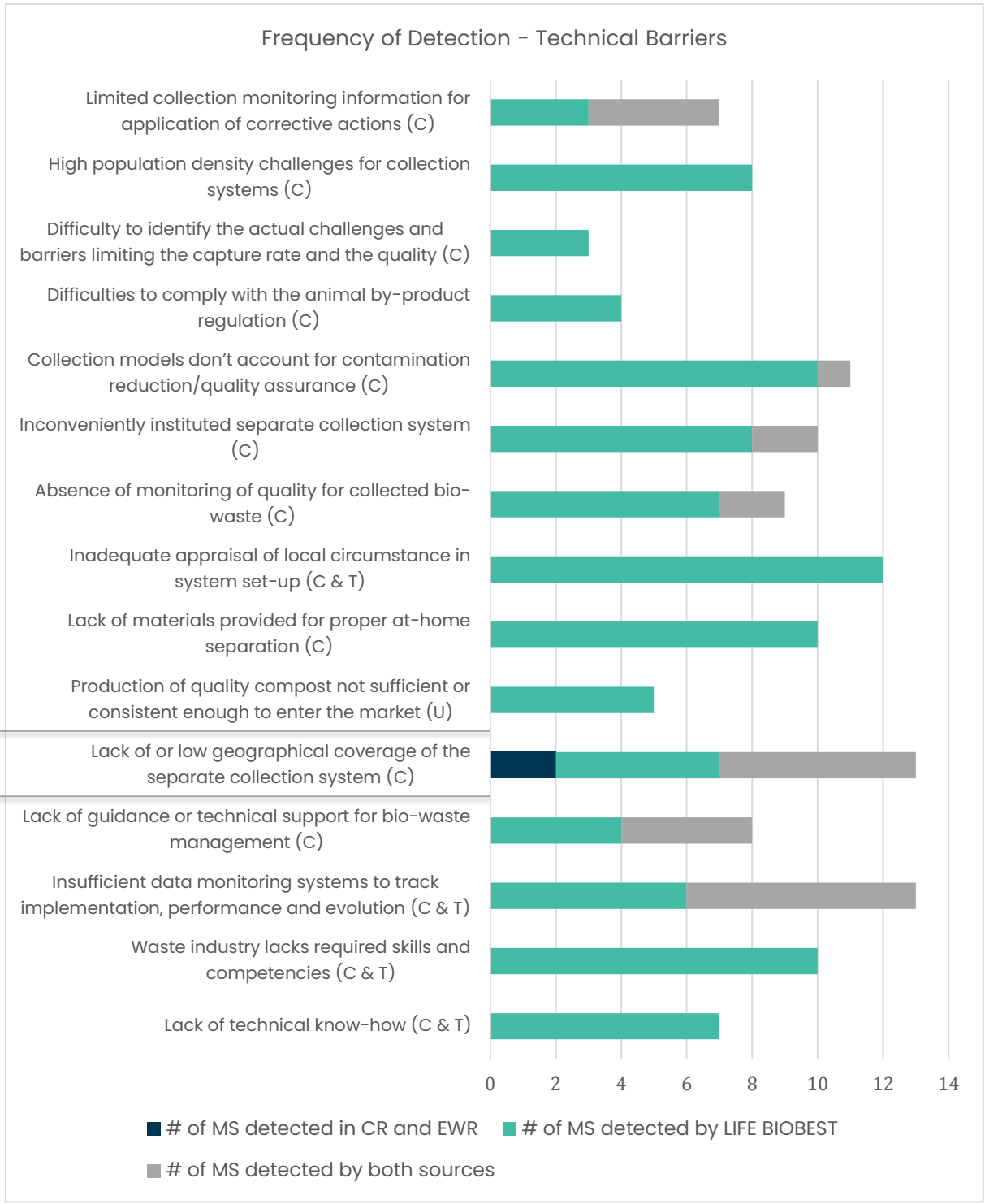
4.4 Technical Barriers

Municipalities are where bio-waste policy meets the pavement. Local authorities apply technical instruments to facilitate the system design, public participation, collection, monitoring, material transportation, transfer to treatment facilities, treatment, etc.

Technical instruments and technological innovations depend on the municipality's financial capacity to utilize or update available infrastructure and equipment. Technical barriers, to that extent, thwart the practical management of bio-waste.

4.4.1 Frequency of Technical Barriers

Figure 18. Frequency of MS technical barriers' detection categorised by governance level



4.4.2 Distribution of Technical Barriers

Table 18. Distribution of MS technical barriers' detection categorised by geographical area

Regions/MS detected	Northern Europe				Western Europe				Central and Eastern Europe				Southern Europe	
Technical	Estonia	Finland	Latvia	Lithuania	Belgium	France	Germany	Ireland	Hungary	Romania	Slovakia	Slovenia	Italy	Spain
Lack of technical know-how (C & T)			✓	✓		✓			✓	✓			✓	✓
Waste industry lacks required skills and competencies (C & T)	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓
Insufficient data monitoring systems to track implementation, performance and evolution (C & T)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lack of guidance or technical support for bio-waste management (C)	✓		✓	✓		✓			✓	✓	✓			✓
Lack of or low geographical coverage of the separate collection system (C)	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Lack of materials provided for proper at-home separation (C)		✓	✓	✓	✓	✓	✓	✓		✓		✓		✓
Inadequate appraisal of local circumstance in system set-up (C & T)	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

Regions/MS detected	Northern Europe				Western Europe				Central and Eastern Europe				Southern Europe	
Technical	Estonia	Finland	Latvia	Lithuania	Belgium	France	Germany	Ireland	Hungary	Romania	Slovakia	Slovenia	Italy	Spain
Absence of monitoring of quality for collected bio-waste (C)	✓		✓	✓		✓	✓	✓	✓	✓	✓			
Inconveniently instituted separate collection system (C)	✓		✓		✓	✓	✓	✓	✓	✓			✓	✓
Production of compost not sufficient in quality/quantity or consistent enough to enter the market (U)				✓				✓			✓	✓		✓
Collection models don't account for contamination reduction / quality assurance (C)	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓
Difficulties to comply with the ABPR (C)	✓				✓		✓					✓		
Difficulty to identify the actual challenges and barriers limiting the capture rate and the quality (C)	✓			✓	✓									
High population density challenges for collection systems (C)					✓	✓	✓	✓	✓			✓	✓	✓
Limited collection monitoring information for application of corrective actions (C)	✓		✓	✓		✓				✓	✓			✓

4.4.3 Discussion of Technical Barriers

Compared to pre-existing sources, LIFE BIOBEST increased the detection of technical barriers by fourfold. Given the municipal government's role in local implementation, it is fitting that most barriers are on the municipal level. Barriers on the national level deal with directing resources, technical expertise, and oversight to the municipal governments.

Barriers	Analysis
Insufficient data monitoring systems to track implementation, performance and evolution (C & T)	Data tracking mechanisms function as progress and performance reports. The lack of detailed and up-to-date information to monitor the objective achievements obstructs the planning or improvements of the system. On the local level, user participation indicators are necessary for authorities to evaluate and improve collection and enforcement. The information about the service and results, too, helps the public to evaluate the service provider. The storage, transmission, and homogenous management of data (especially municipal data) is linked to organizational barriers. Without integrated inter-institutional liaising on upper levels of management, the system's performance and evolution may not be properly controlled.
Inadequate appraisal of local circumstance in system set-up (C & T) Inconveniently instituted separate collection system (C)	Municipalities are diverse in topography, land use, population density, institutional capacity, economy, priorities, cultural disposition, bio-waste producers, etc. These two interrelated barriers signal that there is no one-size-fits-all technical solution and accompanying instruments. Technical instruments and collection/treatment models must be tailored to the local necessities to maximize the quality and quantity of managed bio-waste. Authorities must exercise caution when copying and pasting models and should consider validated best practices.
Collection models don't account for contamination reduction/quality assurance (C) Absence of monitoring of quality for collected bio-waste (C)	Technicians must ensure that collection systems are capable of handling maximum quantities in ways that do not forfeit quality. Moreover, collection models should be equipped with quality monitoring and assurance mechanisms that will lead to the reduction of contamination, such as the DtD collection model that includes the inspection of collected material. General communications and direct messaging to bio-waste producers are important strategies to reduce impurities. In general, as seen in the interviews, there is a lack of detailed information about quality and its evolution. Periodic waste characterisations should be enacted to assess collected materials entering the recycling process. Other complementary mechanisms like economic incentives and penalisations can incentivise bio-waste managers to reduce impurities.
Lack of materials provided for proper at-home separation (C)	Given the domestic habit change necessary and the need for user-friendliness, systems set-up and implementation must include guidance and materials for at-home separation such as vented kitchen caddies, decals, compostable bags, or curbside collection bins. The distribution of these materials is a key outreach activity that should be aimed at increasing public participation to the extent possible. The best moment to do this is during the installation of the collection

Barriers	Analysis
	model, and at-home materials should be updated and redistributed as needed[10].
Lack of technical know-how (C & T) Lack of guidance or technical support for bio-waste management (C)	In some cases, technicians and the waste industry do not have a comprehensive and wide-reaching understanding of bio-waste management especially in territories in which zero waste practices are not widely implemented. Technicians must have the skillset necessary to evaluate a service area's needs, recommend appropriate collection models and oversee their implementation, assess best treatment processes, assist in the coordination of outreach activities, track/monitor participation and progress towards objectives, etc. Guidelines from upper-level authorities such as the EU are important at disseminating know-how and ensure the installed systems are the most efficient possible.

While it may be more a result of good management and less a regulatory/policy barrier, "Lack of or low geographical coverage of the separate collection system (C)" has been included as a variable identified in and transferred from the EWR. The separate collection systems may not be uniformly instituted. Balancing cost effectiveness, facilitation and pressure from upper levels of authority may help extend the coverage of the system.

The geographical coverage and current results of the bio-waste separate collection system is closely tied to the available treatment capacity. The treatment capacity of many MS does not account for future increases in bio-waste flows. Without adequate treatment capacity, they are not ready to implement or increase bio-waste collection. The tension therein demonstrates the urgency to plan and enact treatment measures accordingly.

Across the EU, "High population density challenges for collection systems (C)" is a pervasive difficulty faced by medium-large cities. Due to the distinct context of each city and the transformation of cities over time, bio-waste management systems must be carefully tailored and updated to fit the local (or neighborhood) circumstances. Overcoming this barrier requires skilled individuals and specific strategies for multi-apartment buildings.

As discussed in LIFE BIOBEST's First Co-Creation Event hosted by ACR+, local challenges are barriers faced by the locality based on their specific circumstance. Local challenges surveyed in the event include:

- Difficulties due to extreme weather,
- Difficulties due to wildlife/pests,

[10] The usage of certified compostable bags or liners alongside vented caddies makes the separation at source more user-friendly and invokes a reduction of the amount of water in the organic matter. Among other environmental and economic managerial benefits, this reduces the use of conventional plastics bags that are considered one of the most pervasive impurities in bio-waste characterisations. Local entities with models that require compostable bags should apply the necessary mechanisms for distribution and facilitation of their use.

- Difficulties with certain populations or remote areas,
- Difficulties with tourism or seasonal variation,
- Garden waste influxes overwhelm collection system,
- High transportation costs from the collection area to the treatment facility,
- Odors or bothersome impacts from collection facilities or treatment plants,
- Lack of local users and
- Selection of improper/inefficient treatment technologies.

For more information on the Co-Creation Event, refer to Annex 2: Co-creation Event Results.

Table 19 provides the complementary instruments needed to implement the WFD's separate collection obligation. 0 provides the instruments to implement bio-waste recycling phase.

Table 19. Instruments related to the collection obligations alongside the necessary investments

Instruments needed to implement the collection obligation	Related investments and costs
• Training and empowerment for stakeholders and politicians. • Selection and design of the collection model. • Modification of the collection model and services, new or extended contract for the services, tendering obligations. • Treatment facility or on-site composting deployment. New facilities may require long permissions processes and construction. • Communication campaigns, user information and monitoring services. • Data collection and treatment regarding users, collection results and facility performance. • Control and supervise the performance of private collection for commercial/industrial bio-waste. • Modification of the local ordinances. • Update the management fees for service users.	• Extended or modified collection services (CAPEX and OPEX) • Collection material for users (compostable bags, vented caddies, bins, hangers, etc.) (CAPEX) • User identification and service monitoring technologies (CAPEX and OPEX) • Treatment facilities (update or new) or in situ composting (CAPEX and OPEX) • Consultancy services (OPEX) • Communication and monitoring services (OPEX) • Internal human resources for managing and data monitoring (OPEX)

Table 20. Instruments related to the recycling phase alongside the necessary investments

Instruments needed to implement recycling phase	Related investments and costs
• Facility entrance flow identification and record systems, methods to discard flows in case of low quality. • Characterisation systems and protocols.	• Investments in tracking systems for facility inputs and outputs (OPEX and CAPEX)

Instruments needed to implement recycling phase	Related investments and costs
• Facility flow tracking instruments to follow up bio-waste entrances and related batches and outputs. • Information collection systems of the administration for the quantities delivered to facilities and the outputs of the facilities and the final destination. Clear protocol to record and transfer the information (for public and private facilities). • For on-site composting, realistic and standardised methodology to calculate the recycled flows. • For private collection, entering to private facilities, control and auditing the systems to validate the information.	• Human resources managing these systems and information (OPEX) • Central administration human resources and TICs for consolidating, validating and auditing the information (OPEX and CAPEX)

Table note: OPEX=Operational Expenditures, CAPEX= Capital Expenditures

5 Conclusion & Recommendations

Bio-waste management must overcome the obstacles that prevent it from reaching full potential. This report's findings suggest that a multitude of barriers plague the European institutions and stakeholders struggling to meet the EU mandate for separate collection of bio-waste and the landfill and recycling targets, thereby precluding the closure of the bio-waste cycle.

It is critical to mention that in poorly implemented or managed bio-waste models, neither targets nor the expected improvement on health and environment may be reached. In collection, treatment, and use of biological treatment outputs, quality must be ensured so that the input and output flows do not become a vector for heavy metals, microplastics, and other contaminants.

By showing the frequency and distribution of barriers categorised by topic, level of governance, and step in the bio-waste cycle, the goal has been to disaggregate the barriers to provide a wide and comprehensive view of the constraints and bottlenecks—a necessary step towards the design of corrective measures. Many barriers are interrelated and dispersed across EU MS, necessitating multiple transversal and vertical solutions to overcome them.

The EWRs, CRs, and existing research has been the launching off point for this study. As an additional consideration, where the collection and treatment of bio-waste, including food waste, has not yet been uniformly implemented, it is difficult to ascertain some of the barriers at play due to the absence of real-world application. This is the case in Lithuania, Lativia, Hungary, Romania, Spain, and parts of Belgium, for example.

The core lines of action to improve quantity and quality of bio-waste managed include:

- Close the gaps in and advance the regulatory framework,
- Promote and align economic incentives and funding,
- Extend the network of expert stakeholders across all levels of governance,
- Improve technical know-how and validation of BPs,
- Increase communications, public education and awareness and
- Implement efficient and individualised models (that identifies the user and allows controls of the collected material) and monitor performance.

In the following table, LIFE BIOBEST proposes cross-categorised calls to action that reiterate and detail the findings already mentioned in the discussion sections. The calls to action are categorised by primary topic (economic, legal/administrative, organizational and technical), step/topic relevant to the bio-waste management cycle (collection, treatment, outputs and quality) and the governance target level (promoters or recipients). Primary categorisations have been bolded. Priority actions considered as the first measures that must be taken are signaled with light blue.

Table 21. LIFE BIOBEST calls to action cross categorised by scope, topic in cycle, and target level

LIFE BIOBEST Calls to action	Topic				Step in cycle	Target Level	
	E	L/A	O	T	Collection (C) Treatment (T) Outputs (O) Quality (Q)	Promoter	Recipients
Cascade national recycling targets down to the municipal level with responsibility for waste collection systems and ensure that there are consequences for municipalities that fail to meet targets. National laws state the transfer of the EU objective to regions, thereby giving the capacity to regions to decide how to transfer the objective to the local level.		**X**			C & T	EU, MS	R, M
Set **binding mechanisms based in continuous and effective monitoring as well as appropriate and timely penalties** for non-compliant institutions. Define sanctions for MS and regions that fail to mandate and monitor separate collection as well as for local entities that fail to achieve general recycling targets or bio-waste recycling target[11].		**X**	X		C & T	EU, MS	MS, R, M
Policy measures must include bio-waste **benchmarks and targets for separate collection, quality for bio-waste collected and for quantity of bio-waste in residual waste** (maximum amount per inhabitant) to control the quantity not diverted. Treat the new regulations on bio-waste as reglementary mandates that are directly adopted once the EU norm is approved. *For quality targets refer to the forthcoming quality standards information in LIFE BIOBEST Deliverable 5.4.*		**X**			C & Q	EU, MS	R, M
Create a follow up mechanism in line with Article 10 (6) of the WFD: "By 31 December 2021, Member States shall submit a report to the Commission on the implementation of this Article as regards bio-waste, including on the material and territorial coverage of separate collection and any derogations under paragraph 3". **Set check points for monitoring and comprehensive indicators** (refer to Table 14 and KPIs included in LIFE BIOBEST Deliverable 2.1 Improved and Homogenized Datasets)		**X**	X		C & T	EU, MS	MS, R, M
Define standards for bio-waste entering facilities mentioned in Article 22 of the WFD and cascade to municipal level. *Forthcoming quality standards information in LIFE BIOBEST Deliverable 5.4.*		**X**		X	C & Q	EU, MS	R, M, PC
Certify the quality of the input, recycling process and resulting compost/digestate. Develop mandatory, EU-level **EoW criteria for waste categories falling under the FPR**, and revise existing transformation parameters to better reflect optimal bio-waste treatment conditions, thereby reducing intra-EU fragmentation. Create level playing field and increase cross-border market opportunities. *Forthcoming quality standards information in LIFE BIOBEST Deliverable 5.4 and guidelines in Deliverable 3.3.*		X	X	**X**	T & O & Q	EU, MS	R, M, PC
Promote **accredited notified bodies of the quality assurance schemes** dealing with bio-waste derived fertilising products and accredit at EU level under the FPR the existing quality assurance organization (QAO) for compost and digestate to assess the conformity.		X	**X**	X	T & O & Q	EU	QAO

[11] When the collected flows enter central facilities, estimations of municipal recycling level should be calculated based on the individual input flows and the efficiency of the process.

LIFE BIOBEST Calls to action	Topic				Step in cycle	Target Level	
	E	L/A	O	T	Collection (C) Treatment (T) Outputs (O) Quality (Q)	Promoter	Recipients
Resolve conflict at EU level between the FPR and ABP on the end point in the manufacturing chain by allowing alternative transformation parameters for the composting and AD of bio-waste containing ABP which better reflect current practices[12]. *Forthcoming related guidelines in Deliverable 3.3.*		**X**		X	C & T	EU, MS	R, M, PC
Create or improve **strategic bio-waste implementation plans accompanied by sound financial strategies** in order to streamline and homogenize performance. The plans must integrate BP and technical recommendations as well as include a subsection about facilities.		X	**X**		All	MS, R, M	MS, R, M
Ensure that planned or existing **treatment infrastructure match generation and capture, guaranteeing the proximity principle**. Evaluate and **align the current capacity in both private and public facilities with long term planning** to meet increasing capacity. Consider the adaptation of MBT facilities to treat separated bio-waste.			**X**	X	T	MS, R	R, M, PC
Promote **shared bio-waste collection services or treatment facilities under economic scale efficiency models**, especially among small municipalities.	**X**		X		All	MS, R	R, M
Consider **home, community, and small-scale composting** facilities as a low tech and low-cost solution, especially in low density areas and dispersed population areas, when the model is appropriate.			X	**X**	All	MS, R	R, M
Promote effective and **individualised collection models** (mainly DtD collection schemes) in laws and implementation plans. *Forthcoming related guidelines in LIFE BIOBEST Deliverable 3.1.*		X	X	**X**	C	MS, R, M	R, M
Promote **R&D for the introduction and improvement of quality control methods** of bio-waste entering facilities or delivered to the collection services.	X	X	**X**		All	EU, MS	MS
Promote studies on compost/digestate quality, application methods and benefits to soil, as to facilitate the use of these outputs.		X	**X**	X	Q & O	EU, MS	All
Standardize **management protocols** and data monitoring to ensure proper functioning and **tracking of home composting**[13].			X	**X**	T	EU, MS	R, M

[12] This proposal references food-waste catering ABP (category 3) managed in the framework of municipal bio-waste.

[13] This proposal should be applied to individual composting of households, HoReCa establishments with composting system and community composting points.

LIFE BIOBEST Calls to action	Topic				Step in cycle	Target Level	
	E	L/A	O	T	Collection (C) Treatment (T) Outputs (O) Quality (Q)	Promoter	Recipients
Provide validated **guidelines and best practices endorsed by upper-level authorities** such as the EU are important for disseminating know-how and ensuring the installed systems are the most efficient possible. *Forthcoming related guidelines in LIFE BIOBEST Deliverable 3.1.*			**X**	X	All	EU, MS	R, M
Create **inter-governmental bodies dedicated to the coordination of bio-waste** management across MS regions. The bodies would serve as points of contact to transfer information and coordinate vertically and horizontally.		X	**X**		All	MS	R, M
Creation of a **stakeholders' working group on EU level that is focused on bio-waste** or include a bio-waste working group in the Circular Economy Stakeholder Platform with activities including the organization of regular conferences on the topic.			**X**		All	EU	MS, R
Incorporate **training and empowerment courses for politicians and other key stakeholders**. Promote actions and awareness at local or regional level to avoid partisan interference in the legal application and compliance. *Forthcoming related guidelines in LIFE BIOBEST Deliverable 3.2.*			**X**	X	All	EU, MS, R	R, M
Promote **trainings to equip technicians with skillset** necessary to evaluate a service area's needs, recommend appropriate collection models and oversee their implementation, assess best treatment processes, track/monitor participation and progress towards objectives, etc.			**X**	X	All	MS, R, M	R, M
Promote **awareness and training for agricultural producers** to understand and apply compost and digestate on soil and farmland.			**X**	X	O	MS, R	F
Re-evaluate the effectiveness of current MS **disposal taxes on incinerators and landfills**, increasing taxes to rebalance the economic viability of bio-waste management. *Forthcoming related guidelines in LIFE BIOBEST Deliverable 3.2.*	**X**		X		C & T	MS, R	R, M
Launch specific programme to promote **private and public investment in new treatments facilities and to increase treatment capacity**. This can be related to climate change mitigation actions.	**X**	X	X		T	EU, MS	R, M, PC
Include measures or economic instruments in respective sectorial laws to **enhance the marketability of biogas and compost/digestate**, thereby bolstering the separate collection of bio-waste. **Promote the final uses and the supply chain of the outputs**.	**X**	X	X		O & Q	EU, MS	R, M, PC, F

LIFE BIOBEST Calls to action	Topic				Step in cycle	Target Level	
	E	L/A	O	T	Collection (C) Treatment (T) Outputs (O) Quality (Q)	Promoter	Recipients
Include in national/regional waste laws the **obligation for local authorities to apply waste charges that cover the total cost of waste management services** including complementary activities such as communication and monitoring activities, landfill closure and monitoring, etc. The law could include a complementary obligation to **institute PAYT or variable payment schemes** based on participation[14]. *Forthcoming related guidelines in LIFE BIOBEST Deliverable 3.2.*	**X**				C & T	MS, R	M
Close the MS investment gap through the effective use of **EU funds to develop waste infrastructure** that supports improving bio-waste prevention and recycling performance.	**X**		X		C & T	EU, MS	R, M, PC
Facilitate and standardize **disbursement of EU funds** for national, regional and municipal levels. The funds cover the human resources necessary for the distribution, implementation and justified usage of the funds.	**X**		X		All	EU, MS	MS, R, M
Establish the specifications and destinations of the funds in terms of management model, eligible materials and accompanying activities. One of the main criteria should be the project's capacity to increase quality and quantity bio-waste recycling.	**X**		X		All	EU, MS	MS, R, M
Improve **EU taxonomy by removing unnecessary and burdensome technical criteria**, which de-facto exclude bio-waste recovery through composting and AD from receiving support in the form of green investments.	**X**		X		T	EU	MS, R, M
Align **instruments related to energy and emissions** (such as emissions trading permits, cap-and-trade models, and energy production taxes) with bio-waste management objectives.	**X**		X		T	EU	MS, R, M, PC
Study the necessity and applicability of **EPR for food products**, and later the conditions and options for EPR schemes if utilized.	**X**	X	X		All	EU, MS	All
Establish a **monitoring system with set parameters (KPIs) and update frequencies**. Obligate local entities and operators to monitor and report their data on separate collection and treatment including managed quantities and quality of the flows as well as destination of the outputs. Include the mandate to **control the quality at the service delivery point** as a strategy to minimize impurities at the source.		X	X	**X**	All	MS, R	R, M
Mandate and increase periodic **bio-waste characterisation at entrance to bio-waste facilities**. Composition studies should be applied to the different collection routes. *Forthcoming quality standards information in LIFE BIOBEST Deliverable 5.4 and guidelines in Deliverable 3.3.*		X	X	**X**	C & Q	MS, R	R, M, PC

[14] These measures will promote the producer-pays principle set forth in EU legislation.

LIFE BIOBEST Calls to action	Topic				Step in cycle	Target Level	
	E	L/A	O	T	Collection (C) Treatment (T) Outputs (O) Quality (Q)	Promoter	Recipients
Develop periodic **standardised characterisation for residual waste** in order to monitor the flow of bio-waste not diverted and landfill directive compliance.			X	**X**	C & Q	MS	R, M
Include the **obligation in the national/regional waste laws to update local norms** based on the national/regional laws.		**X**			C & T	MS, R	M
Introduce **obligation for producers to separate bio-waste in the national/regional waste laws** and transpose it into local norms.		**X**			C	MS, R	M
Promote commercial separate collection by applying individualised models with good quality and quantity results. Monitor the performance and destination of the activities using private bio-waste collection services to ensure good practices applications and law compliance.			X	**X**	C & Q	R, M	M, PC
Collaborate with **private companies managing anaerobic digestion facilities** to ensure the quality control of inputs and outputs to effectively return the organic matter to soil.			X	**X**	T & Q	MS, R	R, M, PC
Promote the **application of variable fees** based on the input quality for biological treatment facilities. *Forthcoming related guidelines in LIFE BIOBEST Deliverable 3.2.*	**X**		X		All	R, M	M, PC
Clearly **define roles, responsibilities and quantity/quality objectives in private waste sector contracts**. The control and the monitoring should be developed by the public administration, and there must be mechanisms to update or modify contracts and apply penalties.	X	X	**X**	X	All	MS, R, M	PC
Investigate and validate **best practices for multi-housing apartment buildings**. *Forthcoming related guidelines in LIFE BIOBEST Deliverable 3.1.*			X	**X**	C	R, M	R, M, Ci
Increase **financing for continuous outreach services**, including effective initial outreach campaigns. Use advanced methodology to understand behavior and maintain levels of participation. Increase direct messaging to bio-waste producers to reduce impurities. *Forthcoming related guidelines in LIFE BIOBEST Deliverable 3.4.*			**X**	X	C & Q	M	Ci
Provide **guidance and materials for at-home separation** such as vented kitchen caddies, decals, compostable bags, or curbside collection bins.			X	**X**	C & Q	M	Ci
Include **penalties that accompany inspections** for non-compliant producers at local level.		**X**	X	X	C & Q	M	Ci

Note: Economic (E), Legal/Administrative (L/A), Organizational (O), Technical (T), Citizen (Ci), Farmers (F), Municipality (M), Private Company (PC), Region (R), Quality Assurance Organisation (QAO)

Advancements in the sector must be led by the EC and will require cross-examining modalities and the inclusion of multi-disciplinary expertise. Waste management necessitates concerted coordination across MS in legal, environmental, political, fiscal, organizational, technical, and communication areas.

As a final note, the following LIFE BIOBEST outputs expected in 2024 will provide further insight on separate collection, governance and economic incentives, quality standards, and communication strategies:

- Guideline on separate collection (D3.1 led by CIC),
- Guideline on governance and economic incentives (D3.2 led by ENT),
- Guideline to promote quality compost and digestate (D3.3 led by ECN),
- Guideline on communication strategies (D3.4 led by ZWE) and
- Proposal for EU standards for bio-waste entering recycling processes for high-quality compost and digestate (D5.4 led by ECN).

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8 Definitions

Biodegradable waste (Directive 99/31/EC): any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard.

Bio-waste (Directive 2008/98/EC): biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants. According to the European Commission website, bio-waste does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper, or processed wood. It also excludes those by-products of food production that never become waste.

Disposal (Directive 2008/98/EC): any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. The list of disposal operations includes among others deposit into or the land (e.g. landfill), incineration (on land or at sea), permanent storage (Annex I of Directive 2008/98/EC).

Green waste (Vegetal Waste): biodegradable organic waste of plant origin, susceptible to biological degradation. For the purposes of its management, the FV can be divided into two specific groups that must be managed differently:

a) Vegetable fraction of small size and non-woody type (grass, leaf litter, flower bouquets, etc.). This can be assimilated to kitchen waste in terms of management.

b) Pruning. Large, woody-type vegetable fraction, which requires grinding prior to recovery. The recommendable management of pruning requires specific collection.[15]

Home and community composting: composting of domestic organic waste from kitchens and gardens by households or in a small community composting facility respectively. Home and community composting are usually applied when other bio-waste management options are less appropriate based on the followed local waste management strategy and/or findings of LCA studies on the optimal waste management options.[16]

Kitchen waste (Food Waste): remains from food preparation or handling and processing of food products, leftover food remains, food in poor condition and surplus food that has not been marketed or consumed (separated from its container or packaging).[17]

[15] Extracted from the webpage of the Waste Agency of Catalonia.
[16] Extracted from the webpage of the European Commission.
[17] Extracted from the webpage of the MITERD.

Municipal waste (Directive EU/2018/851): a) mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, bio-waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture, b) mixed waste and separately collected waste from other sources, where such waste is similar in nature and composition to waste from households. Municipal waste is referred to as Municipal Solid Waste (MSW) in this report.

Municipal bio-waste separated and recycled at source ((EU) 2019/1004): municipal bio-waste that is recycled at the place where it is produced by the persons who produce it.

Organic recycling (biological treatment of bio-waste; Directive 94/62/EC): aerobic (industrial composting) or anaerobic (biomethanisation) treatment, under controlled conditions and using microorganisms, which produce stabilized organic residues or methane.

Separate collection (Directive 2008/98/EC): collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment.

Recycling (Directive 2008/98/EC): any recovery operation by which waste materials are reprocessed into products, materials, or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Recovery (Directive 2008/98/EC): any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II sets out a non-exhaustive list of recovery operations.

Residual waste: waste that is neither recycled nor reused, i.e. waste material not collected separately for recycling or composting/digestion, and residues from sorting processes. Residual municipal waste collected must be treated before being either incinerated or landfilled.[18]

Treatment (Directive 2008/98/EC): recovery or disposal operations, including preparation prior to recovery or disposal.

Waste (Directive 2008/98/EC): any substance or object which the holder discards or intends or is required to discard.

[18] Definition adapted from the EEA since no EU legal definition is available.

Waste management (Directive EU/2018/851): collection, transport, recovery (including sorting), and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker.

Waste prevention (Directive 2008/98/EC): measures taken before a substance, material or product has become waste, that reduce: (a) the quantity of waste, including through the re-use of products or the extension of the life span of products; (b) the adverse impacts of the generated waste on the environment and human health; or (c) the content of hazardous substances in materials and products.

9 Annex 1: Interview Summaries

9.1 Methodology

Interviews with MS experts occurred over the period May 2023 – October 2023. Interview subjects were provided a pre-interview survey for ranking barriers prior to the meeting. In general, interviews were a single one-hour long session over video-call. In two cases (CIC and AMORCE), interviews were conducted via email.

In the summary tables that follow, selected passages have been taken from the transcript and reorganized with similar material. The keywords and regulatory/policy barriers detected have been synthesized based on the interviewee's responses in the interview and the pre-interview survey.

Table 22. MS experts interviewed for LIFE BIOBEST D5.2

Subject Name	Jurisdiction	Organization	Completed Pre-interview Survey	Interview Date
Francesc Giró	Catalonia, Spain	Waste Agency of Catalonia (ARC)	Yes	31/5/23
Tim Hermann	Germany	UBA	Yes	15/6/23
David Wilken	Germany	BGK	Yes	19/6/23
Alberto Confalonieri	Italy	Italian Compost Consortium (CIC)	Yes	30/6/23
Mait Kriipsalu	Estonia	Estonian Life Sciences University	Yes	10/7/23
Laszlo Alekzsa	Hungary	Hungarian Quality Compost Association	Yes	11/7/23
Andrej Pristovnik	Slovenia	Ministry of the Environment and Spatial Planning of Slovenia	Yes	29/8/23
Anna Virolainen-Hyana and Nelli Pitkanen	Finland	Finnish Biocycle and Biogas Association	Yes	30/8/23
Percy Foster	Ireland	Composting and Anaerobic Digestion Association of Ireland (Cre)	Yes	19/9/23
Vilma Slavinskienė, Aistė Krinickaitė and Greta Česnaitytė	Lithuania	Ministry of Environment of Lithuania, Waste Policy Group	No	21/9/23
Zoltan Pasztai	Romania	ECO Bihor	Yes	21/9/23
Elina Dace	Latvia	University of Latvia	Yes	25/9/23
Johan Bonnier	Flanders, Belgium	IMOG	Yes	26/9/23
Alexandra Kolarik	Slovakia	ZENZO	No	26/9/23

Subject Name	Jurisdiction	Organization	Completed Pre-interview Survey	Interview Date
Ramon Plana	Spain		Yes	29/9/23
Nicolas Bourdin	France	AMORCE	Yes	4/10/23
Gil Gram, Astrid de Man, Kathleen Schelfhout and Annemie Andries	Flanders, Belgium	OVAM	Yes	9/10/23

In addition, the following experts were consulted:

Table 23. General experts consulted for LIFE BIOBEST D5.2

Subject Name	Topic Area	Organization	Interview Date
Joan Marc Simon	EU Bio-waste Policy	Zero Waste Europe	14/4/23
Stefanie Siebert, Steffen Walk, and Riccardo Gambini	Quality Compost and Organic fertilisers	European Compost Network	22/5/23
Lucile Sever	Biogas and digestate production	European Biogas Association	2/10/23

9.2 Summaries of Interviews with Member State Experts

9.2.1 Waste Agency of Catalonia

The Waste Agency of Catalonia is a public company of the Department of Territory and Sustainability of the Government of Catalonia that is competent concerning waste generated in Catalonia and the waste managed in its territorial area, industrial, municipal, health care, or agricultural waste.

Topic	Summary
Separate collection	Some municipalities installed bio-waste separate collection schemes to reach the legal mandate without considering important aspects such as **solutions to scale, optimization, and outreach campaigns**. A consensus exists that efficient separate collection schemes should be implemented with **individualizing collection and identifying the user**. The current debate has become **politicized between DtD and smart containers**. Large municipalities with more than 50,000 inhabitants remain a challenge, but progress is being made. The new law includes the obligation to use **efficient individualised collection models**.
Social challenges	**Education** is important to explain why separate collection should have limited contamination, especially in the case of bio-waste.
Incentives	The **landfill and incineration tax** (including the evolution of the tax rate), **tax refund system** that returns money to the municipality according to the quantity and quality of the bio-waste collected, and the **grant to construct facilities** and align economic incentives for bio-waste collection.

Topic	Summary
Local challenges	**High density population** and/or high levels of **tourism** affect the day-to-day management of separate collection (collection systems and frequency of collection) as well as additional factors such as building verticality, percentage of immigration, urban configuration of the streets, commercial activity, etc. **Human resources are necessary to carry out monitoring and inspection**.

9.2.2 UBA [Germany]

Founded in 1974, the German Environmental Agency (Umweltbundesamt – UBA) is Germany's main environmental protection agency. The agency ensures that citizens have a healthy environment with clean air and water, free of pollutants to the greatest extent possible. UBA concerns themselves with an extremely broad spectrum of issues, including waste avoidance, climate protection, and pesticide approvals.

Topic	Summary
Separate collection	Fees for the residual waste, also for incineration of the residual waste, are very low. To raise fees is **a political decision that could influence elections**. There is a **lack of support for an incineration tax**.
Cascading waste policy to the municipal Level	In some Landers, **waste fees for both residual and organic waste are comparable, which does not provide an incentive for separate collection.** There is not a structure on the federal or regional level for waste fees. As a result, German municipalities can decide the structure of the fees for themselves.
Quality controls	The Ordinance on Bio-waste focuses on the quality of the produced compost. In recent years, **plastic contamination** is an issue. In 2022, the new ordinance on bio-waste set out to **control the contamination of the input**. The input material prior to the compost process should not have more than 1% impurities. Normally impurities are taken out after the composing process because it's technically easier. The composting process, however, can produce micro particles and plastics. We have the contamination thresholds levels similar to the EU fertilising products regulation.
Social challenges	There are **new techniques with cameras and AI intelligence**. **More awareness campaigns are needed**. It's very challenging to reach people in **high-rise buildings and population dense areas.**
Use of outputs	It's **difficult to market the compost or digestate** and to find someone to take the material for agriculture. At the moment it's easier because the **fertiliser prices are high**.

9.2.3 BGK [Germany]

The Bundesgütegemeinschaft Kompost e.V. (BGK) is recognised by RAL (German Institute for Quality Assurance and Labelling) as the national quality assurance organization for the product groups compost (RAL-GZ 251), fermentation product (RAL-GZ 245), nawaRo fermentation product (RAL-GZ 246), and fertiliser (RAL-GZ 252).

Topic	Summary
Quality controls and responsibilities	In most cases, treatment is in private hands. They **may not have interest in input quality**. This changed with the new bio-waste ordinance. Now they must ensure the quality of input material. After 40 years or 30 years without a system for impurities analysis, now we have a **system to compare the data from all the plants in Germany.** This helps us to know whether the quality is improving and to track development over time. The **legal bio-waste ordinance was a strong driver** in setting legal consequences and limit values. As of 1st of May 2025, controls begin at the point when the collector gives the material to the plant.
Inspection methodology	The collector and the treatment plants have started working together to **improve the quality**. In the future, artificial intelligence may be used to ascertain impurity levels. **The cheaper the bio-waste bin is, the more it is used**. This works as an incentive.
Animal by-product regulation	If animal by-products are in the municipal bio-waste, we have **national thermophilic requirements**.
Use of outputs	Farmers who use compost have **fewer problems with water retention**.

9.2.4 Italian Compost Consortium

The Consorzio Italiano Compostatori (CIC) is a nonprofit organization established in 1992. Their mission is to promote bio-waste recycling and prevention, enhance compost quality and market, organize technical training for the compost sector and assist government bodies in improving bio-waste recycling.

Topic	Summary
Separate collection	The main need is to **increase the per-capita capture rate and the quality of the bio-waste collected**. Currently, bio-waste recycling operators are being incentivized (€) to produce biomethane. A possible consequence is that they are aiming to gather as much feedstock as possible to increase their biomethane production capacity by decreasing the gate fee tariff, **not pressing municipalities to pursue the good quality of the feedstock**.

Topic	Summary
	Some local areas are less "served" in terms of bio-waste recycling infrastructures but, due to incentives mentioned before and public funding for the construction for new bio-waste recycling plants, in a few years the homogeneous distribution of recycling plants throughout the country will be reached.
Social challenges	**Continuous and effective training and education** to citizens is needed to ensure their commitment. **Money to carry out these educational/awareness activities** is missing, alongside with the **scarce interest shown so far by several municipalities**. Many Italian cities/areas with **high population density/high levels of tourism** have an efficient system, so we can confirm that we have the technical capacity to overcome this challenge. The important thing then is that those areas who are starting now take advantage of the best practices that can be shown by other cities/regions of the same characteristics.
Incentives	The modulation of recycling costs (gate fees) with respect to the quality of the collected streams functions as an incentive for separate collection. The **increase of disposal costs** is necessary, as are **incentives for biogas/biomethane production**.

9.2.5 Estonian University of Life Sciences

Estonian University of Life Sciences is the only university in Estonia whose priorities in academic and research activities provide the sustainable development of natural resources necessary for human existence as well as the preservation of heritage and habitat.

Topic	Summary
Public vs. private division of responsibilities	There is confusion about the delegation of responsibilities and ownership in the bio-waste cycle. Neither municipalities nor private companies are fully responsible for **public outreach/awareness or treatment infrastructure**, which results in a lack of **quality source separation**. The unclear divisions of labour and responsibilities create bottlenecks. It is not only collection you have to monitor. Treatment also is in hands of private companies, which is a barrier because if they don't want to do certain things, then municipalities also can't do anything. And the **waste companies have their own priorities**, which doesn't necessarily match to countries priorities.
Local challenges	The **climate and population dispersion affect the bio-waste treatment options**. Composting indoors or in tunnels is more flexible.
Realignment of treatment incentives	The presence of the incinerator triggered competition between private companies. There is not an **incineration tax and incineration fees are inexpensive**.

Topic	Summary
	People now have two options, either join the brown bin collection or home composting. There is a push to implement home composting instead of brown bin collection. **Municipalities support this by giving inexpensive or free composters**.
Quality control	The biggest source of mistake in open windrow composting is the **post contamination with weed seeds**. I would like to have more protected and more controlled environment. It's difficult to explain to municipalities that certification is beneficial because they heavily weigh cost. **Without certification, the flow does not count as recycling**. Impurities are measured as a percent in dry matter and must be less than 0.5. It would be very much necessary to push the municipalities to write the obligation to report impurities.

9.2.6 Hungarian Quality Compost Association

The Hungarian Compost Association was founded in 1999 as the civic organization of biological waste handling and composting professionals. The aim of the establishment was to help specialists in standing for the interests of selective waste handling and composting in a unified constitution.

Topic	Summary
Financing and EU funding	All composting plants were constructed from EU money, but there is **no EU money for the operation of the plant**. Without EU financing, high gate fees are necessary, and this is not realistic in case of municipal solid waste or in case of bio-waste. There is EU money for private companies that can get **finances for developing infrastructure**. The basic idea is that as a big company, MOL [new waste management company] has the financial tools to make all the needed investments in Hungary. MOL will construct and own the new WTE plant. **Because bio-waste is not an EPR, it lacks the tool the financing**.
Incentives	The gate fees and the landfill tax are very low. The landfill tax is **below of operational costs of composting plants**. We introduced the landfill tax 10 years ago with the idea to double it every year. That was at the beginning, in the first year they double it because that was 8 or €9 per tonnes and that was double 18 and to have 36 the next year; however, companies operating landfills and the waste management sites were going bankrupt. Compared to artificial fertilisers, the **price of compost is also very low**. Since the compost prices are low, it does not benefit the treatment economic balance. We will need a **pay-as-you-throw system**.

Topic	Summary
Social challenges	There is **a lack of public awareness/knowledge** about separate collection of bio-waste.
Quality control	Since there is only green waste composting, impurities will be a very important topic in the future. Next year we will start with the **bio-waste separate collection quality monitoring**.
Use of outputs	More than half of the compost we are making goes to agriculture. There is a need for the **education of farmers** and the provision of **subsidies to the farmers** who use compost.

9.2.7 Ministry of the Environment and Spatial Planning of Slovenia

The Ministry of Natural Resources and Spatial Planning is responsible for the management of the natural environment, water resources and physical space. It promotes and coordinates efforts towards sustainable development based on the efficient and economical use of natural resources and ensuring social wellbeing.

Topic	Summary
Separate collection	**The separate collection rate is about 80% or more in Slovenia**. We have centralized composting and home composting for kitchen waste and green waste. Those who use the centralized system pay a waste fee and those who compost at home do not pay the fee. About 48% of people in Republic of Slovenia have at home composting systems. There are 212 municipalities in Slovenia. Waste collection and treatment is in both public and private hands, depending on the municipality. Some municipalities think that the waste treatment is expensive and that the **price of waste treatment is too high**. Today it is about 100 euros per ton.
Quality control	There are **low percentages of impurities** and no mention of a threshold for input or output.
Treatment	We have one incineration plant. It is very small, 30,000 tonnes per year. We wish to have two or three incinerators because our waste goes to incinerators in Austria. There are 9 compost plants and 17 biogas facilities (2 public and 15 private). We are about 50-60% over capacity on compost and in biogas. In terms of capacity, the Republic of Slovenia is good for the next 20 years. We must **direct a part of the bio-waste into the biogas treatment facilities for biomethane production.**

9.2.8 Finnish Biocycle and Biogas Association

Finnish Biocycle and Biogas Association promotes nutrient recycling and the use and development of biogas technology and its knowledge in the society. The association wants to influence positive development of the biocycle sector field by taking part in the legislative development, by publishing information and by giving presentations in events organized by the Association or other actors.

Topic	Summary
Separate collection	In Finland, collection of **bio-waste is expensive**. Separate collection volumes are still very low. The recycling rate of municipal bio-waste is below 40%. Most of the bio-waste is incinerated. **Mixed waste is cheap for waste producers**. When Member States are implementing the updated ETS regulation, which is taking place now in Finland and other Member States, can decide whether they are going to do it in 2027. Or maybe later, by 2030. Or maybe even earlier than 27. We think that **it's better to wait for the EU level implementation guidance** to know how that should be done and then implement that in Finland and that's still under discussion at the level. The incineration of waste generates heat and power without an energy tax. An energy tax does, however, apply to the production of heat from biogas. This is already making **waste incineration more competitive and cheaper**. Separately collected bio-waste is treated both in composting plants and anaerobic digestion plants (AD) plants. This year or coming years, the biggest share of bio-waste will be treated in AD plants, not in composting.
EU funds	The utilization of EU funds is not very common. In Finland, EU funds have been used as investment aid for biogas plants. Investment aid from the national budget is one of the most **important policy instruments to advance biogas and nutrient recycling**; however, the state budget will be cut dramatically over the next year.
Binding targets	There is a landfill ban for organic waste, but there is not an incinerator tax. Heat and energy produced in incineration plants don't need to pay the energy tax for the end product. By 2027 the national bio-waste recycling target is 70%, but it's not binding. It would be very useful if we had a binding target and if the EU waste directive had a more **binding target for bio-waste recycling**. The most important incentive or mechanism to **increase the recycling rate of bio-waste is the separate collection requirement** which is going to be extended next year.
Quality control	There is **no threshold for input contamination**. For output, there are the same sort of quality requirements needed to produce fertilisers.

Topic	Summary
	The **producers of fertilisers are responsible for the quality** of the product and at least once a year, depending on the volumes of the facility, they must make laboratory analysis to show that they meet the quality requirements. Finnish Biocycle and Biogas Association is developing a voluntary-based quality scheme for recycled fertiliser products and there we are asking minimum of quality. They plan to produce a new requirement for bio-waste fertiliser products to tackle the problem of input quality.
Political representation	**Decision makers are not discussing waste legislation and waste management issues**. They are interested in improving self-security of food production, fertiliser production and energy production.
Use of outputs	There is a **need to improve the market for recycling nutrients and fertilisers**. Because now the price of digestate and compost is very low, even negative. The volumes of bio-waste aren't high. As the volumes of bio-waste collected by waste are growing, there is **need for more treatment capacity**. In Finland digestate can be used as fertiliser if it meets the quality limit values that are given in the National Fertiliser Act. It depends on the waste company if the digestate is composted as well.
Contradiction with waste legislation	The Renewable Energy Directive makes it possible to give credits for the organic waste, which is incinerated and for its end product, which **doesn't align with separate collection requirements.** It's not advisable to put too many **limits on what can be incinerated**.

9.2.9 Composting & AD Association of Ireland

Established in 2001, Cré is a nonprofit association of public and private organizations, dedicated to growing the biological treatment sector. Cré supports the production of high-quality outputs, assists the delivery of government waste diversion and bioenergy targets, and promotes the creation of sustainable indigenous jobs.

Topic	Summary
Separate collection	There is **no clear performance indicator or bio-waste target set in the WFD**, which makes it difficult to pursue a common target. A possible **performance indicator is the maximum amount of organics in residual waste**. In this way, organics are being directed away from landfills, incineration, MBT facilities and into source separated bins.
Private and public division of labour	Because the collection market for household waste is an open market, contamination enforcement is low for fear that **customers will move to another more lenient competing private collector.** Since it is not the responsibility of the waste collectors to meet targets for municipal recycling, there is disconnect about how to reach quality and quantity targets.

Topic	Summary
Incentives	Tenants pay a flat rate to cover all utilities, which means they don't directly see the financial cost of waste. As a result, the Irish Government has adopted new legislation referred to as **incentivizing waste charging.**
Social challenges	Education efforts must be increased, standardised, and focused on reducing contamination (especially plastic). Instead of short-term campaigns, **education must be continuous**.
EU Funds	There is **limited knowledge and usage of EU funds**, including those of EU Next Generation, in Ireland.
Quality controls	Although there are plenty of markets for good quality compost, a key issue is to **reduce contamination levels down to 1-3%,** which is the target Cre has set for the sector. There is not currently a set system for monitoring contamination. There's **a need for continuous monitoring of contamination** with quarterly waste characterisations done of collection routes. The data collected should be shared with processors and collectors so that they can charge extra for contamination. Contamination monitoring and enforcement would have to be done by an independent agency paid by the government.
Local challenges	There are **difficulties in the provision of separate collection to high-rise building and multi-household**.
Treatment	There is a landfill levy that will be increased to 85 euros. There's also a new incineration levy**.** A lot of residual waste goes for incineration in Ireland and then it is shipping abroad. In the case of exporting out Ireland, the incineration tax is still collected. Many years ago, since contamination was high, compost plants **stopped shredding incoming feedstocks because it breaks down plastics into smaller pieces, and it's more difficult to screen out.**
Use of outputs	**Among the priority actions is a legal end of waste status for compost and digestate**. Compost and digestate standards are currently voluntary and must be further developed. Compost plants of many European countries are not meeting the EU Fertiliser Regulation standards. There is a **barrier to achieving the status of no longer waste and exporting the end product.**

9.2.10 Ministry of Environment of Lithuania, Waste Policy Group

The Lithuanian Ministry of Environment oversees the environment and natural resources of Lithuania.

Topic	Summary
Separate collection	Very few municipalities have political or technical incentives to organize separate collection of bio-waste. Their arguments were that **bio-waste**

Topic	Summary
	management is not economically feasible, and it would increase waste management costs. There are **few instruments or penalties on the national level** to motivate bio-waste management.
Incentives	The national waste policy has **not adequately incentivized, encouraged, or enforced bio-waste management** on the regional or local level. According to the waste management prevention and management plan, municipalities may use charge inhabitants that compost their bio-waste in individual compost system less, yet the decision to do so must be made by the municipality.
Social challenges	Bio-waste collection and treatment occurs in very few municipalities. When the service is extended to more municipalities, **public awareness/education will be needed**.
EU Funds	Municipalities receive **funds from the EU and national budget in order to motivate their implementation of bio-waste management**.
Quality controls	**No monitoring or quality assurance exists at the national level** because the responsibility of such functions is under municipal levels.
Treatment	With many MBT plants unequipped to process bio-waste, these **MBT plants must be modernized and adapted to treat bio-waste**. As of 2023, the landfill tax increased from 15 to 50 euros per tonne. Incineration taxes have received pushback.
Use of outputs	Output from MBT facilities is **low quality and can only be treated as technical compost** for covering landfills.

9.2.11 ECO Bihor [Romania]

For the past 20 years, ECO Bihor has managed a landfill and recycling centre through a private-public partnership together with the Local Council of Oradea in Romania. The organization is working to promote bio-waste management, communication, quality, and treatment as a private entity.

Topic	Summary
Separate collection	Very **limited coverage of bio-waste collection** and recycling in Romania. Despite recycling targets, municipal and regional governments have not succeeded in motivating or organizing bio-waste separate collection. **Separate collection is more expensive than paying fines or penalties.**
Private and public division of labour	The **implementation and enforcement of waste policy on the national, regional and municipal levels is fragmented and inconsistent.**

Topic	Summary
Incentives	The Romanian Environmental Ministry set a minimum percent threshold on recycling levels. If the target is not achieved, municipalities pay close to €10 per tonne, yet this **penalty is not sufficient to motivate change.** If municipalities have to recycle 60% and basically 40 to 50% of their municipal waste is bio-waste, then bio-waste collection is the best solution. There is a landfill tax of close to €15 per tonne, which goes to **an environmental fund that does not have a direct return to the waste sector.**
Social challenges	There is a **lack of uniform public awareness/educational campaigns.** For decision-makers and politicians, **waste is not a priority or talking point**.
Quality controls	Input and output **quality controls are not standardized or uniform**.
Local challenges	There is **a lack of technical know-how**. Every municipality should have an environmental technician and if that person does not understand the role of waste management in the local context, then progress will be limited. Instead, municipalities are paying penalties year after year without instituting ways to limit their infractions.
Use of outputs	ECO Bihor is one of the few, if not the only, compost producers in Romania with **quality high enough for sale**.

9.2.12 University of Latvia

The University of Latvia, founded in 1919, is the largest university in the Baltics.

Topic	Summary
Separate collection	Latvia's Ministry of Environment stipulates that bio-waste management can start as soon as a waste treatment facility is installed. Eleven municipal owned landfills are the bases of waste management in eleven MSW regions. The **compulsory separate collection of bio-waste was proposed yet postponed in four out of five regions**. Only the region of Riga has a bio-waste management system. In the laws and objectives of bio-waste management, there is **no mention of home composting**.
Organizational barriers	There is a **lack of data** about bio-waste quality and quantity collection and treatment, which makes it difficult to invest in new collection modes and treatment facilities. **Municipalities often lack knowledge, expertise and ambition** towards some environment related goals and actions.
Private and public division of labour	**Roles and responsibilities become convoluted** when contracts are issued from the municipality to waste management companies.

Topic	Summary
	If the municipality lacks capacity or experts or consultancy who could advise them, they become trapped in **long contracts that are difficult to change or update**.
Incentives	It is difficult to adjust waste management fees for users, which leads to a lack of participation and motivation. Households and choose to reduce their collection of residual waste. In doing so, they reduce the fee for the service, but this **information and instrument are not publicly available**.
Social challenges	There is a **lack of uniform public awareness/educational campaigns.**
Quality controls	There are **no quantitative or qualitative criteria set in the legislation**.
Local challenges	Historical rights of land create problems for installing additional containers. It often happens that land is owned by 1 owner, but the house on this land is owned by different owner. To get **permission from the landowner to install something new on this land can be difficult**. **Block housing and apartment buildings are not equipped for separate collection of bio-waste**.
Treatment	There is a **mismatch between the projected amounts of bio-waste that will be generated and the installed capacities**. Two years ago, with the state auditing service, we projected that in most regions there will not be enough bio-waste to treat in these facilities. These capacities were proposed by landfill sites, and they are based on landfill site's perception of how much material they might receive.
Use of outputs	Due to the high quality of Latvian soils, there is **not high demand for compost**.

9.2.13 IMOG [Belgium]

The original name of IMOG – Intermunicipal Association for Public Health – refers to the hygiene aspect of waste disposal. More than forty years after its founding, waste is no longer a problem, but an opportunity. IMOG now produces 75 million kg of raw materials and 75 million kWh annually.

Topic	Summary
Separate collection	KW is not collected with GW since **treating GW only is less expensive than the combination**. Residents can enrol in the GW collection service or use the civic amenity centres.
Incentives	The **durability and dependability of the GW collection service incentivizes continued use**. It is illegal to put GW in landfills or incinerators and, as of January 2024, it is illegal to incinerate KW. A small price for kitchen waste, and for a 50 litres bin of residual waste it will be about €2.50 and for a bin of 30 litres it's €1.10.
Organizational barriers	According to the Flemish Government **kitchen waste and the garden waste should be collected in one bin, which goes against the wishes of the region**.

Topic	Summary
Political barriers	In 2024 there are elections for local politicians. **Politicians across the political spectrum have decided to delay the implementation** of GW and KW combined collection until the 1st of January 2026.
Local challenges	The **penalties and infractions incurred between 2024-2026 are not sufficient to motivate change**.

9.2.14 ZENZO [Slovakia]

ZENZO is an independent civic association that focuses on sustainable waste management with the aim of improving separate collection and prevention of municipal waste generation. They promote the introduction of innovative waste collection schemes and tools, such as PAYT and DtD waste collection systems.

Topic	Summary
Separate collection	Many municipalities are **collecting small amounts bio-waste**, which is **not cost effective.** **Landfills are still much cheaper** than bio-waste separate collection.
Technical barriers	Households connected to the system receive buckets and compostable bags. The city of Bratislava provided citizens with compostable bags for one year. **Results in high rise buildings worsened after they used the supply of compostable bags**.
Social challenges	There is a need for increased **education of farmers** for compost use.
EU Funds	Slovakia has received funding from the EU. **Municipalities can get funding from various financing streams** by applying for them.
Quality controls	We are now in the process of **establishing a national compost association** because we see there is a very lack of information and awareness. There is a **low quality of collected waste**.
Local challenges	Enforcement mechanisms exist but are not used. There is **not a system in place to monitor quality collection**. There is a **political movement against separate collection** of bio-waste.
Treatment	**Recovery facilities are unevenly dispersed**. The evaluation process for **building a new facility is very slow,** with wait times around 2-3 years for building permits.

9.2.15 Ramon Plana [Spain]

Ramon Plana is an environmental consultant and an expert in the compost process and biological treatments of bio-waste. He is the founder of Fertile Auro (FeA), an organization promoting bio-waste management and especially focused on low-cost solutions and educational approaches.

Topic	Summary
Separate collection	Some municipalities are **implementing solutions without considering the local circumstances**.
Home composting	**Home and community composting can be a solution** especially for areas with disperse populations. Small scale facilities can be a viable avenue to promote local bio-waste management, thereby avoiding transportation. Decentralised facilities (low cost, low tech) may be easier to introduce than large-scale centralised facilities.
Incentives	To incentivise citizens, they must be aware of the **potential positive effect that bio-waste collection has in ameliorating climate change**. The **lack of economic incentives and funds leads to poor collection models and treatment infrastructure**.
Organizational barriers	There is a **lack of clarity about institutional responsibility**: what institution or level of government will resolve the issue of bio-waste separate collection.
Social challenges	There is **not a real demand from the society** to change the waste management model. The barriers are not just technical, it is more about **how to convince people to participate**. There is a social or cultural reaction to separating organic waste. In Spain there is not a culture around compost. The **stigma discourages participation**, which therein destabilizes the management model or system. To overcome the political barriers, there must be **demand for compost and citizens must demand separate collection service**.
Political barriers	Given the lack of societal interest, **politicians are not pressured to act**. Instead, they delay the decision until there are resources and enforced obligations from the EU or the central government. There is a **lack of public engagement in the selection of waste management models**.
Use of outputs	There is need for a **national plan to promote compost**, and to give the funds to those municipalities that really want to begin bio-waste separate collection and to create the required treatment facilities. There exists a **lack of synergy between environmental and agricultural policy** for the use of outputs.

9.2.16 AMORCE [France]

AMORCE is a network of French territories committed to ecological transition. It contributes to making local authorities the conductor of the energy transition, the circular economy and sustainable water management by defending the freedom of choice of local authorities in their ecological transition policies as well as sustainable and quality local public services.

Topic	Summary
Separate collection	On a voluntary basis, local authorities can decide to make separate collection mandatory (via the local collection regulation) and decide to set up a fining system with sanctions. The **fining system must be simplified (automation) by the State**. There is a **lack of a system of control and sanctions carried out by the State**, which today argues that it is the responsibility of local authorities while they are not competent to manage this facet. For as long as **local authorities do not have the means to set up the separate collection of bio-waste**, it is not possible to set up incentivizing instruments.
Incentives	One way to improve bio-waste collection and reduce impurities would be to **incentivize collection of bio-waste, making it more economically** viable and attractive compared to residual waste.
Organizational barriers	There is a **lack of coherence in public policies over time**, for example MBT: it was financed by State bodies until the 2010s before the decree of 30 June 2021 on the obligation to justify the sorting at source of bio-waste for MBT units and the additional order of 7 July 2021 specifying the methods of calculating justification for sorting bio-waste at source to be respected. Certain flagship **measures that would have secured the sector and provided a medium-long term framework for investments were not finalised**.
Economic barriers	The lack of financial support**: local authorities face the very sharp increase in the costs of the public waste management service with little upper-level support**, at a time of increased inflation. In high dense and urban areas**, funding from the State is necessary** because these are the areas that require the most investment with technical solutions adapted to their typologies. The priority action is financial support to local authorities so that they have the capacity to set up source separation of bio-waste on their territory.
Technical barriers	There is **a need for skills and technical know-how** to organize and set up new waste management services and for **good management of collection frequencies** to avoid a full/overfilled container. Priority actions **in densely populated areas includes the adaptation of collection frequency and solutions according to the typology of the area**. Hence preliminary feasibility study to adapt the service to the housing and urban areas and its constraints. **Priority actions in tourist areas**:

Topic	Summary
	• Implementation of bio-waste source separation in tourist facilities (hotel, campsite, etc.) • Tourist-friendly communications (on local sorting guidelines) • Distribution of equipment (bag, kitchen bin) facilitated. • Increase in the frequency of collection during the tourist period in the case of door to door or bring collection. • Reference person on the community composting site.
Social challenges	Successful public awareness campaign: • The campaign must be carried out locally by the local authorities and **adapted to the technical solutions put in place on the territory**. Because there is a great heterogeneity of territories and technical solutions. • choices of communication **media/channels defined by the local authorities**.
Local challenges	For urban areas, there is **a lack of available space in buildings in case of DtD collection and in public spaces to set up drop-off points** and organize areas around them to allow collection by trucks.
Quality controls	There is a **lack of a system of control and sanctions of the quality of the collected material**, which means that it is the responsibility of local authorities, although they may not have the competency, to manage this facet.

9.2.17 OVAM [Belgium]

OVAM is the Public Waste Agency in the region of Flanders (Belgium). They strive for a sustainable waste and materials management, a clean & healthy soil and aim for the transition to a circular economy.

Topic	Summary
Separate collection	There is **little to no penalty for incompliance with the bio-waste separate collection mandate**. **Legislation on quality is a necessity** (standards, quality control for the treatment plants, awareness raising for citizens by local authorities).
Incentives	The **price of bio-waste recycling is less than residual waste**.
Political barriers	The political negotiations have taken too much time and are **seen as risk-prone for local politicians**. As a result of the coming election cycle, they asked for a delay of bio-waste separate collection until 2026.
Technical barriers	The **choice of type of container, use of bags, and collection model are debated**. Points of consideration of bin type: • Underground (expensive, higher impurities, no social control) • Bag (leaks, rips, ergonomics, less user friendly to fill) • Small container (ergonomics, need to clean) • Bigger container (need space, need to clean)

Topic	Summary
Quality controls	An independent organization, Vlaco, provides quality certification and control the treatment procedure. To reduce contamination during collection: • Inspection rules: refusing collection if contamination is observed. • Registration of suspected locations (with containers) – regular controls. If too polluted it is not collected. • Pricing on weight basis (not volume) • Social awareness campaigns • Deposit system of packaging waste • Clear sorting rules
Treatment	There is **a lack of treatment capacity**; investments to increase capacity will not happen until there is more collected and until the separate collection mandate is implemented, it is unlikely that capacity will increase. **Not all treatment facilities accept compostable bags** due to their inability to be composted depending on the treatment process.
Use of outputs	A problem in Flanders is that **compost is undervalued and cannot compete with other sources** of organic or non-organic fertilisers.

10 Annex 2: Co-creation Event Results

Summary of the discussions of the first co-creation event (27/26/23)

The discussions focused on three categories of barriers:

- **Barriers due to the policy framework**: it includes all the barriers that are linked with an improper policy framework decided at a higher level (e.g. EU or national level) that might hinder the possibility for local authorities to properly implement bio-waste collection.
- **Barriers due to the local strategy**: it encompasses barriers that are link with the local bio-waste management system and organization, i.e. the collection system, the local governance and sharing of responsibilities, local decision makers, etc.
- **Barriers due to the local context**: any barriers linked with local specificities such as the type of housing, specific population (tourists, transient population, etc.)

Please note we differentiate barriers due to the local strategy and the context as local challenges (i.e., bottlenecks experienced at a local level for which local actions can be implemented to tackle the issue at stake) from barriers due to the policy framework that are systemic barriers.

The following tables provide a brief summary of some of the key challenges and barriers mentioned during the discussion with the participants.

Regulatory Framework	**Collection** Legal/Admin - Lack of clear obligations and targets for bio-waste collection Organizational - Lack of enforcement to make bio-waste sorting compulsory and penalties when bio-waste is incorrectly sorted Technical - Different sorting instructions when it comes to biodegradable plastic bags
	Treatment Organizational - Bureaucratic and administrative barriers to build new treatment plants, including difficulties in land acquisition and investments Legal/Admin - Lack of homogenisation of the regulatory framework at the national level
	Use of Outputs Economic - Lack of market for the outputs due to the lack of incentive to use the quality outputs and the competition with lower quality and chemical fertilisers. Legal/Admin - Lack of regulations and quality standards for compost and digestate

Local Strategy	**Collection** Organizational - The difficulty to monitor individual compliance with the sorting guidelines Technical - The difficulty to set up an effective collection system (e.g. door-to-door) due to a lack of financial resources (additional operational costs, large initial investment), lack of human resources (to adapt the old waste collection system, for the communication campaign, for control and monitoring), or the lack of availability of proper and affordable compostable bags. Economic - The lack of incentives to promote source separation to inhabitants
Local Context	**Collection** Technical - Collection and sorting in high-rise buildings Technical - Issues related to remote areas, seasonal variation, and specific populations Organizational - Tendering and relation with contractor
	Treatment Technical barrier/gap - Need of pre-treatment due to the poor quality of the input material Economic - Difficulties to internalise the costs of treatment plants Local challenge - Odors from treatment plants
	Use of outputs Organizational - Lack of knowledge regarding the outputs and the effect of the outputs per crop and its application Technical - The urban centres do not take responsibility for their waste, including difficulties related to the logistics transporting bio-waste and transporting/applying the outputs

While the local context did impact the selection of barriers (e.g. the population density impacts the collection performances or the possibility to implement treatment units close to the generation of biowaste, or seasonality of bio-waste generation due to tourism), the main differences among the contributions of participants mostly came from the different regulatory framework and the operational organization of bio-waste management. It is also interesting to note that the discussions tend to show a disconnection along the bio-waste value-chain, i.e., between waste collection and waste treatment (with the low quality of collected bio-waste or the separation systems impacting the treatment operators), and between waste treatment and end-users (with a local of knowledge regarding the use and benefit of composting and inadequate legal frameworks).

The results of this event have been considered and integrated into the D5.2. The local challenges mentioned by the participants have been transferred to section 4.4.3 Discussion of Technical Barriers.

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