LIFE BIOBEST

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LIFE BIOBEST

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

D3.2: Guideline on governance and economic incentives

WP3: Set of guidelines

T3.2: Governance and economic incentives analysis

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Public Report

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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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Other Partners Involved:	ENT - Ignasi Puig (taxes on waste and management charges, fee-rebate scheme) ECN – Steffen Walk (German PAYT Cases, example Rheinland-Pfalz and German gate fees) CIC – Marco Ricci & Michele Giavini (Italian PAYT cases and Italian EPR case)
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1.2 Document Revision History

Table 2. Document Revision History

Version Number	Date	Version Type	Short Description of the Changes	Editor
0.1	14/9/23	1st Draft	Document created as 1st version	ENT - Gemma Nohales
0.2	5/2/24	2nd Draft	Document created as 2nd version	ENT - Gemma Nohales & Mike Stinavage
0.3	8/3/24	3rd Draft	Document created as 3rd version to be distributed	ENT- Gemma Nohales & Mike Stinavage
0.4	11/03/24	3rd Draft	Internal peer review	ENT - Ignasi Puig-Ventosa
0.5	19/03/24	4th Draft	Document created as 4th version to be distributed	ENT-Gemma Nohales & Mike Stinavage
0.5	10/04/24	4th Draft	Peer reviewers' contributions in track changes and notes	ACR+ & ZWE
0.7	08/05/24	5th Draft	Revision to include peer reviewers' contributions and Linguistic and format revision Final linguistic and format revision	ENT – Gemma Nohales & Mike Stinavage
0.8	28/05/24	Definitive/ Approved	Definitive and approved version to be submitted	ENT – Gemma Nohales & Mike Stinavage
0.9	26/06/24	Submitted	Submitted to Participant Portal in PDF	ENT - Gemma Nohales

1.3 Table of Acronyms

Table 3. Table of Acronyms

Acronym	Term
AD	Anaerobic Digestion
BW	Bio-waste
D-t-D	Door-to-Door
EC	European Commission
EPR	Extended Producer Responsibility
EU	European Union
GW	Green Waste
HH	Households
ICT	Information Communication Technology
inhab.	inhabitant
kg	kilogram
km	kilometre
KW	Kitchen Waste
l	litre
MBT	Mechanical Biological Treatment
MS	Member State
n/D	No Data
PAYT	Pay-as-you-Throw
RDIF	Radio Frequency Identification
RW	Residual Waste
R-C	Road Containers
SAYT	Save-as-you-Throw
SC	Separate Collection
WFD	Waste Framework Directive
yr	year

1.4 LIFE BIOBEST Project Summary

EU obligations on the selective collection of bio-waste came 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. In a policy brief about barriers and 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.

Four guidelines and 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, beneficial 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 rejects 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.

1.5 LIFE BIOBEST Guidelines

In conjunction with the January 2024 EU separate collection mandate, the LIFE BIOBEST project investigates various facets of bio-waste management ranging from separate collection, implementation of recycling strategies, processing systems and related management options in order to create high-quality compost and digestate products.

To support upper-level authorities and decision makers in streamlining policy measures and lower-level authorities in implementing solutions, LIFE BIOBEST presents four bio-waste management guidelines. Together, these guidelines offer a strategic vision and practical approaches crucial to effective bio-waste management.

The goal is to provide guidance and support for optimising implementation of the EU obligation with evidence from high performing schemes and with the definition of performance indicators. This guidance may be applied to all the involved actors in the system to maximise the potential contribution of bio-waste to circular economy and related EU targets. Whether municipalities are in the initial stages of bio-waste implementation design or an advanced state of management, these guidelines provide a point of reference for policy and decision-makers, local authorities, waste haulers, recycling entities, and technical practitioners.

This work is crucial to promote the collection of large quantities of high-quality bio-waste in order to produce quality outputs such as compost, digestate, and biogas. Given the diversity of local contexts, these guidelines provide a comprehensive outlook on bio-waste management as well as existing Best Practices from a number of EU countries where management instruments are successfully applied.

The four LIFE BIOBEST guidelines are:

- **D3.1 Guideline on separate collection** provides an overview of the different bio-waste separate collection schemes and assesses the pros/cons. This guideline includes a set of Best Practices that focus on collection from households and other producers in various contexts.
- **D3.2 Guideline on governance and economic incentives** discusses the governance tools and economic instruments needed to improve management schemes. The guideline presents these instruments alongside examples of their application and includes an analysis of the economic viability of Best Practices in bio-waste management from separate collection to treatment.
- **D3.3 Guideline on quality compost and digestate** breaks down the treatment technologies and resources that support the production of compost and digestate. The guideline provides insights about the processing options, analysis of product characteristics, quality assurance systems as well as related EU legislation and the ECN quality assurance scheme.
- **D3.4 Factsheets on the analysis of best practices in communication and engagement from various countries** delves into the topic of public

communication and education. Public participation and awareness are key complementary issues to management schemes. This guideline includes an analysis of experiences from frontrunners and gives insight about impacts of communication activities.

The backbone of these guidelines is the empirical knowledge of the LIFE BIOBEST consortium and the successful experiences and instruments provided in each document. Taken individually or as one, these guidelines contain information key for institutions and stakeholders in the bio-waste value chain.

2 Introduction

Waste management is a complex problem characterised by multi-layered interdependencies, compound social dynamics and webs of stakeholders (Lenkiewicz, 2024). The interconnected institutional and regulatory frameworks work to promote or hinder the use of certain measures, thereby streamlining strategies towards common targets. Frameworks must establish transversal and enforceable regulations and include standards for bio-waste collection, processing, and the use of outputs. In this process, economic instruments and incentives are crucial.

In the **LIFE BIOBEST D5.2 Policy brief**, a list of barriers and gaps in the EU regulatory framework was compiled by interviewing experts from diverse geographic locations in the EU, reaching a total of 14 MS. The barriers were categorised by topic (legal/administrative, economic, organizational, technical), level of governance (EU, national, regional, municipal), and step in the bio-waste cycle (collection, treatment, use of outputs and quality), with the goal of disaggregating the barriers and providing a wide and comprehensive view of the constraints and bottlenecks — a necessary step towards the design of corrective measures (Stinavage & Nohales, 2024). Notably, these barriers asymmetrically affect certain levels of government.

On the whole, these barriers show the importance of enforceable regulations to streamline progress towards objectives, which conveys the need for good governance (section 3) and the realignment of incentives through the use of economic instruments (section 4). Regulatory enforcement tools include fines, penalties, and other legal mechanisms against violators with the goal of reaching high levels of compliance.

Among the barriers most related to governance and economic incentives are the following:

Table 4. Related barriers compiled in LIFE BIOBEST D5.2 Policy brief

Categorisation	Barrier
Economic	Lack of financial incentive for local authorities to separately collect bio-waste (C)
	No market or market incentive for compost, digestate, or biogas (U)
	Insufficient resources/finances (C & T)
	Bio-waste collection is more expensive than residual waste collection (C)
	Improper/lack of guidance on use of EU funds and taxonomy (C)
	Lack of financial incentives for the citizen (PAYT, discounts, etc.) (C)
	Lack of resources to build or outfit waste treatment facilities for bio-waste (T)
Legal/Administrative	Non-binding policy or lack of enforced legal obligations to reach minimum standards (C & T)
	EU targets not cascaded to national/regional/municipal government (C & T)
	Inadequate appraisal of best practice options in policy design (C & T)

Categorisation	Barrier
	Lack of local, regional, or national strategy for the separate collection of bio-waste (C)
	Environmental and/or agricultural policies and management protocols lack synergies (T)
Organizational	Lack of or inefficient penalties for non-compliance (C)
	Lack of interest/support from decision-makers/elected representatives (C & T)
	Lack of synchronization across public and private entities in charge of collection and treatment (C & T)
	Lack of economic scale efficiency schemes to develop cooperative management (C & T)
	Poor institutional organization and limited capacity to implement legislation (C & T)
	Institutions lack clarity regarding mandatory separate collection (C)
	Lack of effective communication/educational campaigns (C)
Technical	Insufficient data monitoring systems to track implementation, performance and evolution (C & T)
	Lack of effective data tracking mechanisms for the implementation, evolution, and objective achievements (C & T)
	Distrust from the public regarding the performance of the separate collection system (C)

Note on abbreviations: *Collection (C), treatment (T), use of outputs (U) and quality (Q)*

Source: *LIFE BIOBEST D5.2 Policy brief*

This guideline provides a descriptive survey of the governmental elements and economic instruments that can be leveraged to improve bio-waste management schemes. This includes discussions of the organizational and structural elements of governing bodies as well as economic instruments that may be applied along the bio-waste value chain steps to prevent, collect, valorise and dispose of waste. The final sections of this guideline include description of the costs and the Key Performance Indicators (KPIs) identified by LIFE BIOBEST consortium. The assessment of the BP indicators is detailed in **Annex 2**.

"The diversity of cultures, politics, economies and geographies means that solutions are rarely a matter of cutting and pasting," (Lenkiewicz, 2024). Given the complexity of governance, instruments and local contexts, there is no one-size-fits-all solution. Instead, institutions and public entities must evaluate the options - such as those provided in this document - and select tools that best fit their circumstance. Throughout this guideline, case examples demonstrate how the instruments are applied in specific locations.

The starting point of bio-waste management and the strategies to tackle these barriers must consider the EU's Waste Hierarchy, which 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).

To define and deploy prevention strategies, EU Member States (MS) must adopt specific food waste prevention and reduction measures within their waste prevention programs (Art. 29 of WFD). Food waste is associated with huge environmental and economic cost, making prevention essential. Once the waste is generated, the collection model is key to guarantee the management of high quality and quantity bio-waste.

When selecting a collection model, it is crucial that the model accounts for all the types of bio-waste "sub-flows" and, for efficiency, decide how to manage green waste separately. Individualised collection models with user identification and monitoring systems ensure high per capita collection rates and low impurity levels, particularly D-t-D collection. Individualised models facilitate monitoring of the quality of the bio-waste delivered and provide personalised information to users in order to improve their participation. D-t-D schemes may also be applied to commercial producers. When it is viable and economically efficient, home composting (individual or community) may be advantageous.

For more information, please refer to LIFE BIOBEST guidelines available on the LIFE BIOBEST project website.

3 Governance

Good governance is the lynchpin of effective environmental policy and implementation. The extension, efficacy, longevity and scalability of technical instruments and economic incentives for bio-waste management rely on governance and decision-making to set objectives and direct capital, human resources, infrastructure, communication, and technical know-how.

Making headway, however, is not easy. When citizens perceive environmental policies as financially and behaviourally costly, governments are often wary of the electoral implications (Gainza & Montes-Nebreda, 2023). The partisan discord typical of democracy can cast environmental policies and instruments in an unflattering light, thereby jeopardising the positive public perspective and ecological transition.

Governments in every step of the multi-level governance systems must align their priorities to overcome low environmental interest and to find ways to mandate change. Across all governance types and structures, this requires organization, capacity, transparency and public confidence, empowerment and good data management.

To overcome the legal, technical and financial barriers that affect waste management, it is necessary to distil the essential elements of governance in relation to bio-waste management.

3.1 Organization

Upper levels governments outline necessary measures, communicate the legal and regulatory frameworks and devolve responsibilities to lower levels governments and complementary entities (Stepan, 1999). The clear and effective devolution of power leverages the competencies unique to specific levels of government.

By **cascading EU-level and national recycling targets** down to lower levels of government and ensuring routine follow-up mechanisms and the existence of consequences for non-compliance (see section 3.5), the multi-level governance structure creates **mutual accountability** with respect to targets and mandates. In some cases, like Case 1: Strategic Planning in Aglantzia, Cyprus, initiatives and policy measures from the municipal level can also ascend upwards in a bottom-up approach to higher levels of governance.

Transposition and incorporation of EU, national and regional laws and plans must be embedded and executed at the local level. Upper-level authorities must obligate local entities to update local norms based on national/regional waste laws. Local norms are key in establishing how the implemented collection schemes function and are monitored, as well as the participation instructions and obligations, including possible penalties addressed to the users of the collection service.

Strategic waste management plans on the national, regional, and municipal level reinforce and streamline the regulatory framework, adding key specificities unique to the respective jurisdiction. The plans must be aligned with the mandates and targets, accompanied by sound financial strategies and considered alongside **Best Practices and technical recommendations** in terms of collection models, economic instruments, treatment processes, and the proper use of the output.

Institutions must also be organizationally capable of devolving responsibilities in waste management down to the individual civilian. **Public education and awareness** are tools to onboard members of society, providing necessary information and resources to facilitate participation (see section 3.4).

According to the UN Environment Programme, "National authorities should endeavour to promote the internalisation of environmental costs and the use of economic instruments" (Lenkiewicz, 2024) Sufficient organization is necessary to introduce and manage **landfill and incineration taxes, waste management charges and other economic instruments** (see section 4) needed to finance and invest in the improvement of the system as well as incentivise stakeholders involved in bio-waste management to adopt the proper strategies and actions.

CASE 1: Strategic Planning in Aglantzia (CY)

Central to the success of a municipal waste management system is its strategic plan. In 2020, Aglantzia, a small city in Cyprus with 20,783 inhabitants, created "Holistic Waste Management Program of the Municipality - Municipality of Aglantzia (Nicosia)" to link waste generation to billing. Inspired by PAYT schemes, the municipal administration eliminated the fixed annual waste collection fee, replacing it with a charged based on the volume of residual waste. Residents must dispose of waste through specific pre-paid purple bags.

After the first year of the pilot (2021), the generation of household waste reduced by 30%. As a result, Aglantzia's success was recognized by upper levels of government: the Ministry of Environment subsequently approved a national PAYT project during the 2021-2027 programming period.

Source: Aglantzia Municipality, "Holistic Waste Management" program website

3.1.1 Level of centralisation

The subsequent sections, level of centralisation and type of service provision, describe two defining points of institutional organization and structure that condition bio-waste management and results.

Due to historical and cultural differences, **institutional decentralisation** is a strategy in which the national governments balance differences by granting certain powers of

autonomy to regional governments. The level of centralisation must be carefully considered when applying instruments and tools. National and regional waste policy must be drafted with respect to the level of state centralisation.

Table 5. Descriptions of centralisation and decentralisation

Category	Description
Centralisation	Authority and responsibility are concentrated at high levels of government and in limited governmental institutions and bodies (Ex. France or Hungary).
Decentralisation	Authority and responsibility of major government functions is transferred from central to sub-national governments as well as local governments (Ex. Navarra, Spain).

Source: Own elaboration

3.1.2 Type of service provision

The implementation and maintenance of bio-waste systems depends on the ownership and executor of the service. The classifications of **public, private, and public-private partnership implementation schemes** shape the execution of the service.

Private-public partnerships and public tendering must ensure the provision of all necessary processes by **clearly defining roles, responsibilities, protocols, and quantity/quality objectives** of the companies providing the service. As discussed in **LIFE BIOBEST D5.2 Policy brief**, control and monitoring should be developed by the public administration, and there must be mechanisms to update or modify contracts or agreements, if necessary, in favor of service and model improvements.

In the case of the privatisation of waste services, the level of public intervention may be limited, thereby conditioning general management protocols and service and results monitoring. (Re)municipalization, alternatively, brings services back under public ownership, generally prioritising results and increasing adaptation to the management's needs.

Independent of the type of service provision, the **optimisation of waste collection systems** is a strategy that can significantly improve efficiency, reduce costs, and enhance environmental sustainability. Therefore, a well-design collection model and the continuous monitoring and upgrade scheme of the service together with the use of information and communication technologies can result in better economic balance and savings, which are vital for bio-waste management viability and expansion. See more details regarding model design in **LIFE BIOBEST D3.1 Guideline on separate collection** and **LIFE BIOBEST D3.3 Guideline on quality compost and digestate**.

Green Public Procurement and Innovative Public Procurement (IPP) are additional instruments in the hands of administrations to procure goods and services in a more efficient, innovative and environmentally friendly way. IPP contributes to the modernization of public services by adopting higher-quality and cost-efficient solutions along with innovation and new technologies (Defranceschi, 2016). These two instruments play a role in the EU's efforts to boost a resource-efficient economy, and subsequently to optimise and make more sustainable bio-waste management services.

3.2 Capacity

An institution's organizational capacity refers to its ability to coordinate and fulfil requisites and responsibilities in terms of human resources, finances, sectorial network communications and infrastructure. Institutions must deploy necessary instruments to enforce the regulatory framework.

Human capacity must be sufficient in supply and skillset. As discussed in section 3.4, this requires the training and empowerment of service operators and users along with the financial means to employ workers and onboard the public.

Financial capacity must be solvent and in the form of grants, subsidies, and loans to encourage investment in bio-waste management and innovation in the field. Upper-level governments must be capable of specifying the criteria with follow-up mechanisms and establishing the destinations of **EU funds** in terms of management model and the development of waste infrastructure that supports improving bio-waste prevention and recycling performance. A principal criterion should be the project's capacity to increase quality and quantity bio-waste recycling, which may be achieved by leveraging economic instruments such as subsidies (see section 4.2.5).

Adequate bio-waste treatment infrastructure and investments are key. Planned or existing treatment **infrastructure capacity must match generation and capture in each area**, guaranteeing the proximity principle. There is a need to plan treatment facilities in advance according to bio-waste recycling objectives. Depending on the characteristics of a municipality, shared bio-waste collection services or treatment facilities following **economy of scale efficiency models** may be advantageous for municipalities to share costs and resources under a cooperative system.

A government's capacity extends, too, to their ability to **enforce compliance** through **monitoring, inspections and, when necessary, timely and effective penalties** (see Case 2: Political Will and Oversight in Rheinland-Pfalz, Germany) and the ability to **deploy instruments to incentivise quality of bio-waste flows** (see Case 3: Germany Alternative Strategy to Promote Quality Entrance Flows to Facilities).

CASE 2: Political Will and Oversight in Rheinland-Pfalz (DE)

Among the German states, Rheinland-Pfalz has one of the most ambitious goals to increase quantities of bio-waste and reduce what is left in residual waste. These goals include:

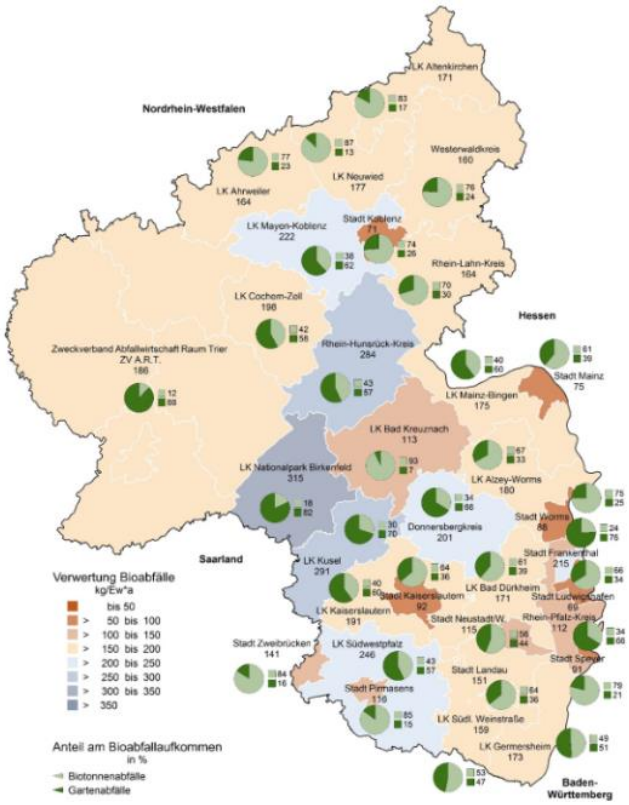
- A specific target for the reduction of organics in residual waste (20 or 28 kg/inhabitant/year, depending on the region cluster),
- At least one compositional analysis of residual waste within a 5-year period performed by each responsible waste management entity and with representativeness for the entire catchment area,
- Promotion of D-t-D collection of bio-waste,
- The provision of bio-waste bins to all households, even those who compost at home, albeit with a smaller size and reduced fee and

To treat all bio-waste in a combination of anaerobic digestion and (post) composting to maximise resource recovery until 2035. Furthermore, each waste management entity shall revise and update their waste management concept every five years to assess the status with the overall waste sorting and reduction targets.

The region is the first in Germany to institute semi-mandatory measures for tracking the progress towards goals presented in the waste management plan. A detailed report on waste management entities including quantities, information on the waste management system as well as the most recent composition of residual waste is published each year to keep track on the status of target achievement. Furthermore, detailed reports on waste statistics focusing on the quantities are published each year (LANDESABFALL BILANZ RHEINLAND-PFALZ 2022, 2023).

CASE 2: Political Will and Oversight in Rheinland-Pfalz (DE)

Figure 1. Map showing quantities of bio-waste and green waste treated



Source: Rheinland-Pfalz Report (ABFALLWIRTSCHAFTSPLAN RHEINLAND-PFALZ 2022, 2022)

CASE 3: Promoting quality entrance flow in Germany

Compared to residual waste, tariffs for bio-waste make its treatment economically advantageous and they must limit and control the entrance flows to minimise the level of impurities. For those who exceed limit values, the treatment managers have a legal right to return the bio-waste to the municipality for remediation. Alternatively, the fee of residual waste may be applied so that the polluter pays instead of the treatment facility.

The recently amended German Biowaste Ordinance includes a legal provision allowing treatment facilities to reject separately collected bio-waste with impurity levels exceeding 3% in fresh matter, measured before entering biological treatment. This involves an initial visual inspection with the option for compositional analysis. However, contracts between facilities and other parties may still permit acceptance of bio-waste with higher impurity levels if the facility can ensure technical impurity removal.

Additionally, there is a control threshold for plastics, currently set at 1% for municipal bio-waste. Bio-waste with less than 1% plastic impurities can be sent directly for biological treatment, while exceeding this threshold requires impurity removal beforehand. For

CASE 3: Promoting quality entrance flow in Germany

more information see **LIFE BIOBEST D5.3 Proposition of quality standards**. As a last option, bio-waste exceeding the impurity-threshold can be accepted as residual waste, resulting in a considerably higher input fee.

Gate fees are typically adjusted within contract period, according to costs, changes in the overall municipal waste composition, but potentially as well the quality of delivered material.

In Germany, gate fees were estimated between 75 – 110 €/t for separately collected household bio-waste and between 60 – 300 €/t for residual waste in 2019. For example, in the district of Borken, each municipality organises their collection by sub-contracting a private company. The treatment company *Entsorgungsgesellschaft Westmünsterland mbH* (EGW) is publicly owned. In 2024, the company charges the following gate fees to municipalities:

- Bio-waste: 92.49 €/t
- Garden waste: 43.09 €/t
- Residual waste: 221.03 – 236.48 €/t (depending on the municipality of origin).

Source: Thuringen report, Borken report and the German Ordinance on bio-waste website

3.3 Transparency and Public Confidence

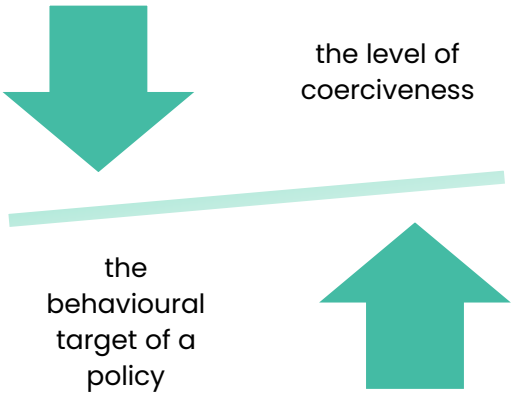
Since waste management depends on separation at source, the public must have confidence in management systems and strategies.

Public confidence in governance relies on a citizen's ability to delineate the roles and responsibilities of distinct governmental actors. "If citizens cannot clearly distinguish spheres of authority across levels of government, they may become more vulnerable to politicians' strategies of blaming other levels of government to excuse or justify bad policy outcomes" (León, 2010).

In terms of policy measures, support depends on **key perceptions about the effectiveness of the policy, its distributional effects, and its impact on the respondents' self-interest** (Dechezleprêtre et al., 2022). Governments must accurately report on the status of their policy implementations and plans, as shown in Case 3: Institutional Accountability in Latvia.

As outlined by de Groot & Schuitema, 2012, two characteristics have significant influence on the acceptability of environmental policies:

Figure 2. Enacting environmental policy to maximise outcomes



Source: Own elaboration based on de Groot & Schuitema, 2012

The **level of coerciveness** refers to the degree to which a measure enforces a change in behaviour and restricts one's freedoms. Coercive environmental policies often lead to lower acceptability rates. People often prefer non-coercive measures that reward over coercive ones aimed at punishing (Drews & van den Bergh, 2016) policies often lead to lower acceptability rates. People often prefer non-coercive measures that reward over coercive ones aimed at punishing (Drews & van den Bergh, 2016). The **behavioural target** of a policy refers to the effort it takes to change a conduct. Policies with "low-cost behaviour" (fewer daily habits need to be adapted by citizens or targets) typically lead to higher acceptability since individual interests are less affected (de Groot & Schuitema, 2012).

In bio-waste policy and management, the level of coerciveness and behavioural target must be carefully considered. In addition to technical deployment of the collection model, authorities should develop complementary tactics, as further discussed in sections 3.4 and 4. Communications and economic instruments must be adjusted in a way that increases public behaviour change and participation in bio-waste services.

CASE 4: Institutional Accountability in Latvia

Although the introduction of bio-waste collection in Latvia has not led to an efficient and economically sound bio-waste management system that match the total population and population density, the systems shortcomings have been publicly evaluated and presented, demonstrating a level of institutional accountability and transparency.

In an audit from May 2022, the State Audit Office of the Republic of Latvia assesses the current state of bio-waste management, addressing the gaps and barriers of financial and data management, sectorial liaising, service provision and infrastructure (Korčagins, 2022). Transparent reports and audits on the issues within the state apparatus are a crucial step towards improved bio-waste systems and management and heightened public confidence.

CASE 4: Institutional Accountability in Latvia

Figure 3. Map of the waste management regions of Latvia

Source: Report from the State Audit Office of Latvia (Korčagins, 2022)

3.4 Empowerment

The advancement of bio-waste management and recycling objectives requires the mobilisation and empowerment of all stakeholders. This includes service users, politicians, technicians, businesses, environmental groups, collection and treatment companies, and government agencies.

3.4.1 Service Users

Public participation plays a role in disseminating the benefits of a policy, engaging the community, and building social capital (Gainza & Montes-Nebreda, 2023). "Successful waste management depends on stakeholder participation, social support and a strong social contract with citizens" (Lenkiewicz, 2024; International Bank for Reconstruction and Development & The World Bank, 2023). Empowering bio-waste service users to participate can be achieved through various means such as meaningful public consultations and the involvement of citizens and community members in policy design, which builds trust in policymakers and governance (Aitken et al., 2016).

Participatory decision-making, an advanced state of public participation, is an inclusive and collaborative form of governance that seeks to involve non-state actors not only as participants, but also in the decision-making process (Sholanke & Gutberlet, 2022). Deploying participatory decision-making and considering the perspective of service users, as shown in Case 4: Participatory Decision-making in Navarra, Spain, enhances local appropriateness of the bio-waste management scheme.

Funding for outreach activities to the general public must be increased and continuous. Implementation campaigns must have ample financial backing, properly designed and reach as many users as possible.

As explained in **LIFE BIOBEST D3.4 Factsheets on the analysis of best practices in communication and engagement from various countries**, ongoing communication mechanisms are necessary to maintain participation levels, including those to resolve incidences of poor participation. Bio-waste management plans must also include the provision of guidance and materials for at-home separation such as vented kitchen caddies, decals, compostable bags, or D-t-D collection bins.

3.4.2 Service Managers & Operators

Onboarding public and private stakeholders is key to developing and implementing effective bio-waste management strategies. **Trainings and empowerment actions** for politicians, technicians, agricultural producers and other key stakeholders on bio-waste collection, treatment and output usage strategies are essential. Politicians, civil servants and consultants must have the **skillset for supporting solutions for bio-waste** systems and improvements.

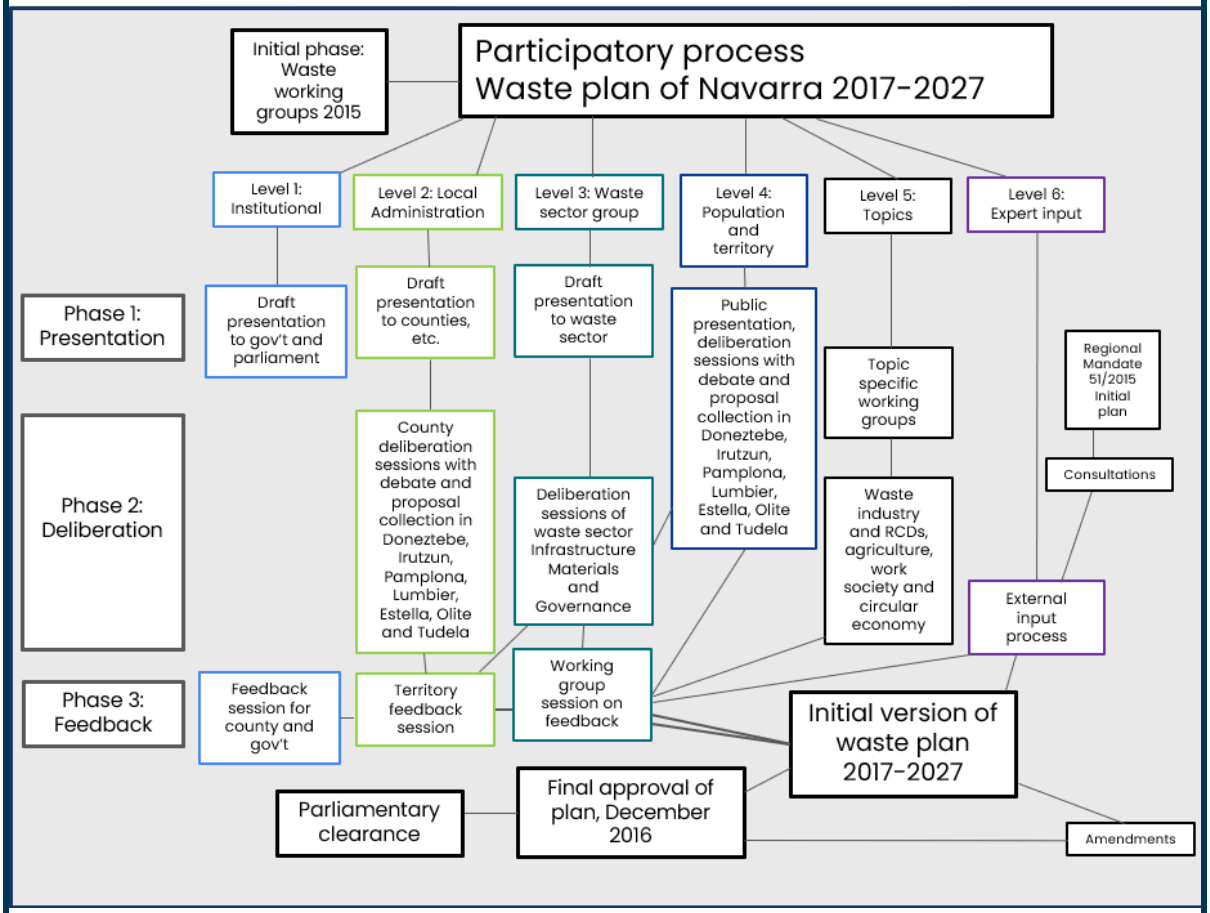
For regional and municipal governments to transform the policy into a locally appropriate and efficient practices, **upper-level authorities** must equip them with technical guidelines and **endorsed know-how**. The **local appropriateness of waste strategies and solutions** is key to efficiently reach management targets.

CASE 5: Participatory Decision-making in Navarra (ES)

The Government of Navarra used participatory decision-making to create the Integrated Plan of Waste Prevention and Management of Navarra 2017-2027 (*PIGRN*). County officials, city halls, technicians, topic-specific experts, and the general public from across the region were consulted. Participants were first presented the draft of the *PIGRN*, followed by meetings to deliberate and debate. Once the deliberation phase was closed, participants' findings were presented and considered for the subsequent draft of the *PIGRN*. In total, 414 individuals participated in the deliberation phase, 231 questionnaires were submitted, and 1,917 individuals provided feedback (Government of Navarra, 2016). This multi-level participatory process heightens the local appropriateness of the plan and system.

CASE 5: Participatory Decision-making in Navarra (ES)

Figure 4. Participatory process for *PIGRN*



Source: Elaborated and translated from PIGRN Report, Government of Navarra, Department of Rural Development, Environment and Local Administration

3.5 Data Management

The development and maintenance of bio-waste management require comprehensive data monitoring systems that incorporate all the information generated in the different stages. Data management is necessary for reporting progress towards objectives to upper levels of government.

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 (Hogg et al., 2018). **Integrated inter-institutional liaising and pre-defined KPIs** (see **LIFE BIOBEST D2.1 Improved and homogenised datasets on municipal bio-waste management in the EU**) on upper levels of management are crucial to properly control the system's performance and evolution, as detailed in **LIFE BIOBEST D5.2 Policy brief**.

Data management systems on the local, regional, national and EU level must be connected and are essential for **monitoring implementation results** (including service coverage), **composition of the residual fraction, infrastructural capacity and economic balance** (including economic instruments effects). It is key to define common standards to ensure reliability, consistency and comparability over time. The EU and Eurostat work on guidance for monitoring of food waste and municipal waste.

National and regional governments must establish an aligned **monitoring system with set parameters (KPIs)**. They must frequently update and obligate local entities and operators to monitor and report their data on separate collection and treatment, including type of service and model, managed quantities and quality of the flows as well as destination of the outputs (see Case 5: Monitoring and Enforcement in Catalonia, Spain).

On the local level, **user participation and incidences indicators** are necessary for authorities to evaluate and improve collection and enforcement. The information about the service and results, too, helps the public administration to evaluate and improve the service. Controlling the quality at the service delivery point and through **periodic bio-waste characterisations** upon entrance to bio-waste facilities are strategies to minimise impurities at the source.

The **collection and management of data** about user type and number of deliveries — while ensuring personal data protection — is key for the establishment and calculation of variable fees and PAYT (see section 4.2.3.1).

For **home composting schemes**, standardised management protocols and data monitoring are key to ensure proper functioning and to track the quantities treated in situ to be included in the recycling targets calculation, see **LIFE BIOBEST D3.1 Guideline on separate collection.**

CASE 6: Monitoring and Enforcement in Catalonia (ES)

The Government of Catalonia, via the Waste Agency of Catalonia (ARC), has demonstrated a robust capacity to implement waste management solutions, particularly those involving monitoring and data management. The main actions include:

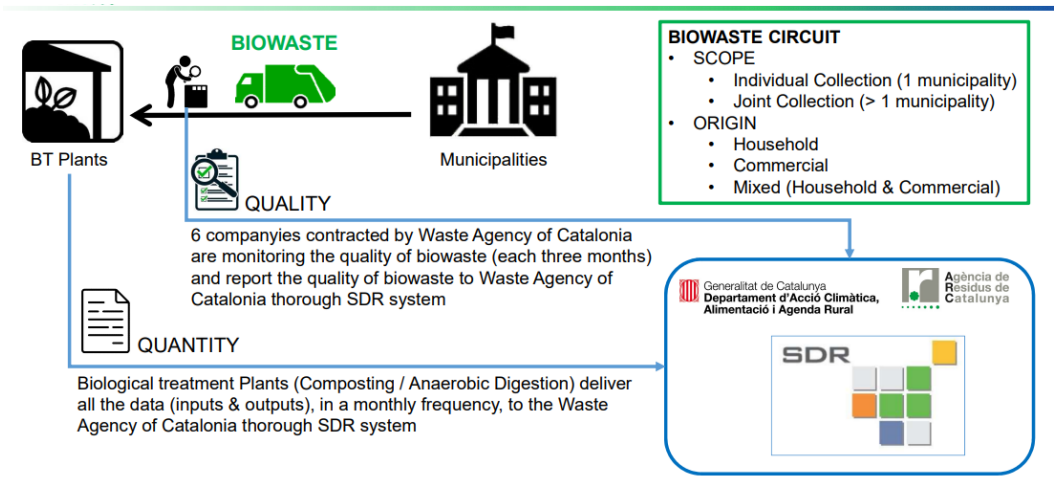
- 'Declaration of the current status' (*Declaració d'Estat Actual*) including for each municipality, the type of collection systems for each fraction, number and types of composters, details about bio-waste schemes, model updates and coverage, treatment destinations, type of contracts, waste management charge and PAYT, etc.
- Publicly available data and statistics about municipal collection including estimation of home composting quantities, food waste and green waste separately collected. Dissemination of the results occurs in articles, workshops and in the annual report.

CASE 6: Monitoring and Enforcement in Catalonia (ES)

- Database about the features of the municipal bio-waste collection circuits. This information is used to plan bio-waste characterisations per circuit and to assign the quantities of bio-waste entered to biological treatment facilities to local entities (with the monthly online reporting provided by facility operators to ARC). For traceability of the bio-waste collected by private operators, ARC has a specific register for private commercial circuits in which the producers, tonnes and composition studies are also reported and monitored.
- Quarterly reporting system of municipal food waste characterisations and also linked to the calculation of the refund of the landfill tax (see section 4.2.1.2). The results are published on an open website, including the bulletin information: quantities, % impurities per material, pictures, etc. The analysis and reporting system are financed by the landfill and incineration tax (see sections 4.2.1.1 and 4.2.1.2).

For more information, see LIFE BIOBEST D2.1 Improved and homogenised datasets on municipal bio-waste management in the EU and LIFE BIOBEST D5.4 EU Comprehensive guidance

Figure 5. Catalan bio-waste quality monitoring scheme



Source: Waste Agency of Catalonia website. Visuals from Francesc Giró (ARC) presentation

4 Economic Instruments

4.1 Introduction

Social demand for greener and sustainable services and the necessity to adhere to new sectorial regulations typically motivate local authorities to adopt more efficient and adequate waste management solutions. Nevertheless, additional elements affect decision-making such as the economic impact of the advanced systems for bio-waste collection and biological treatment. Schemes that are economically advantageous lead to rapid and expeditious integration. Low economic value and demand of waste-based products do not contribute to the viability of advanced solutions.

The adoption of more advanced management solutions is conditioned by the internalisation of the externalities. In the absence of their inclusion in the economic balance of waste management, alternatives available in the lower levels of the waste hierarchy are usually more affordable, thereby impeding the transition to more sustainable systems.

Once externalities are limited or their estimated cost is assumed by polluters, environmentally friendly solutions also become more competitive. For this reason, the polluter-pays principle is part of the waste management policy. The polluter pays principle is a simple idea at the core of EU environmental policy: those responsible for environmental damage should pay to cover the costs (OECD, 2019).

Economic instruments can be effective policy tools to prevent, minimise and soundly manage waste. Furthermore, economic instruments can be useful in encouraging the behavioural changes (for example, waste reduction or investment in improved waste treatment technology) necessary to achieve waste policy objectives (OECD, 2019).

4.2 Type of economic instruments

A general overview and a categorisation of the identified economic instruments applicable to bio-waste management are shown in Table 6[1].

[1] The taxonomy used is adapted from the United Nations Environment Program (UNEP) "Guidance on the environmentally sound management of household waste" (Household Waste Partnership Working Group, 2019).

Table 6. General overview and categorisation of the identified economic instruments

Type of instrument	Variant	Revenue-generating	Revenue /other incentive providing	Cover expenditure for waste management	Influence users-agents behaviour	Contribute to waste management objectives
Waste management service charge	Fixed charges	**X**		**X**		
	Variable charges or PAYT	**X**		**X**	**X**	**X**
	Fee-rebate schemes	**X**		**X**	**X**	**X**
Treatment gate fees	Fixed gate fees	**X**		**X**		
	Variable gate fees	**X**		**X**	**X**	**X**
Final disposal taxes	Landfill taxes	**X**			**X**	**X**
	Incineration taxes	**X**			**X**	**X**
	Disposal tax refund/premium system		**X**	**X** (depends on funds destination)	**X**	**X**
Product taxes	Chemical fertiliser taxes	**X**			**X**	**X** (indirectly)
Tradable permits system	Emissions trading system		**X**		**X**	**X**
	Landfill allowance trading system		**X**		**X**	**X**
Subsidies	Monetary subsidies		**X**		**X**	**X**
	Rewarding systems		**X**		**X**	**X**
	EPR	**X** (depends on EPR design)		**X**	**X** (depends on EPR design)	**X**
	Taxonomy				**X**	**X**

Source: own elaboration

4.2.1 Taxes on waste

Environmental taxes are levies imposed on activities or products that have a negative impact on the environment. These taxes aim to encourage more sustainable behaviour and mitigate environmental harm.

4.2.1.1 Landfill /Incineration Tax

Description

By applying the polluter pays principle, disposal taxes, namely landfill and incineration taxes, increase the associated costs of disposal activities compared to alternative more sustainable treatment options (e.g. composting or mechanical recycling). These taxes are considered an effective instrument to divert waste from the landfill and incineration facilities, and they do it in an economically efficient way.

As typical of environmental taxes, they tend to internalise environmental externalities, thereby increasing the economic efficiency in the allocation of resources in the market (Field & Field, 2012).

Effects on bio-waste

In the case of municipal waste, these taxes are generally paid by local authorities, who are also in charge of waste collection (commercial activities with private collection services are also treated as taxpayers). So, local entities are incentivised to adopt strategies to divert waste from landfills and incinerators, which typically means improving separate collection of bio-waste and recyclables, processing bio-waste into compost and digestate, bio-stabilising the contaminated organics still included in residuals (which decreases the total amount to be landfilled, through the process losses in terms of degradation of biodegradable organic matter and evaporation of excess water) and recovering recyclables from the residual waste fraction before disposal, via mechanical-biological treatment (MBT) plants. Since bio-waste is the largest fraction in municipal solid waste, its diversion should be prioritised.

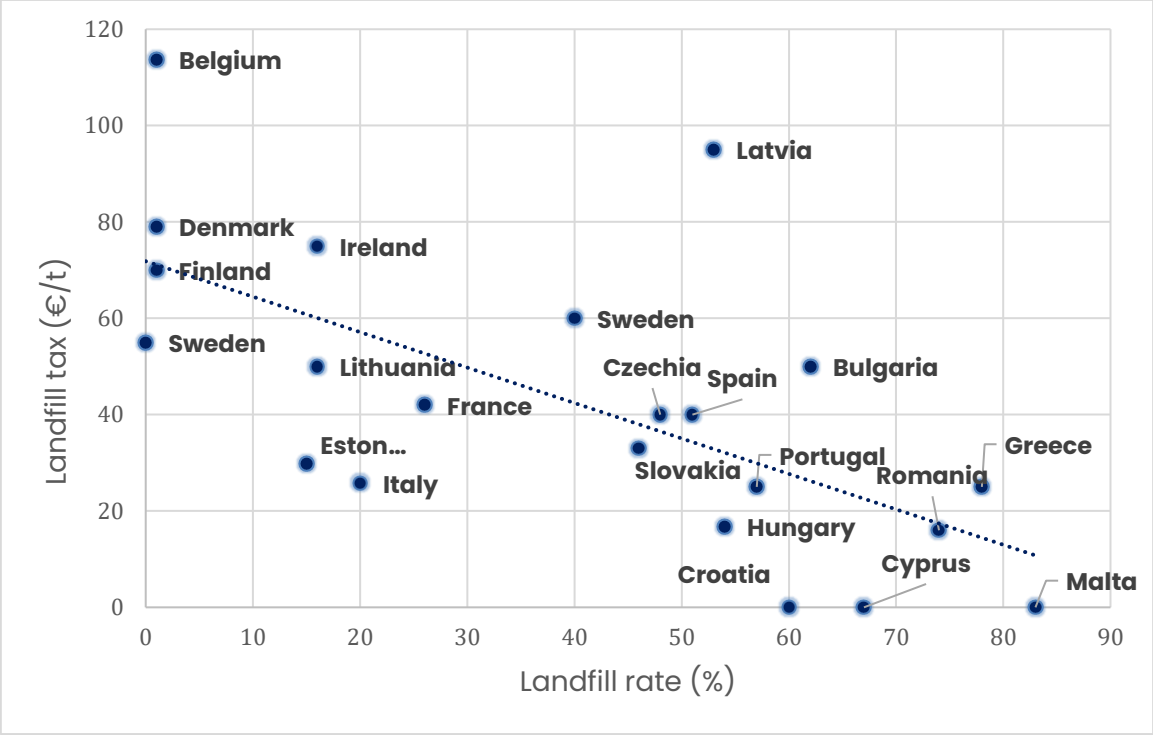
Design aspects & Recommendations

- Environmental tax rates should reflect the marginal external cost, according to economic theory (Pigou, 1920). For this reason, landfill and incineration tax rates usually depend on the type of facility (e.g. incinerators with or without energy recovery) or on the type of waste (e.g. pretreated waste in MBT facilities versus direct landfilling). This increases the economic efficiency of the tax.
- The definition of different tariffs depending on the quantity or proportion of bio-waste contained in disposed flows can be an effective driver to increase the diversion of organic flows, subsequently promoting bio-waste separate collection. This will require the development of periodic compositional analysis of residual waste.
- The modification of tax rates should be incrementally planned and predictable as to increase taxpayers' public confidence in the strategy and facilitate decisions on long-term investments and model updates.
- The tax amount and applied facility fees have a direct influence in their ability to divert waste from landfills and incinerators. There is a negative correlation between

total cost of landfilling (gate fee plus landfill tax) and the percentage of waste being landfilled at a country level (Watkins et al., 2012), see Figure 6.

- Landfill taxes can be applied in combination with bans on the landfilling of certain types of waste, which increases their effectiveness.
- In some cases, the revenue collected from landfill and incineration taxes is used to incentivise or improve waste policies or other environmental policies as a finalist levy. The final impact and acceptance are more positive and extensive.

Figure 6. Landfill rates (2020) vs. Landfill tax rates (2023) in EU Member States



Source: *Own elaboration based on the data from Economic instruments and separate collection systems — key strategies to increase recycling* (European Environment Agency, 2023)

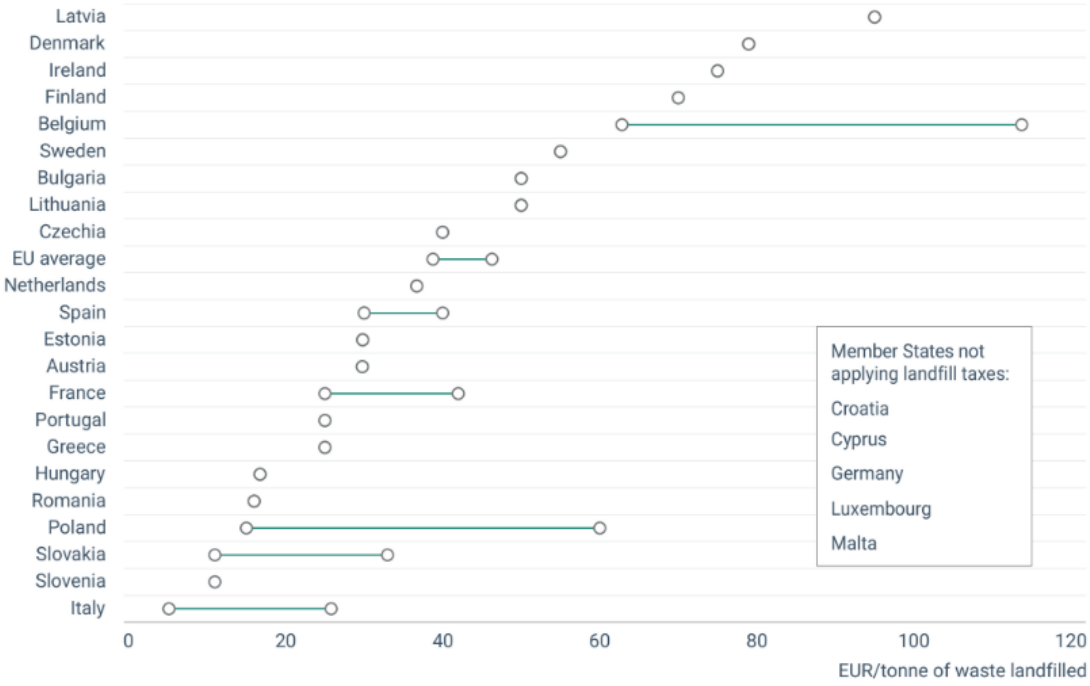
Note: *For the following MS the graph includes the maximum landfill tax rate: Belgium, France, Italy, Poland, Slovakia and Spain. MS included in the graph and not applying landfill taxes: Croatia, Cyprus and Malta.*

Especially for those countries not reaching recycling targets, national and regional governments must reassess the effectiveness of current landfill and incineration taxes and, when necessary, increase and modulate taxes to rebalance the economic viability of bio-waste management.

Current application

Most EU countries (22 MS) apply landfill taxes for municipal waste. Some combine taxes with bans on the landfilling of certain types of waste[2]. Others also have incineration taxes (9 MS), typically with tax rates lower than those for landfilling (European Environment Agency, 2023).

Figure 7. Overview of taxes on the landfilling and incineration of municipal waste in EU Member States, 2023



[2] MS with landfill bans: Belgium, Estonia, Hungary, Lithuania, Luxembourg, the Netherlands, Slovakia (from 2024), Slovenia, Czechia, Denmark, Finland, Sweden, Austria, Germany, Poland, Cyprus, France, Malta, Latvia (European Environment Agency, 2023).

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

CASE 7: Landfill tax and penalty/premium system in Sardinia (IT)

In Sardinia, a management plan including an economic driver was conceived to rapidly enhance the growth of separately collected bio-waste. The plan also guarantees the quality of separate collection, limiting the impurity content and supporting the network of composting plants by developing the market for quality compost.

The premium/penalty mechanism was immediately effective. Separate collection of MSW in Sardinia jumped to 20% in year 2006 (up from 5.3% in 2004) and reaching 47% in 2011. In year 2021, Sardinia collected separately about 75% of all MSW.

The region sets a target separate collection rate that is slightly above the average to incentivise improvement. This target is reviewed periodically. Except for a certain amount in the middle that keep balanced, those municipalities below the target have a surcharge on the residual waste disposal cost, while those above the target rate receive a bonus.

The premium/penalty is based on the percentage of separate waste collection achieved by the municipalities in the previous year and calculated by ARPAS (Regional EPA) and the implementation of punctual tariff system, the Italian name for PAYT. For 2024 the applied scheme is:

- More than 70% of separate waste collection in 2023 + PAYT for all users = 25% reduction on ecotax (CER 200301),

CASE 7: Landfill tax and penalty/premium system in Sardinia (IT)

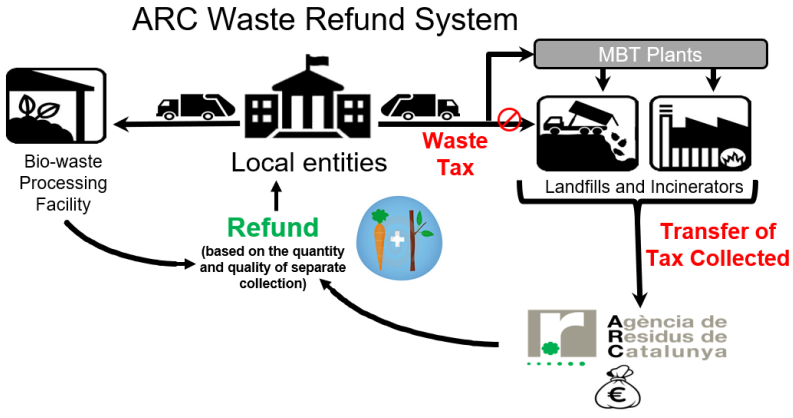
- More than 80% of separate waste collection in 2023 = 25% tax reduction on ecotax (CER 200301),
- More than 80% of separate waste collection in 2023 + PAYT for all users = 50% reduction on ecotax (CER 200301),
- More than 90% of separate waste collection in 2023 = 50% reduction on ecotax (CER 200301),
- More than 90% of separate waste collection in 2023 + PAYT for all users = 75% reduction on ecotax (CER 200301),
- If 65% (required by law) is not reached in 2023, in addition to the increase in the ecotax on landfill disposal (as stipulated in the National Law), the full tariff of the waste disposal plant will be applied, with the addition of a penalty of 5%.

Source: Guidelines for the adoption of PAYT for the urban waste management service in Sardinia, Sardinian Government

CASE 8: Landfill tax and refund system in Catalonia (ES)

Catalan Law 16/2003 established a landfill tax of 10€/t of municipal waste sent to landfill. Later, Law 8/2008 established a tax for incineration (5€) and an additional landfill tax type per tonne (double amount) for local authorities that have not begun to implement the separate collection of the municipal bio-waste, in accordance with the Plan to Implement the Separate Collection of the Municipal Organic Fraction.

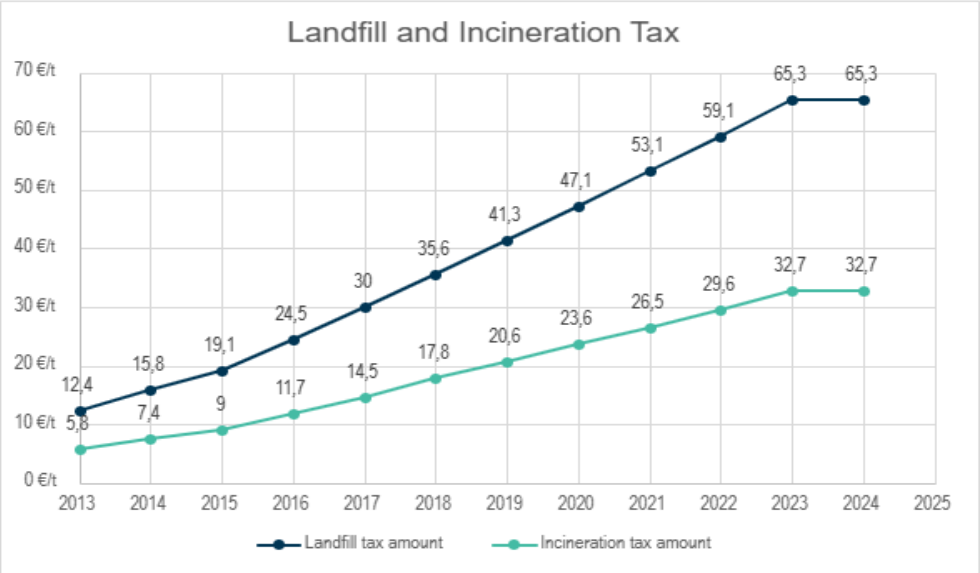
Figure 8. Landfill and incineration tax and tax refund scheme in Catalonia



In the recent years, the evolution of the tax fee has been agreed on and pre-established for a specific period (see Figure 9). The 2023 and 2024 tax was 65.3€/t for landfilling and 32.7€/t for incineration. The Catalan government is considering increasing the landfill final cost towards 130-150€/t.

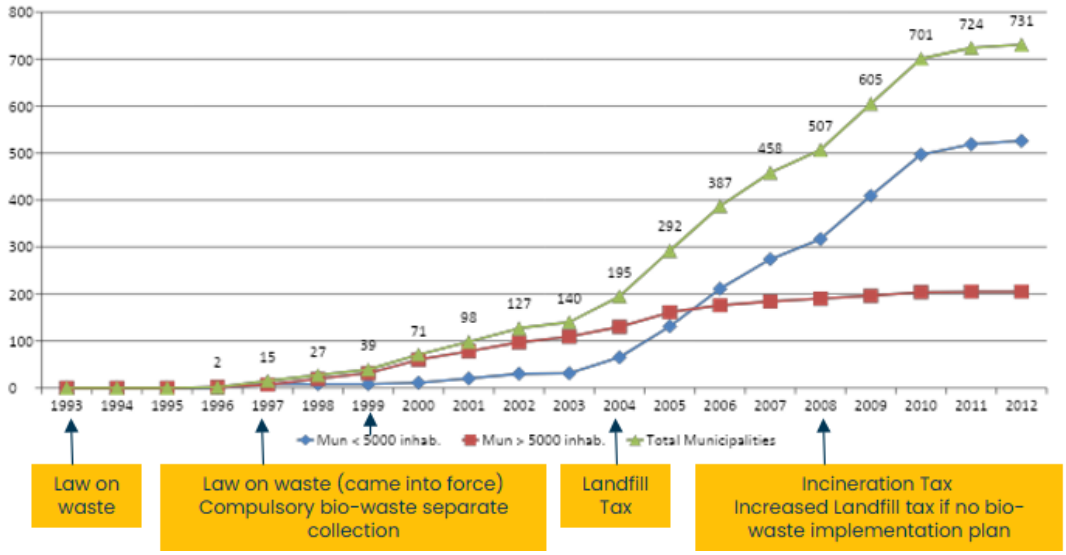
CASE 8: Landfill tax and refund system in Catalonia (ES)

Figure 9. Evolution of the landfill and incineration tax tariffs from 2013 to 2024



The introduction of the landfill tax, and complementarily the increased tariff for municipalities without bio-waste collection plan, was intended to incentivise local entities to start with the deployment (see Figure 10), together with the tax refund system and annual subsidies for materials and communication activities for implementation.

Figure 10. Evolution of the Catalan municipalities with bio-waste separate collection comparing to the main legal and economic instruments applied.



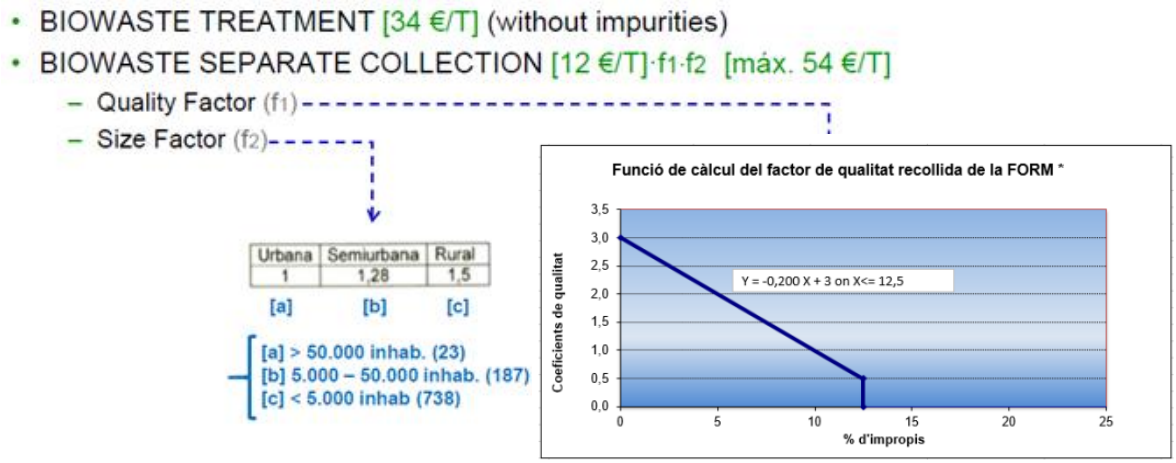
The aforementioned laws establish a refund system that supports municipalities with separate bio-waste collection in place and efforts to reduce impurities. Two main separated refund concepts are calculated for bio-waste: collection (12€/net tonne - discounting impurities - plus a municipality size correction coefficient) and treatment (34€/net tonne - discounting impurities). The collection refund is also multiplied by a

CASE 8: Landfill tax and refund system in Catalonia (ES)

coefficient depending on the quality of the managed flows. If impurities exceed a certain threshold (12.5% in 2023) the coefficient is zero. An extra payment is granted if the impurities are below 3%.

Estimation of the maximum total refund for 2023: 34+54 = 88€/net tonne.

Figure 11. Scheme of the configuration of the return concepts for disposal tax refund system



Source: Waste Agency of Catalonia webpage. Figures from Francesc Giró (ARC) presentation

4.2.1.2 Landfill/Incineration Tax Refund or Premium System

Description

Landfill or incineration tax refund or premium systems are schemes where the revenue of landfill and incineration levies is earmarked and returned to local entities in order to promote more efficient and advanced waste policies and management models.

There are two variations of this instrument:

- Tax refund system: amount of money calculated based on performance parameters. The parameters can refer to the results of the different separate fractions in terms of quantities managed and/or quality. The main example is the Landfill Tax Refund Scheme in Catalonia (see case 8).
- Premium system: established bonus is granted only in case of reaching specific result targets, e.g. a targeted separate collection rate. This scheme can be linked to a complementary penalty system.

Different mechanisms can be established depending on the type of payback scheme:

- The granted refund cash flow is directly returned to beneficiary entities. This is the case of Catalonia's scheme.
- The bonus is applied to the disposal tax tariff for next year. This is the case of Sardinia's scheme that applies a percent discount to next year's disposal levy.

Effects on bio-waste

For both variations, local entities are incentivised to adopt strategies to divert waste from landfills and incinerators to get a refund or discount, which typically means improving separate collection of bio-waste since it is the predominant fraction within municipal waste.

Those refund/premium schemes considering the quantity of bio-waste as the performance parameter to calculate the refund or establish the threshold to access the bonus will apply a more efficient incentive to improve the separate collection of this fraction.

The considered performance parameter can also include the quality of the municipal bio-waste collected and treated along with the quality, so the stimulus goes beyond improving quantities only, promoting low level of impurities as a key requirement to effectively close the cycle of bio-waste.

Local authorities can dedicate these economic resources or savings to cover operational costs of bio-waste collection and treatment and/or develop activities to promote, monitor and improve its management. This can be a driver to invest in better and advanced services without the need to revise or increase charges paid by the waste producers.

Design aspects & Recommendations

- These schemes rely on quality data about the waste management performances from previous year. The information to calculate the necessary parameters should be accessible and reliable with robust reporting systems and adequate controls to ensure data traceability.
- The refund or threshold parameters may be updated and approved for each year to adjust the distribution of the revenue along with the level of incentive.
- Net tonnes (discounting impurities) should be used to define the refund or threshold parameters in order to promote low impurities in the flows separately collected and guarantee their final quality recycling.
- For systems based on refund parameters:
    - Impurities correction coefficients or thresholds should be considered to incentivise the quality of collected flows, especially for bio-waste.

- Other complementary or alternative management options to bio-waste collection can be included in the refund parameters such as home-composting (considering number of operative composters or tonnes managed in situ) or separated management of green waste (considering tonnes collected).
- Complementary refund parameter related to bio-waste treated in biological facilities (considering treated net tonnes) may be considered and it can be modulated according to the variability of gate fees to balance and compensate territorial differences in costs for bio-waste treatment stage.

Current application

This kind of instrument is applied in a few cases. The most relevant cases are found in Catalonia with the tax refund system since 2004 and Sardinia with the penalty/premium system since 2004/5. For more information, see the case boxes of the section 4.2.1.1.

4.2.2 Taxes on products

4.2.2.1 Chemical fertiliser taxes

Description

Mineral fertilisers are affected by limited sources of raw materials and environmental issues (Randive et al., 2021) and their production requires extensive use of energy. This condition affects market competition of mineral fertilisers, disrupting the stability of fertiliser supply (Kurniawati et al., 2023).

Bio-based fertilisers are expected to substitute mineral fertilisers partially or fully in the future (Kurniawati et al., 2023). The European Commission set a goal of 30% reduction of non-renewable resources in fertiliser production within the 2030 climate and energy framework (Chojnacka et al., 2020). In parallel, the EU fertilising product regulation promotes the use of organic and waste-based fertilisers, and the Farm to Fork strategy aims to reduce excess fertilisation and increase organic farming (European Commission, 2020).

Environmental taxes are a policy tool that can be used to reduce environmental damage while minimising harmful economic impacts. Product taxes for chemical fertilisers are potential instruments to incentivise the reduced usage of mineral fertilisers on soils and redirect the market to other alternative products.

Effects on bio-waste

Taxes on chemical fertilisers improve the competitiveness of other types of fertilisers (such as organic and waste-based fertilisers) since they increase both the cost of chemical fertilisers and the related farming activities.

Together with this economic instrument, the existing legal framework can encourage more sustainable farming practices, which includes the use of organic and waste-based fertilisers. This has a direct positive influence on the demand and supply of the organic soil improvers such as compost or digestate. By stimulating market value, this will positively impact organic treatment facilities and their economic balance. Finally, this new scenario will promote bio-waste collection since supply of feedstocks to compost and AD facilities will be also demand-driven.

Design Aspects

The OECD proposes environmental tax measures (OECD, 2011) that are:

- Commensurate with the environmental damage caused,
- Credible and predictable in order to motivate environmental improvements,
- Based in clear communication to achieve public acceptance and
- Combined with other policy instruments to reduce negative externalities.

Another approach would be to use a subsidy to bolster the marketability of sustainable fertilisers. This could be done by providing financial incentives to farmers who use fertilisers that are less harmful to the environment or to sustainable fertiliser producers to defray production costs and lower the market price of the fertiliser. This tactic was enacted through the Rural Development Plans adopted in ten Italian regions to subsidise the use of compost or fund the purchase of technical equipment to spread compost as a fertiliser on agricultural lands (Scuola Agraria del Parco di Monza, 2017).

According to existing research, Belgian, Danish, French, Dutch, German, Hungarian, and Croatian farmers have common preferences for bio-based fertilisers with a similar nutrient content but lower price than chemical fertiliser (Tur-Cardona et al., 2018). A cross-sectorial analysis must leverage the business and marketing opportunities of bio-based fertilisers to promote them (Kurniawati et al., 2023).

Overall, incentives are needed for waste valorisation, and fines are needed to deter the use of non-renewable raw materials (Chojnacka et al., 2020).

Current Application

According to Arlinghaus & Van Dender, 2017, many countries have abolished mineral fertiliser taxes, with Denmark being the exception. This may be due to the challenging of designing the fertiliser taxes and assessing the impacts since “environmental damage

caused by fertiliser run-off varies strongly depending on the receiving environment at local level" (United Nations Environment Programme, 2020).

Figure 12. EU countries applying fertiliser taxes and design description

Country	Introduced in	Abolished in	Tax design	Revenue use
Austria	1986	1996	ATS 3.5 per kg nitrogen ATS 2.0 (approx. EUR 0.15) per kg phosphate	Support grain production sector through export subsidies
Denmark	1998	-	DKK 5 per kg nitrogen, with broad exemptions for agriculture	Reductions in land use tax
Finland	1976	1995	Revised multiple times, level lower than in Denmark and Austria	Finance export subsidies
The Netherlands	1998	2005	Tax per kg nitrogen and phosphate in excess of a regulated threshold	Feeds into general budget
Norway	1988	2000	Ad valorem for nitrogen-based fertilisers, gradually increased from 1% to 20% in 1991	Finance environmentally friendly cultivating practices and information measures
Sweden	1984	2010	Approx. 20% of the fertiliser price	Reduce negative impacts of chemical use in agriculture, finance R&D measure for agriculture

Source: Study on the effects of taxes and subsidies on pesticides and fertilizers (United Nations Environment Programme, 2020)

CASE 9: Fertiliser tax in Denmark

A Danish tax on fertilisers' nitrogen content aims at reducing the recreational use of fertilisers (ex. landscaping, parks and golf courses). The tax is designed to leave livestock and crop producers unaffected since their use of fertilisers is regulated through the Fertiliser Register. The revenue generated from the tax is equivalent to 3 million euros per year. As of July 2019, the tax on phosphate was abolished.

Source: Taxation in Agriculture (OECD, 2020)

CASE 10: Fertiliser tax in Sweden

For 25 years, Sweden taxed mineral fertilisers. Due to the financial crisis, it was discontinued in 2009. The tax was initially designed to target both nitrogen and phosphorus. After the first 10 years, cadmium present in phosphorus replaced the latter taxation base. The tax rate for nitrogen was set at the equivalent of 0.18 euros per kg N, and the tax rate for cadmium at the equivalent of 3 euros per gram.

Source: Fertilizer Tax in Sweden (Andersen, 2018)

4.2.3 Charges and fees

Fees and charges are economic instruments that can be used to recover the costs of waste management and support the principle of user pays, helping to ensure the financial sustainability of waste management services (OECD, 2019).

4.2.3.1 Bio-waste management charges: variable charges, PAYT, SAYT

Description

In most countries, local waste management has a dedicated source of financing. Local authorities may achieve this by levying specific waste charges, which need to be designed to achieve a certain revenue target. The revenue targets depend on the net cost of the service and on the percentage of the cost to be covered.

Flat tariffs or non-variable waste charges based on the characteristics of the dwelling (primarily property value or surface in m^2), the number of inhabitants or water consumption share a common limitation: none of them incentivise reduction, separation or recycling. This is because the amounts being charged do not depend on the individual participation in separate collection. To create such an incentive, the waste charge must be variable and based on actual waste generation (either weight or volume). This is commonly known as unit pricing or pay-as-you-throw (PAYT). Under such models, waste charges increase for users who generate more waste and separate poorly so mainly PAYT is applied to residual waste but other fractions can also be considered. Users who reduce and separate their waste properly pay less.

Unlike PAYT's increase of waste charges based on waste generation, in save-as-you-throw (SAYT) (or reward-as-you-throw – RAYT) systems, users pay less the more waste they separate at source and prepare for separate collection services. SAYT is applied to recyclables and especially bio-waste. PAYT and SAYT can be applied simultaneously: the PAYT scheme used for residual waste and SAYT for bio-waste.

Effects on bio-waste

PAYT or variable charges typically have a favourable impact on recycling rates (European Environment Agency, 2023; OECD, 2019). Moreover, the prevalence of PAYT schemes is one of several key performance indicators of the quality control and traceability of municipal waste management systems (European Environment Agency, 2023).

In the case of PAYT, the effects on recycling rates come from the economic penalisation of delivering residual fraction to the collection service, which encourages users to separate at source more recyclable fractions, especially bio-waste since it is the largest and denser flow. The final effects can also be influenced by the other applied instruments such as the features of the collection model, the limitations of residual waste deliveries, user monitoring, information, etc.

In the case of SAYT, the reduction of the charges associated with the delivery of bio-waste incentivises the users to increase the participation in the collection of this flow.

Design aspects

In the case of waste management costs under local jurisdiction, the best management option is the existence of a differentiated and non-deficit public charge that covers all the related expenses. The charge should reflect real costs, both direct or indirect, of the operations of waste collection, transport and treatment, recycling and final disposal. Other complementary costs should be included such as awareness campaigns and communication, data monitoring, technology implementation and maintenance. Any type of income derived from the application of extended producer responsibility or from the sale of materials and energy should be added to the economic balance.

Variable waste charge schemes are commonly composed of a variable and general component (in some cases it can be called fixed part). The general component is independent of waste generation (it can take any of the forms listed previously when talking about non-variable waste charges) and can be subject to social and environmental discounts (e.g. for home composting or for the use of waste collection centres). The variable component, typically between 5-40% of the total charge, depends on the individual waste generation of each taxpayer. Larger percentage may incentivise more source separation, but, depending on the charge configuration, it may lead to fraudulent practices.

There are many different variants of PAYT schemes, but they are all based on two pillars (ENT & ARC, 2010):

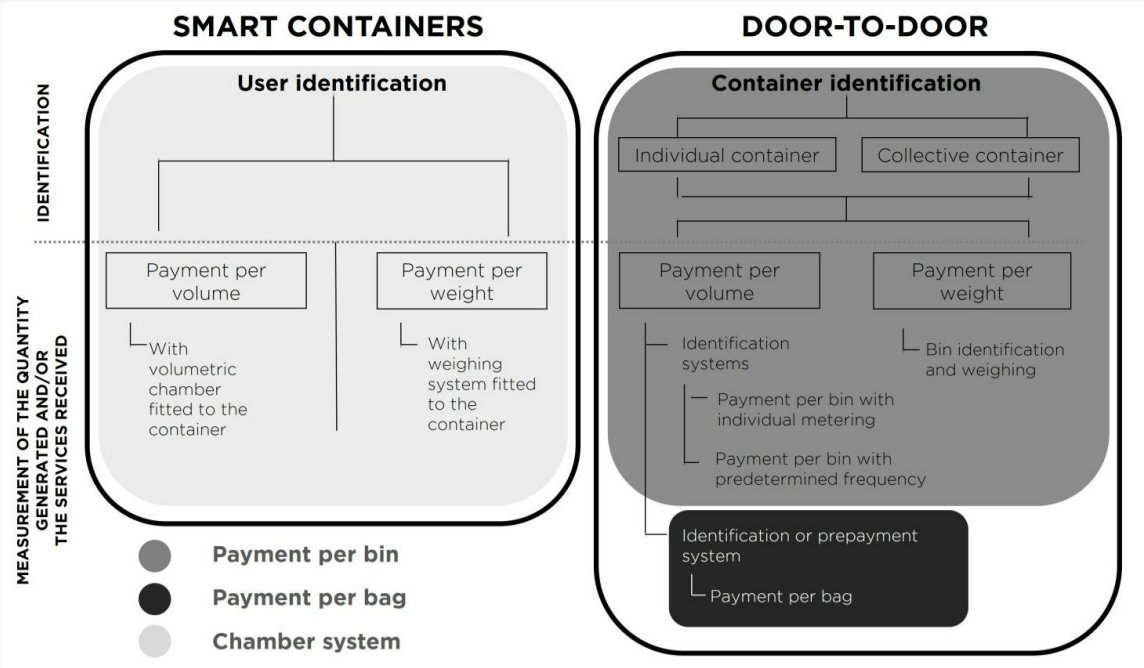
- Identification of the waste producer and
- Measure of the quantity/volume of waste generated and/or the services obtained.

The combination of these first two pillars allows for individual charging. The only scheme that does not identify the user or the receptacle is a variation of the pay-per-bag system,

where users pay (part of) the cost of the service by purchasing standardised waste bags (pre-paid system).

Figure 13 summarises the most common PAYT schemes, according to the main ways of identifying the producer and measuring their waste generation:

Figure 13. Summary of main pay-as-you-throw (PAYT) schemes



Source: Own elaboration based on (Reichenbach, 2004)

An important step in configuring the variable part is to decide the fractions to be charged and assess the needs and options of the collection and data monitoring scheme:

Table 7. Fractions to be considered in PAYT/SAYT schemes and implementation options

Faction charged or rewarded	Collection system	Type of charge	Charge effects	Weaknesses	Monitoring
Residual Fraction	A. Pre-paid standard bags. B. Identified individual bins, caddies or bags. C. Containers with controlled access and chamber system (volume limitation highly recommended).	PAYT	PAYT: Incentive both to reduce waste and to participate in separate collection, particularly of bio-waste. Specific conditions for diapers generators.	Waste tourism or fly tipping can appear for all the collection systems but especially for containers with controlled access. Containers with controlled access systems require the locking of other fractions, especially bio-waste, to avoid contamination.	Comprehensive monitoring and data analysis to detect possible abnormalities in the number of residual waste disposals by each taxpayer. Follow up with "zero producers". Penalties for fly tipping and possibility to open and inspect bags.
Food waste/bio-waste from households	A. Identified individual bins or caddies. B. Containers with controlled access and chamber system (sized entrance recommended).	PAYT	Charges can discourage proper separation and participation. More recommended for schemes where food waste and green waste are collected together.	Susceptible to include bio-waste in other fractions, waste tourism or fly tipping. For food-waste containers with controlled access system it is recommended the control of other fractions, especially residual waste (by locking other containers or applying D-t-D).	Quality of the set-outs should be monitored to avoid the presence of impurities.
		SAYT	Stimulate correct separation and participation with more set-outs. Include a maximum and minimum number of set-outs to receive bonuses or discounts.	For food-waste containers with controlled access system, the control of volumes/quantities delivered to reduce possible frauds is recommended.	Quality of the set-outs should be monitored to avoid the presence of impurities. Monitor possible frauds regarding delivered quantities, especially for containers with controlled access.
Commercial food waste	A. Identified individual bins or caddies. B. Containers with controlled access and chamber system (volume limitation recommended and sized entrance for larger commercial bags).	PAYT	PAYT + D-t-D: To not discourage proper separation, the application of a tariff based on the number and size of bin assigned is recommended. PAYT can be applied to containers with controlled access.	Susceptible to include bio-waste in other fractions, waste tourism or fly tipping. For food-waste containers with controlled access system, the control of other fractions, especially residual waste (by locking other containers or applying D-t-D) is recommended.	Quality of the set-outs should be monitored to avoid the presence of impurities. Residual fraction should be monitored in case it is not complementarily charged.

Faction charged or rewarded	Collection system	Type of charge	Charge effects	Weaknesses	Monitoring
		SAYT	SAYT can be applied to containers with controlled access.	For food-waste containers with controlled access system, the control of volumes/quantities delivered to reduce possible frauds is recommended.	Quality of the set-outs should be monitored to avoid the presence of impurities. Monitor possible frauds regarding delivered quantities, especially for containers with controlled access.
Green waste	A. Identified individual bins, bags or big bags. B. Recycling centres drop off.	PAYT	PAYT + D-t-D: Pay per number of services with a reduced tariff (in respect to residual waste). Option to pay for extra services considering a minimum number of collection rounds in the general part.	Susceptible to include green waste in other fractions (especially within open containers systems), waste tourism or fly tipping.	Quality of the set-outs should be monitored to avoid the presence of impurities. Residual fraction should be monitored in case it is not complementarily charged or it is collected in open containers.
		SAYT	Encourage user drop-off in recycling centres for free or applying a bonus.	-	Quality of the drop-offs should be monitored to avoid the presence of impurities.
Individual home composting	Individual composting at home.	SAYT	Bonused, especially in case of exclusive model (e.g. in areas without separate collection of bio-waste).	Poor composting process performance and use of the complementary collection model.	Monitor the performance of the process and the exclusive use of the composter.
Community composting	Community composting in composter with controlled access (sized entrance recommended).	PAYT	Same considerations as food waste from households in containers with controlled access (exclusive schemes).	Same considerations as food waste from households in containers with controlled access (exclusive schemes).	Quality of the set-outs should be monitored to avoid the presence of impurities.
		SAYT	Same considerations as food waste from households in containers with controlled access (exclusive schemes).	Same considerations as food waste from households in containers with controlled access (exclusive schemes).	In case of bonus in the charge, monitor possible frauds regarding quantities set-out.

Source: Own elaboration

The application of variable charges requires the use of technologies to identify the users or receptacles. Data recording and management should guarantee the integrity and quality of the information and the compliance with personal data protection legislation. Effective management also requires skilled staff and data management platforms along with the maintenance of users' databases to connect the user performance records with the calculation of the charge for each taxpayer.

Variable charges are key instruments to apply the polluter pays principal and contribute to the consolidation of separate collection participation. The core element to incentivise proper separate collection is the type and effectiveness of the collection scheme, namely individualised collections such us D-t-D, which are able to identify the user, limit the number of set-outs of residual fraction and control the quality of the delivered materials. For more details on effective variable charges combined with collection schemes, please see next section 4.2.3.2 on variable charges cases.

Current application

The majority of MS already have a PAYT system of some sort in place for at least part of the population. Most of these MS have introduced legislation that requires the use or development of PAYT systems or allows municipalities to introduce such systems. Fourteen MS use a mix of advanced and basic PAYT systems (see EEA's definition under Figure 14), and another six MS use basic PAYT systems only. No MS uses only advanced PAYT systems. Three of the six MS that currently do not use a PAYT system have plans to implement one (European Environment Agency, 2023).

Figure 14. Overview of the type and population coverage of PAYT systems for households in the EU-27, 2022

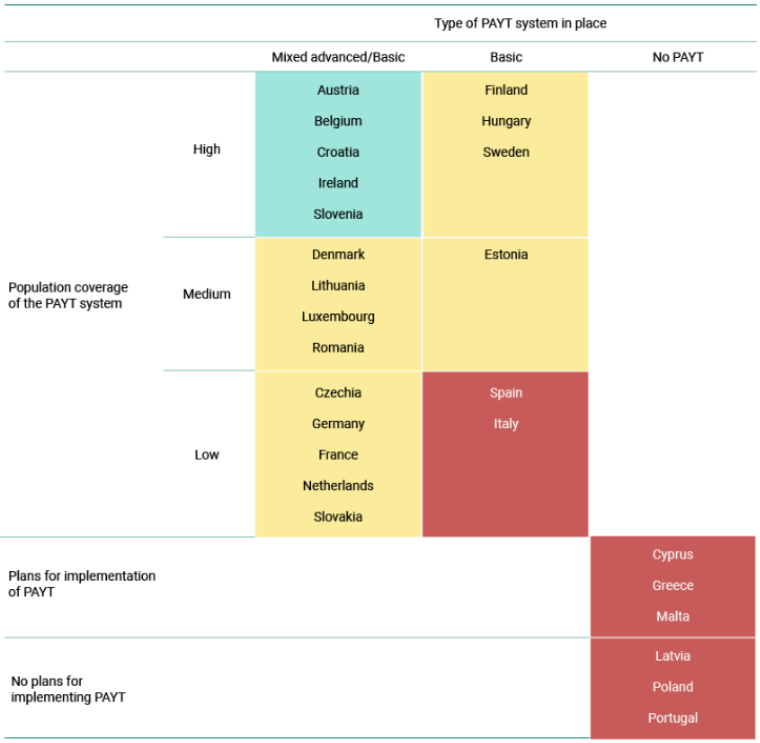


Table Note: No information was available for Bulgaria. Poland applies a PAYT system to only non-household waste producers. According to the report, Advanced and Basic PAYT systems are defined as follows:

- *Advanced PAYT systems provide a direct and visible economic incentive at the time the waste is generated. This includes waste collectors weighing waste containers on pick-up so that waste producers pay by weight of waste generated. Another example is sack-based systems, whereby citizens buy waste sacks from the municipality or service provider, providing an immediate signal of a citizen's waste behaviour.*
- *Basic PAYT systems are, for example, volume-based systems that depend mainly on the size of the container and sometimes also take into account the collection frequency when determining the collection fee. Such systems include designs where households can choose the number or size of the containers for mixed municipal waste when the service contract is agreed.*

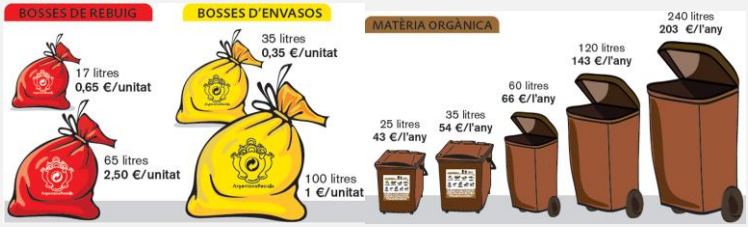
Source: EEA, Economic instruments and separate collection systems — key strategies to increase recycling (European Environment Agency, 2023)

4.2.3.2 Variable charge cases

Figure 15. Variable charge cases in Catalonia (ES)

CATALONIA (SPAIN)		
Local entity / Main features	**Charge calculation**	**More info**
Manlleu 21,164 inhab. (2023), 1,215 inhab./km^2 D-t-D: 4 fractions (glass in road containers) SAYT for FW PAYT for RW and GW Identification system for caddies and bins (RDIF-UHF) %SC: 83.5 (2023) Source: Council of Manlleu webpage (charge calculation from 2024)	The charge for households is composed of two main parts: a general part of 177€ and a variable part including the sum of tariffs for food waste + residual waste + garden waste depending on the number of collections (by brackets of set-outs). • Variable part for FW: minimum tariff 0€ for >20 collect./yr, medium tariff of 11€ for 6-20 collect./yr, maximum tariff of 42€ for <6 collect./yr. The variable charge includes a SAYT approach for FW to incentivise regular use of the FW service bonusing users with good participation levels. • Variable part for RW: minimum tariff 0€ for 4-20 collect./yr, medium tariff of 15€ for >20 collect./yr, maximum tariff of 66€ for <4 collections/yr. Increases in residual waste delivered coincide with higher tariffs. Less than 4 deliveries is considered fly tipping, which is penalised with the highest tariff. • Variable part for GW: minimum tariff 3.75€ for <6 collect./yr, medium tariff of 7.5€ for 6-12 collect./yr, maximum tariff of 12.5€ for >12 collect./yr. The charge scheme also considers specific treatment for vulnerable people and disperse users using closed bring areas with containers.	Fixed and variable charge design for food waste, residual waste and green waste.

CATALONIA (SPAIN)		
Local entity / Main features	**Charge calculation**	**More info**
Vilablareix 3,508 inhab. (2023), 569 inhab./km^2 D-t-D: 4 fractions (glass in road containers) SAYT for FW and light packaging Identification system for caddies and bins (RDIF-UHF) %SC: 91 (2022) Source: Council of Vilablareix website (charge calculation from 2024)	The charge for households is composed of two main variable parts: tariff applied to light packaging plus tariff applied to food waste. The charge includes 4 ranges based on the number of collections with rates increasing the cost when less annual collections are made. For both fractions the charge is defined as a SAYT. For food waste the following 4 brackets are applied: • Minimum tariff of 75€ for >77 collections/yr, • 1st medium tariff of 105€ for 41-77 collections /yr, • 2nd medium tariff of 150€ for 13-40 collections /yr, • Maximum tariff of 225€ for <13 collections /yr. The charge scheme also considers two situations of specific treatment: • In the case of uninhabited homes, the rate is 120€ per year. • In the case of homes that carry out self-composting, the minimum tariff range for bio-waste is applied.	Variable charge design for food waste and light packaging **TAXA ANUAL = TRAM ENVASOS + TRAM ORGÀNICA** ENVASOS Quantes vegades treus els envasos a l'any / TRAM / IMPORT Més de 51 — Tram 1 — 45 € De 25 a 51 — Tram 2 — 75 € De 9 a 24 — Tram 3 — 120 € Menys de 9 — Tram 4 — 180 € ORGÀNICA Quantes vegades treus l'orgànica a l'any / TRAM / IMPORT Més de 77 — Tram 1 — 75 € De 41 a 77 — Tram 2 — 105 € De 13 a 40 — Tram 3 — 150 € Menys de 13 — Tram 4 — 225 € Taxa mínima = 120€ anuals (Tram 1 d'envasos i orgànica) Taxa màxima = 405€ anuals (Tram 4 d'envasos i orgànica)

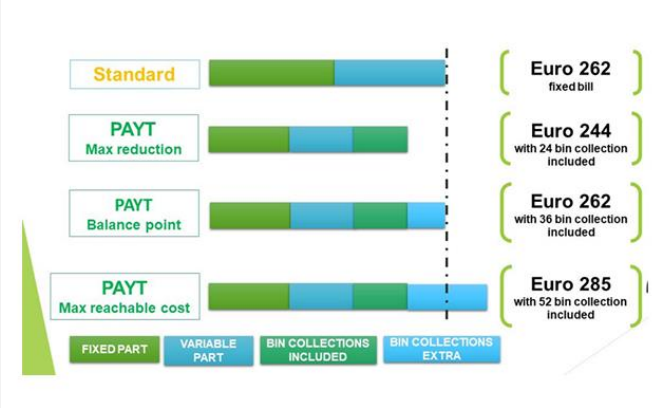
CATALONIA (SPAIN)		
Local entity / Main features	**Charge calculation**	**More info**
Argentona 12,845 inhab. (2023), 506 inhab./km^2 D-t-D: 4 fractions (glass in road containers) Bag pre-paid system for RW (food waste and light packaging only for commercial) Standard pre-paid bags acquired %SC: 87 (2022) Source: Council of Argentona, Joan Pujol presentation (charge calculation from 2024)	The charge for households is composed of two main parts: a general part based on the pre-assigned number of residual bags and a variable part based on the additional residual bags used. The general part includes the pre-assigned number of bags depending on the family size, so users acquire and pay only for the additional bags used. There are 3 categorisations of families: 1-2 people receive 10 bags, 3-4 people receive 20 bags, 5 or more people receive 25 bags. The variable part includes the payment for the number of additional standardised pre-paid bags for residual waste (red). Diapers can be collected in specific identified bags for free. The cost of 17L bags for residual waste (bags can be acquired in local retailers) is 0.65€. Commercial activities pay for food waste bin collection according to the number and volume of bins assigned and have also a pre-paid system for light packaging (yellow bags, 100L bags cost 1€) and for residual waste (bigger 65L bags cost 2.50€).	Type and cost of the pre-paid residual waste and light packaging bags, and commercial activities food waste tariff according to the size of the bin.  Fixed part of the charge according to type of household (number of inhabitants) and the minimum assigned number of residual waste bags.

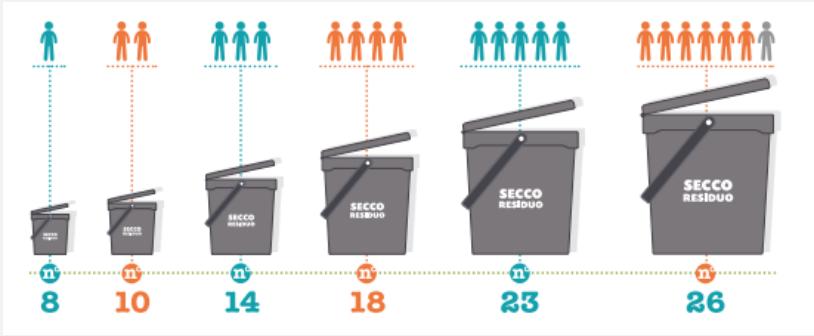
CATALONIA (SPAIN)		
Local entity / Main features	**Charge calculation**	**More info**

KEY IDEAS:

- For pre-paid bags schemes, the design of the bags distribution is key. One option is selling them in the local shops. In order to minimise fly-tipping and to ensure the coverage of unavoidable costs in the system, it is advisable to include the cost of a default number of bags to be used (considering different sizes of families) in the general part of the charge and only pay for the additional bags used.
- The option of SAYT schemes applied to food waste can be more effective to incentivise the participation of users, especially in the first periods of variable tax implementation.
- For food waste charges definition, it is recommendable to set a minimum and maximum number of set-outs to receive the bonuses within SAYT schemes so that possible fraud is minimised.
- The definition of the varaible charge can consider range numbers for collections to minimise the possibility of technical mistakes and data collection errors.
- The application of variable charges should include the monitoring of the fraud and the "zero producers" defined as users with very low or no set-outs of residual waste to the collection system.
- The introduction of bonuses for bio-waste home composting can be a complementary instrument to promote in situ bio-waste management, especially for more disperse households or those not well connected to the general route or service. The application of reduced tariffs or discounts should be conditioned to the monitoring of the process proper performance and if users are not taking advantatge of the collection service for bio-waste.

Figure 16. Variable charge cases in Italy

ITALY		
Local entity / Main features	**Charge calculation**	**More info**
Parma 195,436 inhab. (2022), 746 inhab./km^2 D-t-D: 4 fractions (glass in road containers) Identification system for caddies, bins and bags for the centre (RDIF-UHF) PAYT for RW %SC: 81.24 (2022) National obligation to apply variable charges. Source: RethinkWaste PAYT & KAYT Catalogue, Parma case study by Zero Waste Cities More info in **LIFE BIOBEST D3.1 Guideline on separate collection, Annex 1**	The charge for households is composed of two main elements: a general part based on the number of household members, the square meters of the household and minimum services for residual waste, and a variable part based on residual waste additional collections. The general part already covers a minimum number of collections of residual waste per household, which is intended to cover the fixed costs of managing the system and concurrently to prevent dumping and littering. The variable part includes the additional residual waste set-outs which are charged 0.70€ per bag, 1.40€ per bucket and 4.20€ per wheeled bin. In terms of positive incentives, households get a 12% reduction in the charge (general part) if they home compost. Households making use of diapers are not charged for additional collections.	The waste bill before and after the introduction of the PAYT system, in a 100 sqm apartment with 3 residents: 

ITALY		
Local entity / Main features	**Charge calculation**	**More info**
Sommacampagna (IT) 14,750 inhab. (2022), 360 inhab./km^2 D-t-D: 5 fractions Identification system for caddies, bins (RDIF-UHF) PAYT for RW %SC: 88.43 (2022) National obligation to apply variable charges. Source: Altereko, 20 years of Waste Management in Sommacampagna, 2018.	Sommacampagna is a pioneer in MSW recycling; the town started D-t-D collection including kitchen waste in 1998, being among the first Italian cases to reach 65% separate collection. A PAYT charge for households was initially introduced in 2000 with pre-paid bags and then transformed by equipping each household with 40L buckets with RFID -UHF transponders. The charge for households is composed of two main elements: a general part based on the number of household members and the square meters of the household, and a variable part based on residual waste additional collections. The variable part includes the additional residual waste set-outs that exceed the minimum number, which are charged with 0.6€ per caddie (40L) and 1.80€ (120L) per wheeled bin. Households making use of diapers are incentivised to buy a kit of washable diapers with an economic support of 90€.	Number of set-outs per year of the residual waste bin per size of family.  The figure shows the number of times the household bins are emptied per year, according to the size of each family. On average a bin for a family of 3 people is collected about every 4 weeks.

ITALY		
Local entity / Main features	**Charge calculation**	**More info**
TREVISO (IT) 85,082 inhab. (2023), 1,530 inhab./km^2 D-t-D: 5 fractions Identification system for bins and buckets PAYT for RW (and for recyclables) %SC: 87.11 (2022) National obligation to apply variable waste charges. Source: Contarina SPA, link 1, link 2, link 3.	Treviso is a large and dense city in Veneto region, part of a consortium totaling 554,000 inhabitants. In 2014 open bring banks were removed and D-t-D collection was introduced, together with PAYT on residual waste. Separate collection rate increased from 55% to 85% in just one year. Bins, buckets and frequencies are adapted to the urbanistic situation. The charge for households is composed of the following main elements: a general part modulated according to the territory (73.94€ for outskirts and 79.84€ for the centre) and the minimum service for residual waste calculated as follows: 120 x (n+1) litres of residual per year where n is the number of members (e.g. for a family of 4 people, 120 x 5 = 600L); a variable part based on residual waste additional collections. The variable part includes the additional residual waste set-outs which are charged with 0.084€/L (component related to the collection cost) + 0.075€/L (treatment cost) according to the volume of the bin. The price of collections exceeding the minimum is higher than other Italian PAYT schemes (19 € for a 120L bin) and pushes for high separate collection. In order to foster waste prevention, dry recyclables are included in a PAYT scheme according to a threshold of collections.	Modulation of the D-t-D scheme in Treviso, with all fractions measured for PAYT components.

ITALY		
Local entity / Main features	**Charge calculation**	**More info**

KEY IDEAS:

- National (or regional) laws mandating the implementation of variable taxes is key for the introduction and widespread adoption of variable charges.
- D-t-D collection schemes benefit and facilitate the introduction of variable charges based on PAYT for RW, as there is an identification of the waste producers and an individual control (both for quality and non-compliance) of the collections of other recyclable fractions, especially bio-waste.
- The introduction of a minimum number of collections for residual waste in the general part (based on the size of the family in some cases) is a key strategy to cover general service costs, simplify collection data monitoring, and minimise fly-tipping.
- The inclusion of dry recyclables in the variable charge scheme can incentivise waste prevention; however, the design of the variable charge should prevent waste tourism or dumping.
- In a PAYT scheme including residual waste, households making use of diapers should have a dedicated collection service for diapers without additional charges.

Figure 17. Variable charge cases in Germany

<table>
<tr><th colspan="3">GERMANY</th></tr>
<tr><th>Local entity / Main features</th><th>Charge calculation</th><th>More info</th></tr>
<tr>
<td>Freiburg

236,140 inhab. (2022), 1,543 inhab./km²

D-t-D: 4 fractions (glass in road containers) main model

PAYT for RW

Identified wheeled bins with stickers

%SC: 70 (2022)

Source: Freiburg report</td>
<td>The charge for household RW is composed of two main elements: a fixed and a flexible general part.

The fixed general part (flat rate) covers the disposal services such as paper bin, bio-waste bin (incl. cleaning), bulky waste pick up, operation of municipal recycling centres, collection of garden waste (2 per year), operation of garden waste yards, collection of Christmas trees, and collection of harmful substances.

The flexible part for RW is established based on the number and size of the bins and the frequency of collection (weekly or fortnightly) selected by the user once a year. This covers transport and treatment cost for residual waste. For bins that are shared among apartments, the charge is split regardless of their individual behaviours.

In case the user would need to change the bin size, the applied tariff to activate the new service is 34.55€ and the modification request of the collection frequency costs 11.12€.</td>
<td>Typical waste fee stamp on waste bin indicating the purchased tariff (e.g., collection frequency, bin size) for the current calendar year.

Two-level fee structure

<table>
<tr><th>household</th><th>household fee</th></tr>
<tr><td>1-person household</td><td>109,44 €/a</td></tr>
<tr><td>2-person household</td><td>114,60 €/a</td></tr>
<tr><td>3-person household</td><td>142,32 €/a</td></tr>
<tr><td>4-person household</td><td>159,60 €/a</td></tr>
<tr><td>> 5-person household</td><td>189,36 €/a</td></tr>
</table>
<table>
<tr><th>container fee</th><th>collection weekly</th><th>collection every 2 weeks</th></tr>
<tr><td>35 liter</td><td>87,36 €/a</td><td>43,68 €/a</td></tr>
<tr><td>60 liter</td><td>150,00 €/a</td><td>75,00 €/a</td></tr>
<tr><td>140 liter</td><td>349,44 €/a</td><td>174,72 €/a</td></tr>
<tr><td>240 liter</td><td>600,00 €/a</td><td>300,00 €/a</td></tr>
</table>
</td>
</tr>
</table>

GERMANY		
Local entity / Main features	**Charge calculation**	**More info**
Ahrweiler (region): 128,146 inhab. (2021), 163 inhab./km^2 D-t-D: 4 fractions (glass in road containers) main model PAYT for RW Identified wheeled bins with stickers and identification %SC: 63 (2022) Additional information: BW: 133.2 kg/inhab./yr – 1.6% impurities (2021) RW: 98.2 kg/inhab./yr – 23.4% organics (2021) Source: District of Ahrweiler website	The charge for households is composed of two main elements: a flexible general part for BW and RW and a variable part based on PAYT for RW. The flexible part for BW and RW is established based on the number and size of the bins selected by the user. BW service includes a weekly collection in summer and fortnightly in the rest of the year. The PAYT for RW is based on number of collections. The provided general collection frequency is once per month. The user pays for a minimum of 6 collection and 6 additional and optional collections are included in the variable part. Besides the charge system, the regional authority tries to keep as much green waste out of the bio-waste bin (focus on food waste) by offering different options for green waste collection: nearby specific green waste collection points in each town, specific seasonal D-t-D collection (no food waste allowed), drop-off at recycling centres.	Multi-level fee structure considering household size, additional bio-waste fee, PAYT scheme for residual waste including residual waste bin size.

Emptying Fees for Residual Waste Containers	Price
Residual waste 80-l	4.32 €
Residual waste 120-l	6.48 €
Residual waste 240-l	12.97 €
Residual waste 1100-l	59.44 €

Basic Fees		
Household	Fees without bio-waste bin	Fees with bio-waste bin
1 person household	127.32 €	139.20 €
2 person household	152.76 €	166.80 €
3 person household	181.32 €	198.00 €
4 person household	195.96 €	214.80 €
5 or more person household	206.76 €	225.60 €

GERMANY		
Local entity / Main features	**Charge calculation**	**More info**
Aschaffenburg (region): 177,080 inhab. (2022), 253 inhab./km^2 D-t-D: 4 fractions (glass in road containers) main model PAYT for BW and RW Identified wheeled bins with stickers and identification %SC: 83.5 (2022) Additional information: BW: 39.1 kg/inhab./yr – 4.0% impurities (2021) RW: 65.7 kg/inhab./yr (lowest value in Germany) – 38.9% organics (2021) Source: District of Aschaffenburg website	The charge for households is composed of three main elements: a flexible general part for BW and RW, and a PAYT for BW and a PAYT for RW. The flexible part for BW and RW is based on the number and size of the bins selected by the user. The PAYT for BW is based on the number of collections and weight. The provided general frequency is a weekly collection in summer and fortnightly in the rest of the year. The user does not have to pay for a minimum number of collections or weight. All the provided services are counted in the PAYT part of the charge. The PAYT for RW is based on the number of collections and weight (fixed part is different for bin sizes) with a fortnightly collection frequency. There is no minimum number of collections or weight to be collected in fixed part.	Fees charged for the containers of varying sizes and their emptying fees. **Basic Fees** **Container** / **2020-22** 120 l-RM — 54.00 € 240 l-RM — 108.00 € 660 l-RM — 297.00 € 1,100 l-RM — 495.00 € Weight Fee — 0.25 € **Emptying Fees** 60 l-/120 l-BM — 0.50 € 120 l-/ 240 l-RM — 2.70 € 660 l-/1,000 l-RM — 10.00 € Residual waste bag — 12.00 €

GERMANY		
Local entity / Main features	**Charge calculation**	**More info**
Wasserburg am Inn (town) 12,411 inhab. (2022), 660 inhab./km^2 D-t-D: 3 fractions (dry recyclables and glass in road containers) as main model PAYT for RW Identified wheeled bins with stickers and identification %SC: 75 (2022) Additional information: BW: 86.4 kg/inhab./yr - 1.1% impurities (2021) RW: 91.1 kg/inhab./yr (lowest value in Germany) - 25.3% organics (2021) Source: City of Wasserburg Am Inn website, October 2023 report and pamphlet	The charge for households is composed of two main elements: a flexible general part for RW and a PAYT for RW. There is no tariff for BW which has a fortnightly collection frequency. The flexible part for RW is based on the number and size of the bins selected by the user. The PAYT for RW is based on the number of collections and weight. The provided general collection frequency is monthly. The user does not have to pay for a minimum number of collections but a minimum weight of 5 kg per collection is charged. All the provided services are included in the variable part.	Fee structure including basic fee, fee according to emptying frequency and weight fee. **FEES FOR RESIDUAL WASTE** The residual waste fees are composed of a **basic fee**, an **emptying fee** and a **weight fee**. **Basic Fee** Applies to each residential and commercial unit on a property (as per Sections 1-7 of the Waste Fee Regulations). It is independent of the number and size of residual waste bins. Under certain conditions, a commercial business may apply to be exempt from the basic fee. 4.50 € per month **Emptying Fee** Applies to each emptying of the residual waste bin. The frequency of emptying can be determined by the user. Upon request, a fixed bi-weekly or weekly collection frequency can be ordered, resulting in exclusion from the PAYT scheme. Consequently, this increases the cost per collection to 6 € or 12 €, respectively. 2 € per emptying **Weight Fee** Applies to each kilogram of residual waste that is recorded by the weighing equipment on the collection vehicle. 0.43 € per kilogram

GERMANY		
Local entity / Main features	**Charge calculation**	**More info**

KEY IDEAS:

Charges in Germany are designed as follows:

- Pre-established charges, either a flat rate or based on the volume, number and type of bins (annual update): most municipalities only distinguish by the bin number and sizes ordered. Some municipalities only charge a service tariff for residual waste and not for bio-waste (the costs for bio-waste are covered within the residual waste tariff). As much as it is intended as a variable tariff scheme, the mechanism established to update the volume, type and number of bins needed is generally on an annual basis. Due to the additional fee to request the change, it minimises the incentive for an improved sorting, e.g., accompanied by a change to a smaller residual waste bin volume.
- PAYT per volume and/or weight: where PAYT is applied, it is always for residual waste, which may then be combined with no charge, a fixed service charge or PAYT for bio-waste. The main difference among PAYT schemes for residual waste is the range for the resident to save costs normally based on the number of minimum pick-up services included in the fixed part and the additional number of pick-up services (variable part) to be used throughout the year (Example: the provided general collection frequency is 26 times per year, i.e. fortnightly. Municipality A includes 13 collections and municipality B 20 collections in the fixed part). In case of a weight based PAYT, it is similar with a minimum weight that is included in the general part of the charge. Commonly, the weight fee for bio-waste is below the one for residual waste. PAYT charge is commonly applied for single and semi-detached houses where the bin can directly be connected to the user. Most multi-household buildings pay a fixed charge since all residents use the same bins that are collected each service day.

Other considerations on the different fee scheme combinations:

- The combination of PAYT for residual waste and no charge/fixed charge for bio-waste might cause contamination in bio-waste if users try to reduce the quantities of residual delivered to the service by using bio-waste bins.
- When PAYT is applied for both fractions the calculation method should be advantageous for bio-waste (its final service cost should be cheaper than residual waste) to incentivise bio-waste separation.

4.2.3.3 Fee-rebate schemes

Through the use of fees and rebates, fee-rebate (or feebate) systems apply fees to activities that are less environmentally friendly compared to the average. At the same time, activities considered more ecologically friendly receive rebates, making them more economically attractive. The more environmentally damaging an activity is the greater the fee, and vice versa. Activities with the average environmental performance are neither charged nor subsidised. Globally, fees and rebates cancel each other out, and therefore this tool is neutral for the budget of the administration that sets it up (apart from the rather limited administrative costs). This economic instrument can be applied to products and services but could also be applied in the area of waste management.

Most municipalities group themselves to manage solid wastes more efficiently within intercommunal entities, sharing collection services and treatment facilities (e.g. composting plants). In these associations of municipalities, costs are distributed according to some criteria (e.g. number of inhabitants or amount of waste entered to the shared facilities) which often do not provide sufficient incentives for good practices. In this context, a feebate system could be adequate to reward those municipalities making significant steps towards efficient waste management and targets achievement, whilst penalising the others, using the average values as a reference. Some indicators that could be used to define fees/rebates to stimulate separate collection of bio-waste could be per capita generation of bio-waste entering composting facilities or percentage of separate collection of bio-waste (in both cases, if possible, discounting impurities).

The articulation of this instrument was proposed theoretically, and it was suggested that the feebate (fb) was defined for each municipality (i) and waste treatment (in this case we assume that the feebates refer only to one treatment, i.e. composting) as a linear function of the difference between the per capita waste generation of the municipality and that of the association (Puig-Ventosa, 2004).

$$fb_i = n * \left(\frac{t_i}{pop_i} - \frac{\sum_{i=1}^{p} t_i}{\sum_{i=1}^{p} pop_i} \right) * pop_i$$

Where: t_i tonnes from the municipality *i* brought to a composting facility

pop_i population of municipality *i*

n constant defined for composting

If *n* is defined as a negative value, those municipalities with higher per capita waste collection of bio-waste will obtain a rebate, while the others would face a fee. Corrections of waste generation can be applied in cases of seasonal population or high concentration of large producers. Another reference indicator to be used is the quantity of residual waste per capita collected.

CASE 11: Fee-rebate scheme in the Metropolitan Area of Barcelona (ES)

A fee-rebate scheme, with some variations, was successfully applied in the Metropolitan Area of Barcelona from 2004 to 2017 in order to promote separate waste collection. The scheme had strong similarities with the feebate system presented in this section.

At that moment, households were charged according to their water consumption and type of property in which they were living with 12 possible tariffs depending on the combination of these two variables.

The idea was that any of the 12 basic tariffs applied was multiplied by a coefficient depending on the percentage of source separation achieved by the municipality, in relation to the average results in the metropolitan area. A coefficient above 1 means that the municipality is performing lower than average, resulting in higher charges for their citizens, and vice versa. The fee-rebate was calculated in the following way:

$$fb_i = 0{,}15 * \left(\frac{\frac{t_i}{pop_i}}{\frac{\sum_{i=1}^{p} t_i}{\sum_{i=1}^{p} pop_i}} - 1 \right)$$

The formula used the same notation as the one presented in this section. However, in this case, t_i referred to the annual amount of waste not collected separately (i.e. carried to landfills, incinerators or mechanical-biological treatment plants).

The final coefficient applied to the tariffs was calculated as: coefficient $t_i = 1 + fb_i$

Source: (Puig-Ventosa, 2006)

4.2.3.4 Treatment Facility variable gate fees

Description

Waste producers pay a gate fee to waste management companies for the treatment of their waste. The gate fee for composting and anaerobic digestion plants varies depending on the type of process, type and quality of bio-waste and location of the plant. It is influenced by several factors such as the cost of labour, the cost of energy, the cost of rejects treatment and the revenue for output product. For biogas production in AD plants, additional elements are included in the economic balance such as energy sales and economic incentives for green energy production (see section 4.2.5.2). In some cases, gate fees cannot be updated due to variations in cost factors and contract timeline.

The type and structure of bio-waste treatment gate fees can vary depending on the nature of the entities operating the facilities: public, public consociated entity, private or public-private partnership. In the case of separate organisations for collection and treatment, the municipality or district in charge of the collection (or producers using private management services) contracts the treatment provider with a pre-determined gate fee.

The quality of the bio-waste collected is an important element in biological treatment process design as well as in the calculation of gate fees. Bio-waste flows with high levels of impurities impact on the process and technology needed. This translates into higher operating costs. The main implications are the loss of treatment capacity and the need for a more complex and technological pre-treatment, thereby requiring the management of more reject flows. Additionally, impurities have a direct impact on the quality of the compost, notably the concentration of heavy metals (Cu, Pb, and Zn) (Rodrigues et al., 2020).

Effects on bio-waste

Variable gate fees based on the percentage of impurities can be applied to reflect the additional treatment costs related to low-quality bio-waste. The application of a range of gate fees based on the quality of the material entering the facility (for instance, according to the % of impurities of the bio-waste to be treated) incentivises higher quality of the flow and lower costs incurred by the defined variable tariff.

Design aspects

- Gate fees should be more expensive for residual waste than bio-waste. The inclusion of any landfill or incineration tax applied to treatment rejects can also modify the final gate fee value.
- There should be a threshold of impurities (measured in percentage) for accepting bio-waste flows. Exceeding this value implies the possibility to treat contaminated bio-waste as residual waste through the corresponding treatment line or facility. The limits can also be established for specific types of impurities such as plastics.
- Typical ranges applied according to the level of impurities:
    - Lower cost ranges under 3-5% of impurities,
    - Medium cost ranges between 5-10%,
    - High cost above 10% and
    - Above 10% or 15% the flows should not be accepted.

CASE 12: Variable gate fees in Catalonia (ES)

The majority of the biological treatment facilities in Catalonia establish a range of fees based on the percentage of impurities of the incoming bio-waste. An example is included in the following table:

Table 8. Metropolitan Area of Barcelona, public prices for bio-waste treatment 2022

Service	Class	Gate fee t 2020
Treatment of biowaste (Anaerobic digestion + composting of digestate produced)	Delivery of organic matter with a content of impurities equal to or less than 3%	67.00 €/t
	Delivery of organic matter with a content of impurities more than 3% and less than 10%	73.00 €/t
	Delivery of organic matter with a content of impurities more than 10% and less than 15%	83.00 €/t
	Delivery of organic matter with a content of impurities more than 15% and less than 20%	98.00 €/t
	Flows with more than 20% of impurities are not accepted and are treated as residual fraction	-

Source: (Metropolitan Area of Barcelona, 2023)

4.2.4 Tradable Permit Systems

Although cap and trade schemes are widely used in environmental policy, they are seldom applied in the field of waste management. Trade permit schemes set a cap or quota for pollution, allowing only permit holders to pollute according to the quantity of permits they hold. Examples of this instrument are the Landfill Allowance Trading Scheme (LATS) applied in UK as well as the EU Emissions Trading System.

4.2.4.1 Landfill Allowance Trading Scheme (LATS)

Launched in 2004, LATS drove landfill diversion targets. Through LATS, allowances for landfilling biodegradable MSW were allocated to local authorities. In this scheme, local authorities can opt in to bank, borrow, or trade allowances. Annually, the quantity of landfill allowances disbursed was reduced based on the landfill diversion objectives.

LATS was used in the United Kingdom as an instrument to comply with the targets on reduction of biodegradable municipal waste stipulated in Directive 1999/31/EC of the European Parliament and of the Council of 26 April 1999 on the landfill of waste. In this case, allowances referred to biodegradable municipal waste. By 2005 the system had successful results: the reduction of biodegradable municipal waste landfilled was around 7% annually during the period 2005/06–2011/12 and 4.2% during the previous period. Nevertheless, the scheme was discontinued after the completion of the 2012/13 targets, since it was considered redundant with the UK Landfill Tax (Calaf-Forn et al., 2014).

4.2.4.2 EU Emission Trading System (EU-ETS)

Based on the cap-and-trade principle, the EU ETS sets limits on the total amount of greenhouse gases that can be emitted by the facilities and operators covered by the system. In order to ensure that emissions decrease over time, the cap is reduced annually in line with the EU's climate target (Vähk & Schägg, 2021).

The cap is expressed in emission allowances, where one allowance gives the right to emit one tonne of CO_2eq (carbon dioxide equivalent). Each year, companies must align allowances with emissions. Otherwise, fines are imposed. Companies can buy or trade allowances on the EU carbon market. If an installation or operator reduces their emissions, the spare allowances can be used in the future or sold.

Although emissions from waste incineration are already included in the ETS, municipal solid waste (MSW) incineration plants are currently exempted (more than 500 facilities). The voluntary inclusion of MSW incinerators under ETS Article 24 only has been incorporated by Denmark and Sweden (Vähk & Schägg, 2021), as well as by Lithuania (VšĮ "Žiedinė ekonomika," 2019).

The inclusion of lower hierarchy options like municipal waste incineration installations in the EU ETS would contribute to the circular economy by encouraging upper hierarchy options while also contributing to economy-wide decarbonisation. Since recycling and regeneration activities are already covered by the EU ETS, the inclusion of municipal waste incineration installations would reinforce incentives for sustainable management of waste, and especially bio-waste, in line with the waste hierarchy (European Commission, 2022).

The ENVI committee is proposing to include in ETS scheme municipal waste incinerators from 2028 but before, in 2026, a review of the related impacts and potential measures will be conducted. For more details on this topic, see **LIFE BIOBEST D5.2 Policy brief**.

4.2.5 Subsidies

Subsidies include any form of explicit financial assistance to target stakeholder such as grants, soft loans, tax breaks, accelerated depreciation, etc. (Hogg et al., 2011). In the waste management sector, subsidies may be used to encourage better waste management or waste reduction and may take the form of direct subsidies or tax exemptions.

EU funds and different EU subsidies programs, in the recent years, are excluding residual waste management and treatment activities in favor of economic support to separate collection and recycling along with prevention and reuse. Complementarily, the DNSH principle ("do not significantly harm") defined in the EU taxonomy (see also section 4.2.6) excludes any support to projects with negative effects related to six environmental objectives, one of them focused on circular economy which penalises incineration and elimination activities together with climate change objective for greenhouse gasses mitigation.

4.2.5.1 Subsidies for bio-waste collection or facilities implementation or improvements

Subsidies are key instruments to contribute and facilitate the introduction or improvement of bio-waste collection systems and treatment facilities. Bio-waste management subsidies provided by regional or MS authorities can address different purposes:

- Introduce bio-waste management. Cover part of or total investment needed to start with the collection system including elements such as campaigns, bins, compostable bags, composters, trucks, identification technology, etc.
- Improve the existing collection model. Cover part of or total investment needed to upgrade existing collection systems including elements such as identification technology, reminders in communication campaigns, replace old equipment, etc.
- Implement or update treatment facilities. Cover part of or total investment needed to design, construct and test new facilities or update and improve the existing processes with new or more advanced equipment, more capacity, etc.
- Quality compost production. Provide economic help to those activities producing quality compost covering part of the costs for treatment and marketing activities.
- Support pilot projects and innovation. Cover part of or total costs for the deployment of pilot projects related to new collection schemes or treatment technology or additional instruments such as PAYT schemes or innovative communication and engagement methods.

The design and management of the subsidies should incorporate the following criteria:

- Subsidies related to waste or bio-waste management must target local authorities with waste management competencies, facility management companies or commercial producers starting separation at source.
- The terms of reference of the subsidies must establish the specifications and destinations of the funds in terms of management model and technologies, eligible materials, investments, and accompanying activities. One of the main criteria should be the project's capacity to increase quality and quantity bio-waste recycling.
- Human resources necessary for the distribution, implementation and administrative justification of the funds should also be eligible.
- Subsidies must follow public expenditure management principles. A proper monitoring of the outcomes of the economic flow application must be deployed in terms of type of expenses, economic efficiency, actions implemented and their results.

CASE 13: Annual grants from Catalonia Regional Government (ES)

Since 2005, the Waste Agency of Catalonia has provided annual grants for bio-waste separate collection implementation and improvements especially addressed to local entities but also to commercial activities (implementing separate collection in their premises). The following actions referring to municipal and similar bio-waste projects are financed:

- Separate collection of bio-waste (organic fraction and vegetable fraction) and
- Self-composting projects.

The following materials and activities are financed:

- Diagnosis and action plans,
- Elements for selective collection (bins, containers, compostable bags, etc.),
- Elements for home composting projects,
- Complementary equipment to facilitate collection and treatment (including user identification technology) and
- Advisory, communication, training and information actions.

The latest grants provided in Catalonia came from the NextGenerationEU funds. These funds are being provided to MS in line with their national Recovery and Resilience plans – the roadmaps to reforms and investments aimed to make EU economies greener, digital and more resilient. Plans includes investments for circular economy where bio-waste collection and treatment are generally a key topic to be tackled (EC Directorate-General for Budget, 2022).

In the case of Spain, NextGenerationEU funds are transferred to autonomous communities to provide subsidies within the "Plan to support the implementation of waste regulations and the promotion of the circular economy". The financing lines of action linked to bio-waste are the implementation of new separate collections and improvement of existing ones, and the construction and improvement of specific facilities for the treatment of bio-waste collected separately.

Source: Waste Agency of Catalonia website, MITERD website

4.2.5.2 Subsidies for biogas/biomethane

Description

The implementation of adequate support measures is essential for the further development of biomethane. Several EU MS have implemented such subsidies or incentives schemes.

Subsidies can help realign finances to make biogas and biomethane more affordable and competitive compared to other forms of energy associated to higher environmental externalities. This indirectly incentivises the collection and treatment of bio-waste feedstocks. The value and duration of operational support for biomethane differs largely across the different countries and regions.

Current Application

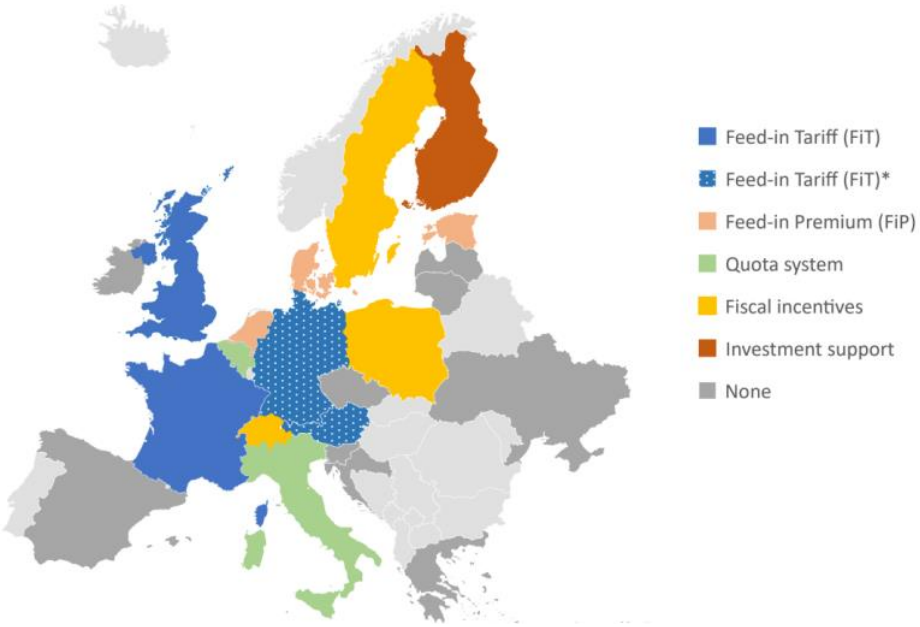
For many countries, upgrades from biogas to biomethane are an attractive alternative for existing biogas plants, as it can help decarbonise the natural gas grid. This has led to a shift from subsidies for biogas towards subsidies for biomethane. Table 9 relays the economic support schemes deployed for renewable sources (Couture et al., 2010; Decorte et al., 2020). Figure 18 shows the application of these support schemes in the EU (Decorte et al., 2020).

Table 9. Types of support schemes for renewable gases

Type of Tariff	Description
Feed-in Tariff	Feed-in tariff is a technology-specific support scheme providing a technology specific remuneration per unit of renewable energy.
Feed-in Premium	A Feed-in premium is a bonus to be paid above the prevailing, pre-specified benchmark market price. It is a technology-specific subsidy level per unit of renewable energy at a pre-set, fixed or floating rate.
Quota/green certificates scheme	In a quota/GC system, the production of renewable energy is encouraged by an obligatory target stating a specific share of renewable energy in the mix of producers, consumers or distributors. Renewable energy generators benefit by selling their energy to the grid at market price and by selling certificates on the green certificates market.
Fiscal incentives	Tax exemptions or reductions may be an additional support scheme.

Source: (Couture et al., 2010; Decorte et al., 2020)

Figure 18. Support schemes for renewable gases in place per country



Source: Mapping the state of play of renewable gases in Europe (Decorte et al., 2020)

*In Austria and Germany, the support schemes apply only if the end-use of the biomethane is electricity production. In Belgium, the support scheme is only applicable in Wallonia.

CASE 14: Biogas Incentives in Sweden

Sweden provides fiscal incentives and tax exemptions for renewable biogas and biomethane. Biomethane imported to Sweden can be double subsidised. This has led to the consumption of more than double the amount of biomethane produced. This is due to Sweden's consumption-focused incentives, whereas most MS tend to subsidise the production or injection of biomethane.

Source: Mapping the state of play of renewable gases in Europe (Decorte et al., 2020)

4.2.5.3 Rewarding Schemes

A reward system is an instrument whereby waste producers who achieve specific results or performance in terms of separate collection and service usage receive incentives. These incentives can be either monetary such as bonuses, discount vouchers or social coins; or non-monetary such as points to be exchanged for municipal services, public transport tickets, etc.

The primary purpose of a reward system is to motivate waste producers by providing positive reinforcement for their efforts and proper participation.

CASE 15: Ecopoints in Cascais (PT)

City Points Cascais allows citizens to win points by participating in predefined actions. Users can win points in activities related to waste management by dropping off waste at recycling points, recycling beverage containers in dedicated reverse vending machines, reusing (second hand markets), etc. City Points instrument was applied in the pilot project within RethinkWaste EU LIFE Project to incentivise the user participation in the new bio-waste separate collection with closed electronic containers. Pilot project users received an electronic key to access the bins as well as bags to separate organic fraction.

The list of point winning actions is frequently updated via the City Points Cascais app. A certain number of points can be exchanged for vouchers for discounts in services, books and workshops, sustainable products and access to events and museums.

Figure 19. Examples of actions to earn points in the City Points Cascais reward system

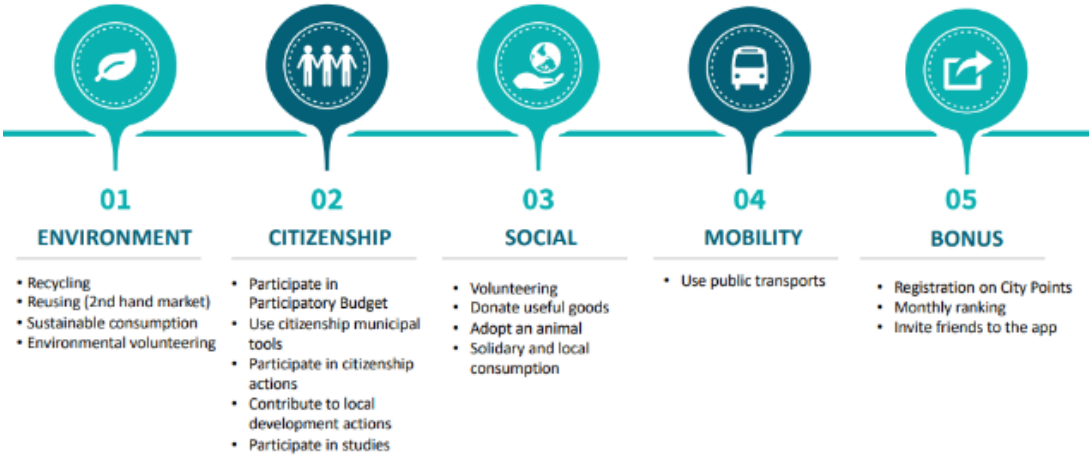


Figure 20. Example of prizes for participation in City Points Cascais reward system

Source: Cascais Ambiente, Waste4Think City Points Program website

CASE 16: Tropaverde's Rewarding scheme in Galicia (ES)

Tropaverde is a web platform that aims to promote recycling and environmental responsibility among citizens directly rewarding good environmental actions. This platform is operating in Galicia. When residents bring specific waste fractions such as textiles, cooking oil, and WEEE (Waste from Electrical and Electronic Equipment) to municipal civic amenity sites or recycling centres, they receive a voucher with a code. By introducing the code on the Tropaverde website, residents are rewarded points (often 30 or 50) as long as they reached a minimum quantity of for each type of fraction (see Table 10).

Points can be used to purchase services and goods at local businesses such as restaurants, retailers and sporting facilities. The services offered on the website (meals, massages, tickets to events) cost a few hundred points, thereby encouraging repeated deliveries of recyclable fractions.

Table 10. Minimum quantities for waste fractions delivered to reward system in the Tropaverde scheme

WASTE FRACTION	MINIMUM QUANTITY
Used cooking oil	1L
Paper and cardboard	1 large paper bag
Batteries	10 units
Toners	3 units
Clothes	6 large garments or 12 small garments
WEEE	0.5 kg
Plastic caps	1 full bag

Source: REthinkWASTE: Collection of experiences about pay as you throw (PAYT) and know as you throw (KAYT) (Waste4Think, 2020; Lisai et al., 2021), Tropaverde website.

4.2.6 Other instruments

4.2.6.1 Extended Producer Responsibility (EPR)

Extended Producer Responsibility (EPR) is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. An EPR policy is characterised by (OECD, 2016):

- The shifting of responsibility for the end-of-life management (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities; and
- The provision of incentives to producers to take into account environmental considerations when designing their products.

Food products are one of the main flows that are not covered by an EPR scheme, leading to a lack of economic and management support for leftovers and bio-waste. A specific analysis would be key to determine the necessity and potential configuration of an EPR system. In the absence of an EPR, to foster the proper management and compensate its economic balance, food waste reduction and bio-waste flow management must be supported by other financial and complementary instruments.

In some EU MS, EPR organizations collect fees from producers introducing products with compostable packaging on the market. With the exception of Italy, see the case box below, the fees are not used to support the management of compostable packaging when this material arrives at biological treatment facilities.

CASE 17: EPR for compostable packaging in Italy

Biorepack is the Italian EPR scheme collecting the fee for compostable plastic packaging released on the Italian market and collected together with food waste. The fee is used to support the organics recycling sector in programmes to help remove contamination from organic streams and also in funding long term public education programmes.

In 2022, Biorepack managed about 52,000 tons of compostable plastic packaging in Italy (covering about 65% of the total population). Economically speaking, this supports the collection, transport and recycling of these items at industrial compost and combined biogas and composting facilities.

Source: (Gilbert & Ricci-Jürgensen, 2023)

4.2.6.2 Taxonomy

The EU taxonomy criteria for economic activities is a part of the EU's plan to increase sustainable investment and the implementation of the European Green Deal. This classification system defines the technical criteria that must be complied with in order for an activity to be considered sustainable, thereby establishing a common definition of the environmentally sustainable economic activities.

The EU taxonomy also considers bio-waste management as a key activity, as seen in Annex II of the EU Taxonomy Regulation, Transition to a circular economy. Included are the following activities related to the collection and treatment of bio-waste: collection and

transport of non-hazardous and hazardous waste & recovery of bio-waste by AD or composting (European Commission, 2021).

Nevertheless, as discussed in **LIFE BIOBEST D5.2 Policy brief**, it is necessary to reconsider some aspects of bio-waste management in the EU taxonomy. This includes the revision of unnecessary and burdensome technical criteria that complicate support in the form of green investments for bio-waste recovery through composting and AD (European Compost Network, 2023).

5 Bio-waste management economic balance

5.1 Parameters involved in the economic balance of bio-waste management

The management of bio-waste involves different types of costs that can be differentiated for each management stage. It is important to consider and include in the economic balance all the necessary activities and related expenses to obtain a clear overview, optimise the balance and properly design all the investments, charges/fees, and other economic instrument necessary to support and incentivise the proper management and reach the desirable results. Any type of income or revenue must be added to the economic balance to obtain the net cost results.

In Table 11, all the costs related to each step of the management chain and activity developed are classified and described.

Table 11. Cost concept involved in bio-waste management in each stage of the management chain

Stages	Cost Concepts	CAPEX	OPEX
General	Administration internal human resources for policy enforcement, accompanying and supervising local entities, local management deployment, etc.		**X**
	Information management systems of the administration for management results/statistical data monitoring. Including quantities delivered to facilities and the outputs and their final destination (for public and private facilities).	**X**	**X**
	Consultancy services to support the administration.		**X**
	Administration control and supervision of the performance of private collection for commercial or similar bio-waste producers.		**X**
	Administration management of taxes, charges/fees, subsidies and other economic instruments along with penalties. Consideration of incomes from the charges/fees payment or from any other type of instruments such us tax refund systems or subsidies.		**X**
Implementation	Collection material for users: compostable bags or liners, vented caddies, bins, containers, hangers, technological elements, information materials, etc.	**X**	
	Implementation campaign		**X**
Collection service	Collection service: staff, fuel, collection vehicles, maintenance, cleaning, technology management and maintenance, etc.	**X**	**X**

Stages	Cost Concepts	CAPEX	OPEX
Monitoring and continuous communication	User identification and service monitoring technologies: user identification elements, bins tags, portable or on-board tags reader systems, monitoring platform, management staff, maintenance, etc.	X	X
	Continuous communication services and inspections.		X
	User collection and identification material for replacements and new users.	X	
Treatment in situ/home-composting	Composter, aerators, other equipment, site preparation, structuring material, etc.	X	
	Continuous communication and monitoring services (users and process performance).		X
	Compost analysis and marketing/distribution.		X
Treatment and outputs management	Treatment facilities construction or improvement/updates.	X	
	Treatment facility operation: staff, supplies, maintenance, final treatment of rejects, etc.		X
	Facility data monitoring: inputs, batches and outputs, fees and costs/incomes, etc. tracking and control systems and staff.	X	X
	Bio-waste characterisation and entrance control.		X
	Compost/digestate analysis and marketing/distribution. Other products marketing/distribution. Consider revenues from the sale of outputs.		X

Table note: Operational Expenditures (OPEX) and Capital Expenditures (CAPEX).

Source: Own elaboration.

5.2 Economic KPIs proposed by LIFE BIOBEST

LIFE BIOBEST has defined a set of Key Performance Indicators (KPIs) that are considered reference indicators that facilitate the assessment of the bio-waste management situation of a territory and the design of future strategies. They are presented in **LIFE BIOBEST D2.1 Improved and homogenised datasets on municipal bio-waste management in the EU**. Table 12 presents the four KPIs related to the bio-waste management economic balance, as a reference of specific indicators to evaluate the economic results of the collection and treatment.

Table 12. LIFE BIOBEST KPIs related to the bio-waste management economic balance and results

KPI code	KPI name	KPI concept/purpose	Observations
Qualitative KPI10	**Ratio between collection costs (€) for bio-waste vs. collection costs for mixed/residual MSW (no units as it is a division)**	Compares the cost for a municipality to collect bio-waste with the one for collecting mixed/residual MSW.	Allows to assess the cost efficiency of the two main schemes for MSW collection. Cost shall include Value Added Taxes (VAT) if VAT is a cost for local authorities. Express result as a fraction (e.g. 4/2).
Quantitative KPI14	**Ratio between treatment costs (€) for bio-waste collected separately and cost for treating mixed /residual MSW (no units as it is a division)**	Highlights the economic viability of bio-waste separately collected and sent to recycling compared to residual waste treatment or/and disposal.	KPI to be assessed starting from the gate fees in €/tonne for the two treatment options considered. The cost must include disposal taxes. Express result as a fraction (e.g. 2/5).
Quantitative KPI15	**Average price for compost/digestate sold (€/t)**	Describes the average price of a compost/digestate product specific for a treatment facility.	To be assessed per facility. Average can be used on a regional level.
Quantitative KPI16	**Premium price for compost/digestate sold (€/t)**	Describes the premium (higher) price of a compost/digestate product specific for a treatment facility.	To be assessed per facility. Average can be used on a regional level.

Source: LIFE BIOBEST D2.1 Improved and homogenised datasets on municipal bio-waste management in the EU.

For the assessment of KPIs applied to best practice cases, please see Annex 2.

6 Conclusions

This guideline gives an overview of governance and economic instruments crucial to the improvement of bio-waste management. The application of these instruments facilitates the prevention, collection, sustainable disposal and valorisation of bio-waste by leveraging policy and economic balances. The deployment of economic instruments to rebalance the costs and incentivise effective waste management are imperative.

6.1 Recommendations related to governance

Governments in every step of the multi-level governance systems must align their priorities to overcome low environmental interest and to find ways to incentivise bio-waste collection instead of residual waste. To do this requires organization, capacity, transparency and public confidence, and good data management.

Core lines of action include:

- Incorporate strategic waste management plans on the national, regional, and municipal level to reinforce and streamline the regulatory framework, adding key specificities unique to the respective jurisdiction.
- Solvent financial capacity supported by grants, subsidies, and loans to encourage investment in bio-waste management and innovation in the field.
- Governments must be capable of specifying the criteria with follow-up mechanisms and establishing the destinations of EU funds in terms of management model and the development of waste infrastructure that supports improving bio-waste prevention and recycling performance.
- Adequate bio-waste treatment infrastructure and investments are key. Planned or existing treatment infrastructure capacity must match the planned volumes of bio-waste generation and target collected amounts, favouring the proximity principle.
- Ensure the provision of all necessary processes by clearly defining roles, responsibilities and quantity/quality objectives in waste related private-public partnerships and public tendering.
- Utilise public participation and participatory decision-making in policy design and implementation. Public confidence and acceptability depend on public perceptions about the effectiveness of the policy, its distributional effects, and its local appropriateness.
- Deploy well-designed campaigns with sufficient resources for the implementation of bio-waste collection and continuous user communication and monitoring services. Provide materials for separation at the source.
- Implement training and empowerment actions for politicians, technicians, agricultural producers and other key stakeholders to improve skillset for bio-waste management systems.

- Data management systems on the local, regional, national and EU level must be connected and are essential for monitoring implementation results (including service coverage, quality/quantity and objective achievements), composition of the residual fraction, infrastructural capacity and results of disposal taxes.
- User participation, incident monitoring and related indicators are necessary for local authorities to evaluate and improve collection and enforcement.
- Control the quality at the service delivery point and implement periodic bio-waste characterisations upon entrance to bio-waste facilities to minimise impurities at the source.

6.2 Recommendations related to economic instruments

Economic instruments can be effective policy tools in the prevention, minimisation and sound management of bio-waste. Furthermore, economic instruments can be useful in encouraging the behavioural changes necessary to achieve waste policy objectives (OECD, 2019). In some cases, these instruments are a decisive tool to mobilise authorities and producers to improve bio-waste management.

Food products are one of the main flows that are not covered by an EPR scheme. In the absence of these kinds of schemes, to foster the proper management and compensate its economic balance, food waste reduction and bio-waste flow management must be supported by other financial and complementary instruments.

Core lines of action include:

- Promote disposal taxes on incinerators and landfills and re-evaluate the effectiveness of current ones, increasing or modulating taxes to rebalance the economic viability of bio-waste management.
- Complement disposal taxes with tax refund or premium system that return the tax revenue to the local entities according to the quantity and quality of the bio-waste collected and treated.
- Include measures or economic instruments in respective sectorial laws to enhance the marketability of biogas/biomethane and compost/digestate. Promote the final uses and the supply chain of these outputs.
- Include in national/regional waste laws the obligation for local authorities to apply waste charges that cover the total cost of waste management services.
- Promote and implement PAYT or variable charges schemes based on participation in the separate collection services and number of set-outs for residual waste. This type of charges can be included in waste laws as a compulsory measure to extend their implementation. Data recording and management should guarantee the integrity and quality of the information and the compliance with personal data protection legislation. The array of examples included in this report provide various

possible approaches that may fit various contexts and may include a certain varying degree of complexity, efficacy and simplification.

- Promote the application of variable gate fees based on the quality of the input bio-waste in biological treatment facilities. Complement these fees with the establishment of impurities limits to accept the collected flows.
- 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. The inclusion of lower hierarchy options like municipal waste incineration installations in the EU ETS would contribute to the circular economy by encouraging upper hierarchy options.
- Subsidies are key instruments to facilitate the introduction or improvement of bio-waste collection systems and treatment facilities. For a more efficient and well targeted subsidies, it is key to 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. The EU provides a varied set of possible funding mechanisms, framed by the EU Taxonomy, that may fit different projects and necessities, and which exclude funds to landfilling and incineration, thereby directing all funds to activities on separation, composting, recycling and reuse.
- Optimised collection models and the continuous monitoring and improvement of the service will result in a more advantageous economic balance and savings. Shared and consociated bio-waste collection services or treatment facilities under economic scale efficiency models is a key instrument especially addressed to smaller local entities.

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Annex 1: Assessment of the main economic instruments

Table 13. Quality assessment of taxes, fees, charges and subsidies instruments

Assessment parameters	Landfill/Incinerator taxes	Tax refund scheme	Variable collection/management charges	Variable gate fees
Fractions	Residual waste/rejects	Bio-waste	Bio-waste and residual waste	Bio-waste
Step in the chain (point of intervention)	Final treatment	Collection, treatment	Collection	Treatment
Targets	Local entities/private managers	Local entities/private managers	Waste producers (citizens and economic activities)	Local entities, private collection managers
Promoters	National, regional authorities	National, regional authorities	Local entities/private collection companies	Regional authorities/public and private facility managers
Legislative change (Mandatory/voluntary)	Mandatory by law	Introduced by law	Mandatory by ordinance/public price/private contract with private managers; an obligation to introduce it may be stipulated by national or regional authorities	Mandatory by ordinance/public price/private contract with private managers
Data source	Register of tonnes entering landfill and incinerator by local entity or private producer	Register of tonnes of bio-waste separately collected/treated/self-composted	Register of quantities/volumes/number of set-outs of residual and bio-waste	Register of tonnes of bio-waste treated
Data Accessibility/quality	Transfer the information from the facility operator database to a central database of the promoting authorities or data declarations by the operator. As	Access to local entity collection data and facility operator database by promoting authorities. It is optimal to use only data registered by	Local entity (directly or by public contract) or private collection operator data. Importance of the register quality, integrity, personal data	Facility operator own data of tonnes delivered and quality control (visual inspection, characterisation, etc.)

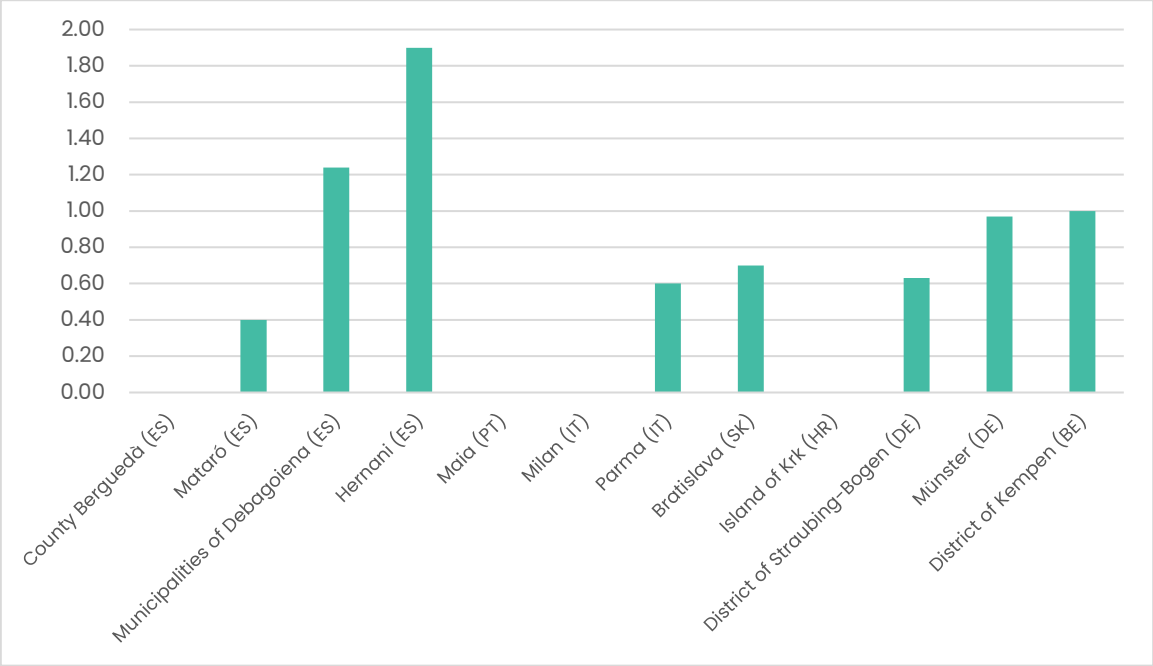
Assessment parameters	Landfill/Incinerator taxes	Tax refund scheme	Variable collection/management charges	Variable gate fees
	data is also used to pay gate fees, it should be consistent.	treatment facilities. As data is also used to pay gate fees, it should be consistent.	protection, and the reliability of ICTs used.	
Effects on waste economic balance	Increase of the final cost of landfill and incinerators so incentive to divert recycling fractions, especially bio-waste	Any type of refund (related to a tax) can be used to cover bio-waste collection and treatment cost or invest in the improvement of the related service. The application of specific refunds based on parameters related to bio-waste (quantity and quality) strongly promote separate bio-waste management.	Charge reduction for those users delivering more bio-waste (SAYT). Charge increase for those users delivering more residual waste (PAYT). The variable tariff calculation should be defined in a balanced way, so as to compensate the bonus with the increase of tariff for users not participating in separate collection.	Gate fees based on the % of impurities in the bio-waste, will imply the higher the quality of the input flow, the less the cost charged, which is a clear economic signal at treatment stage that will be reflected in the final management balance of this fraction.
Effects on bio-waste quantity	Incentive to increase bio-waste collected quantities as the quantity of residual waste will directly decrease	In case of refunds for concepts related to bio-waste there is a clear incentive to increase the collected quantities.	Incentive to separate at source bio-waste in case of PAYT for residual or SAYT for bio-waste. Incentive for self-composting in case of fee reduction for this activity.	No direct effect on quantity
Effects on bio-waste quality	No direct effect on quality	In case of refunds for concepts related to bio-waste including quality thresholds or correction coefficients based on % of impurities, there is a clear incentive to increase the quality of collected bio-waste.	No direct effect on quality. But for variable fees implemented with D-t-D systems usually there is control of the deliveries, so bio-waste with high levels of impurities is not collected and therefore, registered as residual waste.	Incentive to control and improve the purity of the bio-waste flow in the collection stage.

Assessment parameters	Landfill/Incinerator taxes	Tax refund scheme	Variable collection/management charges	Variable gate fees
Effects on producers' awareness/participation	Tax cost should be transferred to producers via increasing management fees. Incentive to separate more at source, especially in case of variable charges.	Tax refund income should be transferred to producers via reducing management fees. Incentive to separate more at source, especially in case of variable charges.	Direct incentive to participate in bio-waste separation at source, especially in the case of SAYT systems for participation in bio-waste collection.	The control and improvement of the purity of bio-waste in the collection stage is translated in communication campaigns and more efficient model implementation so the participation and proper selection of the user is encouraged.
Political acceptance	High acceptance, driver to comply with legislation, its application is very extended.	High acceptance, driver to comply with legislation and to obtain more advantageous economic balance	Medium acceptance, driver to comply with legislation but increasing of local waste management charges for users with bad performance or if the charge revision involves including all the real costs is not desired by some politicians, especially in election periods.	Medium acceptance, driver to comply with legislation but may increase the cost of bio-waste in case of no efficient models with low quality.
Management tasks/costs	Medium management complexity/cost. Administrative costs to collect and manage data (tonnes, taxpayers register, etc.) and levy the tax amounts. The tax payment can be delegated to facility managers.	Medium management complexity/cost. Administrative costs to collect and manage data (tonnes, taxpayers register, calculate the amounts refunded, etc.) and payback process.	Hight management complexity/cost. ID technology and ICT cost, users and collection data management, administrative cost	Low management complexity/cost. ICT cost, users and input flow data management, quality control cost, administrative cost

Annex 2: Complementary information about the bio-waste economic KPIs assessment

Considering the information collected and KPIs calculated for a list of selected bio-waste management Best Practices within the **LIFE BIOBEST D3.1 Guideline on separate collection**, the results of the main KPIs available for each BPs are shown and discussed in the graphs below. In Figure 21 and Figure 22, results are consolidated and assessed to demonstrate that bio-waste collection and treatment can be economically favourable in comparison with residual waste management. In Figure 23, the market prices applicable for compost/digestate are also evaluated.

Figure 21. Ratio bio-waste/residual waste collection cost

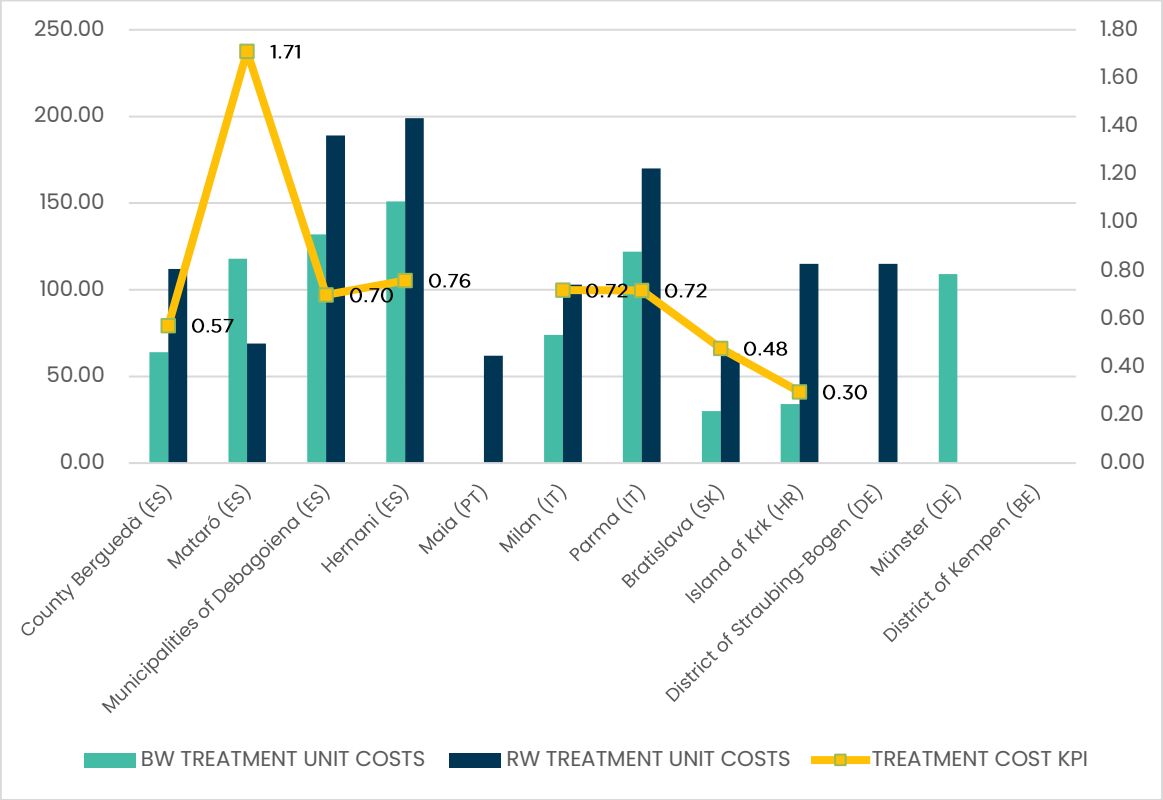


Source: Own elaboration

The KPI of the *Ratio between collection costs for bio-waste vs. collection costs for mixed/residual waste* compares the cost to collect bio-waste with the cost for residual waste to verify whether bio-waste collection is economically advantageous for the local entity. The results below "1" indicate that bio-waste collection is cheaper than residual waste and results above "1" show the contrary. For this KPIs, the BPs selected obtain the following results:

- KPI<1 for 4 cases: Mataró, Parma, Bratislava, District of Straubing-Bogen.
- KPI ≈ 1 for 2 cases: Münster and District of Kempen (ratio of BW vs RW collection cost are balanced).
- KPI>1 for 2 cases: Municipalities of Debagoiena, Hernani.

Figure 22.Treatment cost KPI and bio-waste vs. residual waste unit treatment cost (€/t)

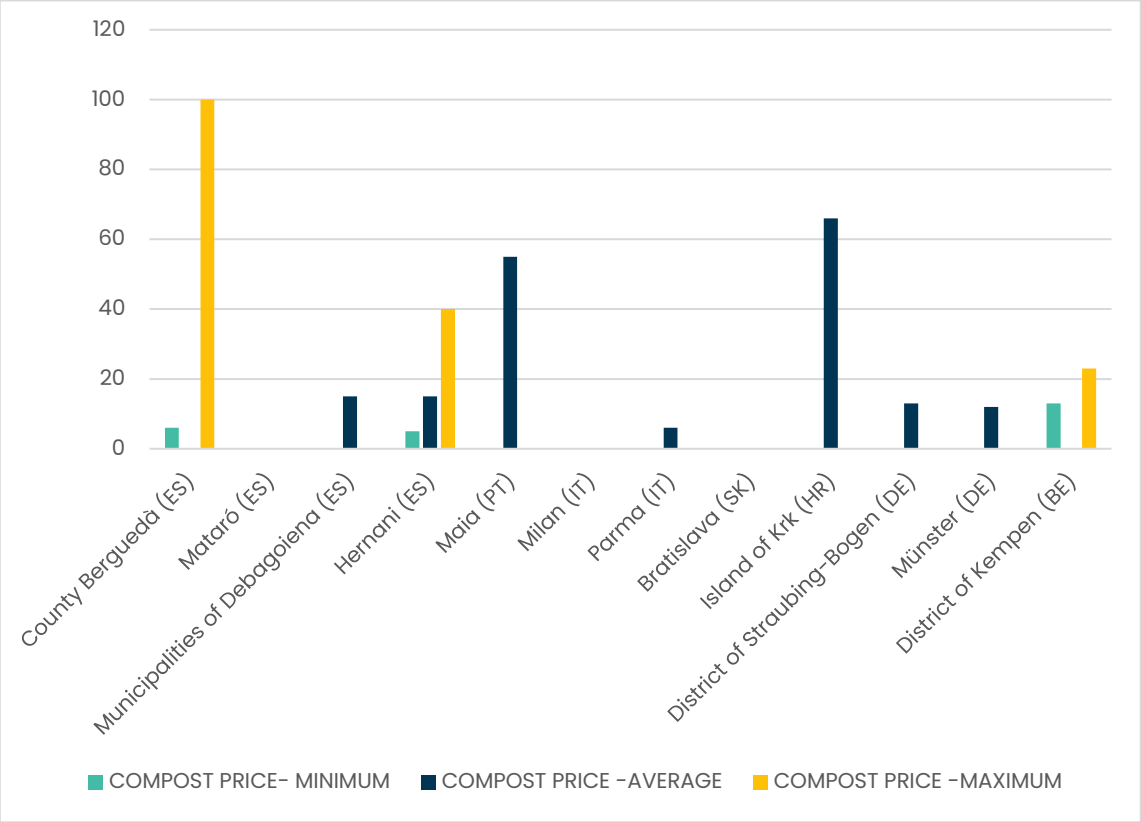


Source: Own elaboration

The KPI of the *Ratio between treatment cost for bio-waste collected separately and cost for treating mixed /residual waste* (€/t) makes it possible to compare the treatment unit cost for bio-waste with the cost for residual waste to verify whether biological treatment for source separated bio-waste is economically advantageous for the local entity. Results with cheaper unit cost for bio-waste are desirable and contribute to the economic viability of the separate collection and management. For this KPIs, the BPs selected obtain the following results:

- KPI<1 and BW unit cost < RW unit cost for 7 cases: County of Berguedà, Municipalities of Debagoiena, Hernani, Milan, Parma, Bratislava, Island of Krk.
- KPI>1 and BW unit cost > RW unit cost for 1 case: Mataró.

Figure 23.Compost price (maximum, average, minimum price) €/t



The KPI of the *Price for compost/digestate sold (€/t)* shows the level of value in the marked of this biological process product. Results with high and medium prices are the desirable ones that contribute to the economic viability of the biological treatment process and consequently make the separate collection and management more economically advantageous for the local entity.

- High prices for 4 cases: County of Berguedà, Hernani, Maia, Island of Krk.
- Medium price for 1 case: District of Kempen.
- Low prices for 4 cases: Municipalities of Debagoiena, Parma, Münster, District of Straubing-Bogen.

Data was not available for a few cases, due to the fact bio-waste is shipped to a private site (which may not like to disclose the market price of outputs) or there were no consolidated datasets for the municipal facility or the public waste company.

Detailed information for the original data of each BP is provided in Table 14 together with the related assessment of the KPIs.

Table 14. Bio-waste economic KPIs assessment of LIFE BIOBEST selected BPs

BPs Cases	RATIO BW/RW COLLECTION COSTS	BW/KW vs RW TREATMENT UNIT COSTS	COMPOST PRICE	Assessment
Berguedà County (ES) 39,772 inhab. (2020), 33.5 inhab./km² D-t-D (90% inhab.) and bring points with community composters (10% inhab.) SC rate: 70% (2022) KW+GW: 125 kg/inhab./yr (2020)	n/D	**BW 64 €/t (the fee varies based on impurities) (2022)** RW 47 €/t plus landfill tax (65.3 €/t) (2022)	**Maximum price 100 €/t** (bagged in 50 litre sacks), minimum 6€/t for compost in bulk	○ Landfill tax increases the cost of RW treatment so BW is economically advantageous ○ Compost produced has high market price for bagged format, in bulk selling has low market price ○ Catalan disposal tax refund system compensates part of the BW costs
Mataró (ES) 128,956 inhab. (2022), 5,731 inhab./km² Open bilateral load R-C D-t-D residential outskirts (2% inhab.), Mobile bring points with Containers with controlled access -city centre (5% inhab.) SC rate: 34% (2020, before new individualised models) KW: 42 kg/inhab./yr (2020) KW in D-t-D=97 kg/inhab/yr	**0.4 (2022)**	KW 118 €/t (82 € base fee+36 € extra fee for % of impurities for KW) (2022) **RW 69 €/t (the fee includes the incineration tax) (2022)**	**For free**	○ The ratio of BW vs RW collection cost is advantageous for BW. ○ The RW treatment cost for the incinerator is cheaper than BW composting so this penalises BW balance. ○ Catalan disposal tax refund system compensates part of the BW costs (34 €/t treated), which compensates high treatment cost for BW. ○ GW is treated for free. ○ Compost produced has no market price, this does not benefit the treatment facility economic balance.
Municipalities of Debagoiena (ES) 62,888 inhab. (2022), 183 inhab./km² D-t-D in 3 municipalities and R-C in 5 municipalities SC rate: 77% (2020) KW: 97 kg/inhab./yr (2020)	**1.24**	**132.39 €/t (subsidized by 30% based on the relation between the amount of RW and BW)** 189.13 €/t plus MBT tax (10 €/t) or Incineration tax (15 €/t)	Average price 15 €/t	○ The ratio of BW vs RW collection cost is not advantageous for BW. ○ The BW treatment cost (includes subsidy) is cheaper than RW (includes taxes) so this benefits BW balance. ○ Compost produced has low (average) market price

BPs Cases	RATIO BW/RW COLLECTION COSTS	BW/KW vs RW TREATMENT UNIT COSTS	COMPOST PRICE	Assessment
Hernani (ES) 20,647 inhab.(2023), 517 inhab./km² D-t-D for 80% of HH & home-composting for 20% of HH SC rate: 81% (2022) KW: 90 kg/inhab./yr (2022)	**1.9**	**KW: 151 €/t (2022)** RW 199 €/t (including disposal tax)	Average price 15 €/t (range 5 to 40 €/t)	○ The ratio of BW vs RW collection cost is not advantageous for BW. ○ The BW treatment cost is cheaper than RW (includes taxes) so this benefits BW balance. ○ Compost produced has low (average) market price, but with high maximum value.
Maia (PT) 134,959 (2022), 1626 D-t-D, Connection rate: 43% SC rate: 34% (2022) KW: 44 kg/inhab./yr (2022)	n/D	**0 €/t (subsidy policy of LIPOR)** 62 €/t (rounded up)	**55 €/t**	○ The BW has not treatment cost (subsidised) so this benefits BW balance in respect of RW treatment cost (no high value). ○ Compost produced has high market price.
Milan (IT) 1,400,000 (2022), 7,000 D-t-D SC rate: 63% (2020) KW: 91 kg/inhab./yr (2020)	n/D	**KW: 74 €/t (2013)** RW 102,8 €/t (2015)	n/D	○ The BW treatment cost is cheaper than RW so this benefits BW balance.
Parma (IT) 195,436 inhab. (2022), 746 inhab./km² D-t-D & Emergency points SC rate: 82% (2021) KW: 101 kg/inhab./yr (2021)	**0.6 (2015)**	**KW: 122 €/t (2015)** RW 170 €/t (includes incineration tax)	Average price 6 €/t (in Italy for in bulk compost)	○ The ratio of BW vs RW collection cost is advantageous for BW. ○ The BW treatment cost is cheaper than RW (includes taxes) so this benefits BW balance. ○ Compost produced has low (average) market price.
Bratislava (SK) 475,500 inhab. (2022), 1,290 inhab./km² D-t-D, 53% of HH with BW SC rate: 38% (2022) KW: 44 kg/inhab./yr considering the quota of HH connected	**0.7 (2022)**	**KW: 30 €/t (2022)** RW 63 €/t (2022)	n/D	○ The ratio of BW vs RW collection cost is advantageous for BW. ○ The BW treatment cost is cheaper than RW so this benefits BW balance.
Island of Krk (HR) 21,000 inhab. (2022), 52 inhab./km²	n/D	**KW: 34 €/t (2022)** RW 115 €/t (includes transport)	Average price 33 €/m3 ± 66 €/t (in bulk) * 500 kg/m3	○ The BW treatment cost is cheaper than RW so this benefits BW balance.

BPs Cases	RATIO BW/RW COLLECTION COSTS	BW/KW vs RW TREATMENT UNIT COSTS	COMPOST PRICE	Assessment
D-t-D, 95% of HH with BW SC rate: 61% (2022) KW: 220 kg/inhab./yr (2022)				○ Compost produced has high (average) market price.
District of Straubing-Bogen (DE) 150,000 inhab. (2022), 88 inhab./km^2, 727 (City of Straubing) D-t-D with wheeled bins SC rate: 72% (2021) KW: 88 kg/inhab./yr (2021)	**0.63**	BW n/D RW 115 €/t	Average price 12.50 €/t	○ The ratio of BW vs RW collection cost is advantageous for BW. ○ The RW treatment cost is quite high, but no data for BW. ○ Compost produced has low (average) market price.
Münster (DE) 319,441 inhab. (2022), 1,037 inhab./km^2 D-t-D with wheeled bins, 80% of HH with BW SC rate: 72% (2020) KW: 55 kg/inhab./yr (2020)	0.97	KW 109 €/t RW n/D	Average price 12.10 €/t	○ The ratio of BW vs RW collection cost is almost balanced. ○ The BW treatment cost is quite high, but no data for RW. ○ Compost produced has low (average) market price.
District of Kempen (BE) 533,227 inhab. (2020), 346 inhab./km^2 D-t-D with wheeled bins, >70% of HH with BW SC rate: 73% of MSW (2020) KW: 61 kg/inhab./yr (2020)	1	n/D	13-23 €/t	○ The ratio of BW vs RW collection cost is balanced. ○ Compost produced has medium-low (average) market price.

Table acronyms: Door-to-Door (D-t-D), road containers (R-C), households (HH), separate collection (SC), no data available (n/D), residual waste (RW). For some of the BPs the separated fraction is kitchen waste (KW), and for others, it is bio-waste (BW) that also included green waste.

*Source: Own elaboration based on the information of **LIFE BIOBEST D3.1** **Guideline on separate collection, Annex 1**.*

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