LIFE BIOBEST

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LIFE BIOBEST

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

D3.1: Guidelines on separate collection

Annex 1. Best Practice cases on bio-waste collection

WP3: Set of guidelines

T3.1: Separate collection analysis

JUNE **2024**

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

PROJECT NAME:	**LIFE BIOBEST**
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Other Partners Involved:	ECN – Steffen Walk (German and Austrian cases) ENT – Gemma Nohales & Mike Stinavage (Spanish cases)
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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	15/12/23	1st Draft	Document created as 1st version to share with partners to include their cases	CIC - Alberto Confalonieri & Marco Ricci
0.2	19/03/24	2nd Draft	Document created as 2nd version to be distributed to peer reviewers	CIC - Vera Brambilla, Alberto Confalonieri, Irina Krutova, Eva Maria Lopez, Michele Giavini, Marco Ricci
0.3	05/04/24	2nd Draft	Peer reviewers' contributions in track changes and notes	ENT & ECN
0.4	24/04/24	3rd Draft	Revision to include reviewers' contributions	CIC - Vera Brambilla, Alberto Confalonieri, Irina Krutova, Eva Maria Lopez, Michele Giavini, Marco Ricci
0.5	08/05/24	4th Draft	Final linguistic and format revision	ENT – Mike Stinavage & Gemma Nohales
0.6	23/05/24	Definitive/ Approved	Definitive and approved version to be submitted	ENT – Mike Stinavage & Gemma Nohales
0.7	18/06/24	Submitted	Submitted to Participant Portal in PDF	ENT – Gemma Nohales

1.3 Document Overview

A set of best practices cases from different EU Member States and for a range of regional, urban or rural settlements is presented in this document. The report includes complementary information to the guidelines on separate collection of bio-waste (D3.1) elaborated by LIFE BIOBEST project. Moreover, it should be considered a useful reference to the concepts and examples mentioned in the set of the four guidelines (**LIFE BIOBEST D3.1 Guideline on separate collection**, **LIFE BIOBEST D3.2 Guideline on governance and economic incentives**, **LIFE BIOBEST D3.3 Guideline on quality compost and digestate** and **LIFE BIOBEST D3.4 Factsheets on the analysis of best practices in communication and engagement from various countries**) prepared by the project.

Each best practice case is presented concisely summarising the relevant information in a factsheet divided into chapters/sectors addressing a number of information relevant to understand how bio-waste produced at households (and other waste producers) is managed locally.

Finally, these best practice cases have been assessed according to the Key Performance Indicators (KPI) proposed by the project in **LIFE BIOBEST D2.1 Improved and homogenised datasets on municipal bio-waste management in the EU** focusing on the performances of the bio-waste separate collection and of the recycling plants.

1.4 Table of Acronyms

Table 3. Table of Acronyms

Acronym	Term
B-P	Bring point
C-C	Collection centre or Municipal recycling centre
D-t-D	Door to door
f.m.	Fresh matter
GW	Garden waste
Ho.Re.Ca.	Hotels, Restaurants and Cafeterias
inhab.	Inhabitant
km	kilometre
KPI	Key performance indicator
KW	Kitchen waste
L	Litre
m^3	Cubic meter
MBT	Mechanical biological treatment
MSW	Municipal solid waste
mth	month
PAYT	Pay as you throw
R-C	Road containers
RW	Residual Waste
RFID	Radio-frequency identification
t	Tonne(s)
times/wk	number of times per week
wk	week
yr	year

1.5 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.

1.6 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 Investigation of Best Practice cases

This document summarises 15 best practice cases investigated within the LIFE BIOBEST project and has been conceived as essential part of **LIFE BIOBEST D3.1 Guideline on separate collection**. All cases represent European realities that have activated a separate collection scheme for bio-waste. The related information is presented in the form of factsheets and use technical terms that are explained more in detail in the abovementioned guidelines.

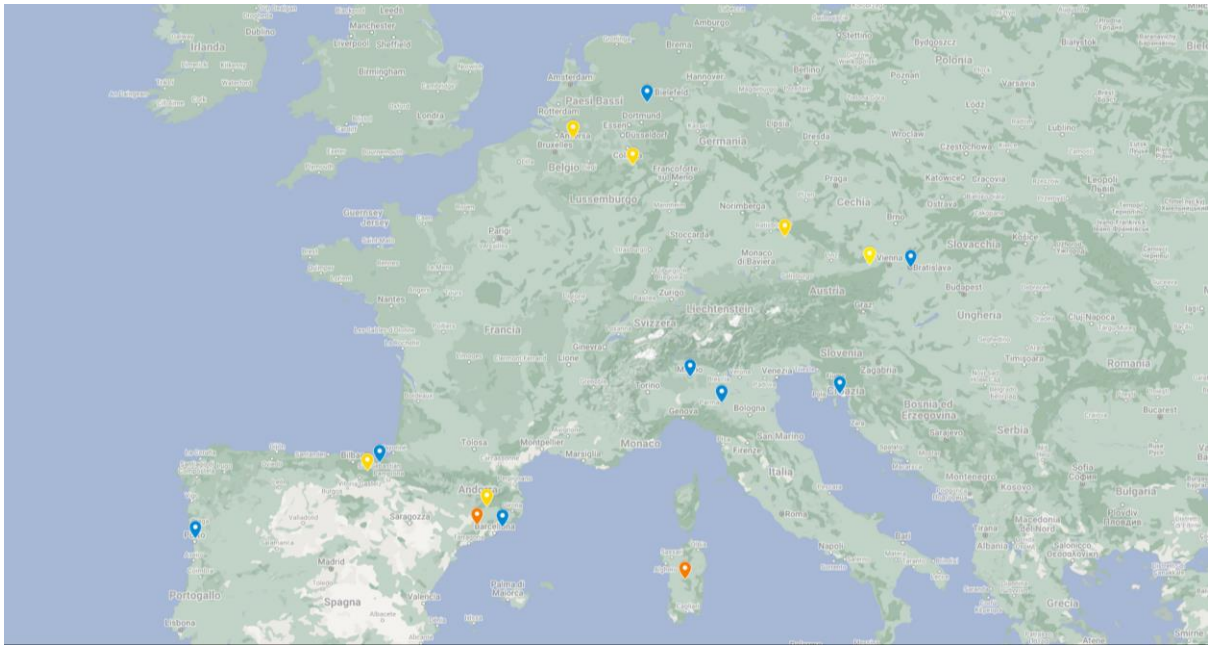
2.1 The cases investigated

The type of cases investigated include single municipalities and cities, group of municipalities (i.e., a larger set of municipalities managed by a single waste association or authority) and regions.

For each case, the key data about the location (on a map), inhabitants and density of population is provided. Cases include densely populated areas (cities) as well as medium to low density zones. Some cases have significant seasonal tourism.

The following Figure 1 shows the distribution of the studied cases across Europe, being complemented by Table 4 which includes the number of cases per Member State and the type.

Figure 1. Map of the cases evaluated by the LIFE BIOBEST project



Source: own elaboration

Note: Blue pin indicates single cases, yellow pin indicates districts and orange pin indicates regions

Table 4. List of best practices cases investigated per Member State and type

EU Member State	Number of total cases identified	Cities/ single municipalities	Regions/ Group municipalities	Touristic
AT	**1**		1	
BE	**1**		1	
CR	**1**		1	1
DE	**2**	1	1	
ES	**5**	2	3	3
IT	**3**	2	1	1
PT	**1**	1		
SK	**1**	1		
TOTAL	**15**	7	8	5

2.2 The type of information gathered

All cases have been surveyed focusing specifically on a set of information addressing the separate collection of bio-waste, the type of treatment or recycling processes for bio-waste, the costs associated to collection and recycling and the main uses of the products (i.e., compost and/or digestate) obtained from recycling and to be used as fertilisers.

In particular, the information reported in each factsheet on the separate collection scheme focuses on:

- The type of collections schemes for bio-waste, distinguishing between the collection of kitchen waste (KW) and of garden waste (GW), and on residual waste.
- The type of receptacles provided to households and commercial producers (the Ho.Re.Ca. sector); in this sense, a qualitative description in pictures is provided.
- The main frequency of collection - for each waste type investigated - provided to households and – if available –commercial producers.
- The existence of PAYT fees or charges applied to households during the collection of MSW.
- The quantitative and qualitative data regarding the separate collection of bio-waste and of residual waste.
- The diversion rate achieved for bio-waste in terms of amounts collected separately compared to the total potential available.

The information about the recycling process in place for the waste collected focuses on:

- The type of recycling facilities, i.e. composting, anaerobic digestion or combined anaerobic digestion & composting facilities.
- The gate fee that each type of facility applies to kitchen waste and (in some cases) to other bio-waste streams.
- The main use of the compost or digestate obtained, including the average cost/revenues from selling compost.

The economic information gathered focuses on:

- The ratio between the costs for collecting kitchen waste and those for residual waste (the latter being considered as the basic collection service that needs to be provided in any MSW management scheme).
- The gate fees for recycling bio-waste and the gate fees for disposing residual waste (for the latter eventual landfill-, incineration- or other disposal fees/taxes are quoted/considered).
- The fees/taxes applied to households, detailing if a PAYT charge or fee is in place or expected to be in the near future. This information is missing in some cases.

The final part of each factsheet includes a short overview of local, regional or national legislation addressing the separate collection or recycling of bio-waste alongside the reference to the sources.

3 Single Best Practice Cases

This section includes the factsheets of the 13 best practice cases investigated, focusing on single municipalities or group of municipalities.

3.1 City of Maia

City of Maia (PT)		
POPULATION (inhab.)	**DENSITY (inhab./km²)**	**TYPE**
134,959 (2022)	1,626	Urban
COLLECTION MODEL		
The MSW management is carried out by LIPOR (Municipalities Association for Sustainable Waste Management of Greater Porto Area)		
Kitchen waste		
Year of Implementation: 2005 **Collection scheme:** D-t-D **Connection rate:** 43% of households including high-rise buildings. 300 commercial activities connected **Allowed waste fractions:** KW only, including cooked food-scraps; GW collected with a separate scheme		
Garden waste		
Collection scheme: Bring scheme at 5 C-C and D-t-D on demand		
Residual waste		
Collection scheme: D-t-D with advanced individualized identified systems and applying PAYT; bins for residual waste equipped with RFID transponder		

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW & residual waste	**D-t-D**		• **KW:** 2 times/wk • **Residual waste:** 0.25 times/wk
GW	**D-t-D & C-C**		Upon request
Ho.Re.Ca.	**D-t-D**		• **KW:** 3 times/wk

Additional info

- KW from each household needs to be sorted without any type of bag; plastic and bioplastic bags are forbidden
- For delivering KW to collection service, households are equipped with small buckets or wheeled bins

TREATMENT MODEL

- **KW:** Regional Composting facility (managed by LIPOR)
- **GW:** Regional Composting facility (managed by LIPOR)
- **Residual waste:** Incineration facility (managed by LIPOR)

RESULTS

Residual waste reduction after introducing bio-waste collection	4% between 2004 and 2007
MSW separate collection rate	34% (2022)
MSW production per capita	431 kg/inhab./yr (2022)
Residual waste collection per capita	283 kg/inhab./yr (2022)
Bio-waste collection per capita	• KW: 44 kg/inhab./yr (2022) • GW: 22 kg/inhab./yr (2022)
Impurities in bio-waste	≈ 4% in KW D-t-D (estimated)
Bio-waste in residual waste or bio-waste diversion rate	• KW: 27% of residual waste • GW: 9% of residual waste KW diversion from residual waste about 37%
Bio-waste treatment	LIPOR district facility treats both KW and GW from a larger area including the city of Maia

ECONOMICS AND FISCAL	
Collection costs	---
Bio-waste treatment costs	0 €/t (policy of LIPOR, district composting plant)
Residual waste treatment costs	62 €/t (rounded up)
Product marketing	Compost is sold at 55 €/t to farmers for vineyards, horticulture, olive groves, orchards and for gardening activities
Taxes and Fees for households	Since 2013/14 the city council is applying a PAYT fee on the amounts of residual waste collected at each household

LEGISLATION

- The decision to start the separate collection of KW and GW taken by local authorities does not following a specific legal obligation or target for separate collection

SOURCE OF INFORMATION AND IMAGES

- LIPOR, personal communication, 2023
- Maiambiente, personal communication, 2023

Further information:

- https://www.maiambiente.pt

3.2 City of Hernani

City of Hernani (ES)		
POPULATION (inhab.)	**DENSITY (inhab./km²)**	**TYPE**
20,647 (2023)	517	Urban

Hernani is a town in the Basque province of Gipuzkoa near the capital, San Sebastian. It is a heavily industrialized city with some 240 industrial companies surveyed located along the banks of the river Urumea

COLLECTION MODEL

The waste collection is managed by the public consortium of the province of Gipuzkoa, GHK (*Gipuzkoako Hondakinen Kontsortzioa*)

Kitchen waste

Year of Implementation: 2010
Collection scheme: D-t-D for 80% of households while 20% of them practice home composting; D-t-D collection also at Ho.Re.Ca.
Connection rate: 100% of population
Allowed waste fractions: KW only, including cooked food-scraps

Garden waste

Collection scheme: Bring scheme at municipal collection centres

Residual waste

Collection scheme: D-t-D with reusable caddies or bags

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW & Residual waste	**D-t-D**		• **KW-Households:** 3 times/wk • **RW-Households:** 1 times/wk • **KW- Ho.Re.Ca.:** 3 times/wk
GW	**C-C**		• **Households:** 6 days/wk
KW & GW	**Community composting**		• **Households:** every day

Additional info

- On the day of collection, households place the 20 L caddies of KW on the pedestrian path or hang them on specific hook placed by the municipality
- For KW, households can use paper bags or compostable (bioplastic) liners

TREATMENT MODEL

- **KW**: Anaerobic digestion & composting plant managed by GHK
- **GW**: Composting facility belonging to the Gipuzkoa province
- **Residual waste**: MBT & Incineration facility manged by GHK

RESULTS

Residual waste reduction after introducing bio-waste collection	86% (between 2009/2011)
MSW separate collection rate	81% (2022)
MSW production per capita	388 kg/inhab./yr (2022)
Residual waste collection per capita	70 kg/inhab./yr (2022)
Bio-waste collection per capita	KW: 90 kg/inhab./yr (2022)
Impurities in bio-waste	< 1 % in KW

Bio-waste in residual waste or bio-waste diversion rate	KW is up to 2% of residual waste, GW up to 3,7% of residual waste (2022)
Bio-waste treatment	The city estimates that in addition to the bio-waste collected about 26 kg/inhab./yr are treated with home and community composting
ECONOMICS AND FISCAL	
Collection costs	Ratio of KW to residual waste collection cost: 1.9
Bio-waste treatment costs	• KW: 151 €/t (2022) • GW 0 €/t (2022)
Residual waste treatment costs	199 €/t (including disposal tax)
Product marketing	• Compost produced is sold mainly in bulk, in big bags but also in 50 L bags. • Average price of 15 €/t (range 5 to 40 €/t)
Taxes and Fees to households	--
LEGISLATION	
• In 2002, the regional waste management consortium in Gipuzkoa, faced with a nearly full landfill, proposed to build two new incinerators. Citizens strongly opposed the incinerators. Hernani and two other small cities in the region established an ambitious program of D-t-D collection of source-separated waste, including bio-waste • In 2010 the city adopted a D-t-D collection scheme including the separate collection of KW; the new scheme reduced the total MSW managed by about 40%. In 2012 the city also promoted home and community composting	
SOURCE OF INFORMATION AND IMAGES	
• Council of Hernani, Waste data 2022 • ZWE, ZW Best Practices: Hernani, 2013 • Personal communication from J. Kortajarena (Garbitania Zero Zabor), 2023	

3.3 County of Berguedà

County of Berguedà (ES)		
POPULATION (inhab.)	**DENSITY (inhab./km2)**	**TYPE**
39,772 (2020)	33.5	Rural

Berguedà is a county that oversees MSW management in 31 towns in the province of Barcelona, Catalonia

COLLECTION MODEL

Twelve out of thirty-one towns in Berguedà have a D-t-D collection model (4 main fractions, glass in R-C), which includes the most populated municipality of Berga (16,762 inhab. in 2022). The remaining small towns manage bio-waste by community composters and collect other MSW with road containers

Kitchen waste

Year of Implementation: 2018
Collection scheme: D-t-D (90% inhab.) and B-P with community composters (10% inhab.)
Connection rate: 100% of population
Allowed waste fractions in KW collection: KW, including cooked food-scraps, commingled with some small amounts of GW (grass, tree clippings and leaves)
Changes of model after implementation: The bio-waste collection started in 2005 and the initial model presented open R-C

Garden waste

Collection scheme: D-t-D with wheeled bins and B-P at the 3 municipal C-C serving the whole area

Residual waste

Collection scheme: D-t-D (90% inhab.) and bring points with open R-C (10% inhab.). The R-C scheme applied in the 19 small towns will be replaced with closed containers with controlled access in the near future

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW & Residual waste	**D-t-D**		• **KW**: 3 times/wk • **Residual waste**: 1 or 0.5 times/wk
	Closed bring points with identification		• For decentralised households and as Emergency point for D-t-D users
	Community composters (small towns)		• **KW:** Households can deliver daily
	Commercial D-t-D		• **KW**: 4 times/wk • **Residual waste**: 1 or 0.5 times/wk
GW	**C-C**		• **GW**: open between 6 and 7 days/wk
	D-t-D		• **GW**: 3 times/wk

Additional info

- Compostable bags/liners are compulsory, certified according to the EN-13432 standard and initially provided by the municipality
- For KW, D-t-D households caddies capacity of 20 L; Ho.Re.Ca wheeled bins capacity from 40 to 1,100 L
- For GW, D-t-D wheeled bins of 120 L capacity

TREATMENT MODEL

- **KW**: Composting facility
- **GW**: Part of the GW is delivered to the composting facility treating KW, part to other private composting plants
- **Residual waste**: Landfill

RESULTS	
Residual waste reduction after introducing bio-waste collection	71% (between years 2004/2020)
MSW separate collection rate	70% (2020)
MSW generation per capita	446 kg/inhab./yr (2020)
Residual waste collection per capita	136 kg/inhab./yr (2020)
Bio-waste collection per capita	KW + GW: 125 kg/inhab./yr (2020)
Impurities in bio-waste	Depending on the routes, impurities for KW range from 0.63% to 5.33%. The charaterisations occur every trimester for each route by ARC
Bio-waste in residual waste or bio-waste diversion rate	In D-t-D collection the percentage of bio-waste in residual waste is around 2.5%, in R-C collection (rural municipalities) the percentage is around 19%
ECONOMICS AND FISCAL	
Collection costs	--
Bio-waste treatment costs	64 €/t (the fee varies based on impurities) (2022)
Residual waste treatment costs	47 €/t plus landfill tax (65.3 €/t) (2022)
Product marketing	• Compost is used in agriculture or gardening • Compost from community composters is used by inhabitants. It is also used by the city council for the maintenance of public gardens • Compost from industrial plants is sold; minimum 6€/t for compost in bulk; maximum price 100 €/t (bagged in 50 L sacks)
Taxes and fees for households	• Fix fee for households (different tariffs for D-t-D municipalities and smaller towns with bring points) • By 2025, Berguedà intends to apply PAYT
LEGISLATION	
• Catalan Law 9/2008, of 10th July, amending the Law 6/1993 of 15th July regulating waste, establishes the biowaste separate collection of municipal waste in all the municipalities in Catalonia • Catalan Law 8/2008, of 10th July, on the financing of waste management infrastructures and final waste disposal taxes, repealing Catalan Law 16/2003, of 13th June, updates the initial landfill and incineration tax per tonne of municipal	

waste sent to landfill or incinerator. There is a refund system to local authorities calculated according to the quality and quality of organic waste collected and entering to biological treatment

- Spanish Law 7/2022, of April 8, on waste and contaminated soils for a circular economy establishes the obligation to collect separately bio-waste of domestic origin, including domestic or community composting. The obligation applies by June 30, 2022 for local entities with more than five thousand inhabitants, and by December 31, 2023 for larger communities. It is also mandatory to separate commercial and industrial waste, at source, both managed by local authorities and directly by authorised managers before 30 June 2022 Additionally, it establishes a maximum percentage of impurities of 20% f.m. from 2022 and 15% f.m. from 2027

SOURCE OF INFORMATION AND IMAGES

- Information from the Waste Agency of Catalonia, 2023
- Direct information and photos from the Berguedà County Council, 2023

Further information:

- www.bergueda.cat/triem/
- www.compostatgebergueda.cat

3.4 County of Debagoiena

County of Debagoiena (ES)		
POPULATION (inhab.)	**DENSITY (inhab./km²)**	**TYPE**
62,888 (2022)	183	Rural

Debagoiena, a county, oversees MSW management in 8 municipalities in the province of Gipuzkoa, Basque Country. The municipality in Debagoiena with the highest population is Arrasate-Mondragón (21,760 inhabitants)

COLLECTION MODEL

Gipuzkoako Hondakinen Kudeaketa, S.A.U. (GHK) is a public owned company responsible for MSW management for the municipalities of Debagoiena county

Kitchen waste

Year of Implementation: Between 2010 and 2014
Collection scheme: D-t-D in 3 municipalities and R-C in 5 municipalities
Connection rate: 100% of population
Allowed waste fractions in KW collection: KW including cooked food-scraps and commingled with some GW (grass, tree clippings and leaves)
KW from Ho.Re.Ca. is collected in a collection service provided by the county or city hall

Garden waste

Collection scheme: Drop-off at recycling centres as well as collection by an organization subcontracted by GHK

Residual waste

Collection scheme: D-t-D and R-C with weekly service

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW & Residual waste	**D-t-D**		• **KW**: 3 times/wk • **Residual waste**: 1 time/wk • **Ho.Re.Ca.**: depends on municipality
	R-C		• Regular service in a mixture of locked and unlocked bins
GW	**C-C**		• Daily delivery to a point nearby the compost facility

Additional info

- For KW, households can use compostable bioplastic bags (EN-13432 standard) or no bag/liner at all

TREATMENT MODEL
• **KW**: Composting facility, managed by GHK • **GW**: Composting facility, managed by GHK • **Residual waste**: MBT + incineration facility

RESULTS	
Residual waste reduction after introducing bio-waste collection	--
MSW separate collection rate	77% (2020)
MSW generation per capita	392 kg/inhab./yr (2020)
Residual waste collection per capita	93 kg/inhab./yr (2020)
Bio-waste collection per capita	GW: 26 kg/inhab./yr (2022) average data
Impurities in bio-waste	Approx. 5% in KW
Bio-waste in residual waste or bio-waste diversion rate	20% of KW in residual waste = 84% of KW diversion from residual waste (2020)
ECONOMICS AND FISCAL	
Collection costs	Ratio of KW to residual waste collection cost: 1.24
Bio-waste treatment costs	132.39 €/t (the rate is subsidised by 30% based on the relationship between the amount of residual waste and bio-waste)

Residual waste treatment costs	189.13 €/t plus MBT tax (10 €/t) or Incineration tax (15 €/t)
Product marketing	• Compost produced is used in agriculture and gardening • Compost produced is sold in bulk (average 15 €/t) or in 50 kg sacks
Taxes and fees for households	No PAYT fee system is applied

LEGISLATION

- Spanish Waste Law 7/2022, dated April 8, on waste and contaminated soils for a circular economy states that in the collection stage, it is necessary to collect separately bio-waste of domestic origin, including domestic or community composting, before June 30, 2022 for local entities with more than five thousand inhabitants, and before December 31, 2023 for the rest. It is also mandatory to separate commercial and industrial waste, both managed by local authorities and directly by authorised managers, at source before 30 June 2022. Additionally, for the first time conditions are raised on the quality of biowaste, establishing a maximum percentage of impurities of 20% f.m. from 2022 and 15% f.m. from 2027, and leaving the door open for a further reduction in the future

SOURCE OF INFORMATION AND IMAGES

- A. Etxaniz Eizagirre (Debagoieneko Mankomunitatea), 2023
- K. Iraolagoitia Otxandiano (Debagoieneko Mankomunitatea), 2023
- A. Moreno Gonzalez (GHK), 2023

Further information:

- www.debagoiena.eus/sites

3.5 City of Mataró

City of Mataró (ES)

POPULATION (inhab.)	DENSITY (inhab./km²)	TYPE
128,956 (2022)	5,731	Urban + Touristic

The coastal municipality of Mataró is the capital and largest town in the county of Maresme, in the province of Barcelona

COLLECTION MODEL

The collection service is managed by a private company selected by a public tender issued by the council

Kitchen waste

Year of Implementation: 2008

Collection scheme: Bring points in general, D-t-D only for large commercial and public facility producers

Connection rate: 100% of population

Allowed waste fractions in KW collection: KW including cooked food-scraps and commingled with some GW (grass, tree clippings and leaves)

The same for KW collected at Ho.Re.Ca.

Changes of model after implementation:

- D-t-D for households in the outskirts (2% population), since end 2022
- Mobile B-P with closed containers with controlled access for households in the city centre (5% population), since beginning 2022
- D-t-D for commercial activities – located at commercial axes, big producers, industrial zones, seafront, since end 2021
- The city programmes to deploy advanced individualised identified systems in all the neighbourhoods in the coming years

Garden waste			
Collection scheme: Bring scheme at 2 municipal C-C and specific D-t-D with wheeled bins for households in areas with high generation of waste (mainly for grass, tree clippings and leaves)			
Residual waste			
Collection scheme: In general B-P with open bilateral load R-C, while D-t-D and mobile bring points applied in specific (minor) zones			
WASTE	**SYSTEM**	**RECEPTACLE**	**COLLECTION FREQUENCY**
KW& Residual waste	**R-C**		• **KW**: winter 2 times/wk summer 3-4 times/wk • **Residual waste**: 7 times/wk
	D-t-D		• **KW**: 3 times/wk • **Residual waste**: 1 time/wk
	Mobile bring points		• **KW**: 7 times/wk • **Residual waste**: 2 times/wk
	Commercial D-t-D		• **KW**: 5 times/wk • **Residual waste**: 1 time/wk only in the centre and seafront
GW	**C-C**		• **GW**: 7 times/wk
	D-t-D		• **GW**: 1 time/wk
Additional info • For KW each household is equipped with a vented kitchen caddy plus a set of compostable bioplastic liners • Bags/liners are compulsory, certified according to the EN-13432 standard and initially provided by the municipality			

TREATMENT MODEL	
• **KW**: Anaerobic digestion & composting facility (wet process) • **GW:** Small-scale composting facility. Municipal pruning debris is shredded and used as mulch • **Residual waste:** MBT+incineration facility	
RESULTS	
Residual waste reduction after introducing bio-waste collection	17% (between years 2005/2010)
MSW separate collection rate	34% (2020, data do not include the effects of the new individualized models)
MSW generation per capita	389 kg/inhab./yr (2020)
Residual waste collection per capita	319 kg/inhab./yr (2020)
Bio-waste collection per capita	• KW: 42 kg/inhab./yr (2020) • GW: 5 kg/inhab./yr (2020)
Impurities in bio-waste	6% in KW open R-C and mobile bring points (2022) 2% in KW D-t-D (2022)
Bio-waste in residual waste or bio-waste diversion rate	16% of KW in residual waste, equal to 46% of KW diversion from residual waste (2020)
Other results	New models data for 2022/2023: • KW D-t-D: 97 kg/inhab./yr • KW Mobile bring points with containers with controlled access: 50 kg/inhab./yr • KW Commercial D-t-D: 13 kg/inhab./yr • KW Open R-C: 32 kg/inhab./yr
ECONOMICS AND FISCAL	
Collection costs	Ratio of KW to residual waste collection cost: 0.4 (2022)
Bio-waste treatment costs	• KW: 118 €/t (82 € base fee+36 € extra fee for % of impurities for Mataró's KW) (2022) • GW: for free (as the level of impurities is 0%) (2022)
Residual waste treatment costs	69 €/t (the fee includes the incineration tax of refuses) (2022)
Product marketing	Compost is distributed to farmers for free (collaboration agreements)

Taxes and fees for households	• Currently fix fee for citizens • For commercial activities, public fee based on the fractions delivered and m^2 of the premises • In 2023 the city council is planning to introduce a PAYT scheme for households and commercial activities

LEGISLATION

- Catalan Law 9/2008, of 10th July, amending the Law 6/1993 of 15th July regulating waste, establishes the bio-waste separate collection of municipal waste in all the municipalities in Catalonia
- Catalan Law 8/2008, of 10th July, on the financing of waste management infrastructures and final waste disposal taxes, repealing Catalan Law 16/2003, of 13th June, updates the initial landfill and incineration tax per tonne of municipal waste sent to landfill or incinerator. There is a refund system to local authorities calculated according to the quality and quality of organic matter collected and entering to biological treatment, among other refund concepts
- Spanish Law 7/2022, of April 8, on waste and contaminated soils for a circular economy stablishes the obligation to collect separately bio-waste of domestic origin, including domestic or community composting, before June 30, 2022 for local entities with more than five thousand inhabitants, and before December 31, 2023 for the rest. It is also mandatory to separate commercial and industrial waste, both managed by local authorities and directly by authorised managers, at source before 30 June 2022. Additionally, it establishes a maximum percentage of impurities of 20% from 2022 and 15% from 2027

SOURCE OF INFORMATION AND IMAGES

- Information from the Waste Agency of Catalonia, 2023
- Direct information from the Municipality of Mataró, 2023

Further information:

- https://www.mataro.cat/ca/temes/mataro-neta/recollida-de-residus

3.6 City of Milan

City of Milan (IT)		
POPULATION (inhab.)	**DENSITY (inhab./km²)**	**TYPE**
1,400,000 (2022)	7,000	Urban

Milan is the economic capital of Italy with a large presence of offices, business headquarters and small businesses. On a daily basis, Milan is visited by 0.5 million people for business or tourism.

COLLECTION MODEL

The MSW of the city is managed by the public company AMSA, part of A2A group. D-t-D collection of MSW has always been applied in Milan. Before 2013, KW was collected only from large producers of the Ho.Re.Ca. sector.

Kitchen waste

Year of implementation: 2013/2014
Collection scheme: D-t-D for households and commercial activities
Connection rate: 100% of population
Allowed waste fractions in KW collection: KW only, including cooked food-scraps; GW collected with a separate scheme
Changes of model after implementation: Since the new scheme was applied, the city extended bio-waste collection to most public markets

Garden waste

Collection scheme GW: Bring scheme at all municipal collection centres

Residual waste

Collection scheme residual waste: D-t-D with bags

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**		• **Households**: 2 times/wk • **Ho.Re.Ca.**: ≤ 6times/wk • **Markets**: 1 time/wk
GW	**C-C**	At 4 municipal collection centres	• Open 7 days/wk
Residual waste	**D-t-D**		• **Households**: 1 time/wk • **Ho.Re.Ca.**: 1 time/wk

Additional info

- For KW, each household is equipped with a vented kitchen caddy plus a set of compostable bioplastic liners
- Bags/liners are compulsory, certified according to the EN-13432 standard and initially provided by the MSW company AMSA
- High-rise buildings are equipped with wheeled bins for KW according to the number of households served
- External monitoring task force set up by the MSW company randomly checks KW bins about impurities, shortly before collection
- To increase participation by households, intensive information activities including repeated press releases were begun three months prior to starting separate collection

TREATMENT MODEL

- **KW**: Anaerobic digestion & composting plant, biomethane production
- **GW**: Composting facility
- **Residual waste**: Incineration facility managed by A2A

RESULTS

Residual waste reduction after introducing bio-waste collection	31% (between 2012/2015) following the new scheme (D-t-D)
MSW separate collection rate	63% (2020)
MSW production per capita	434 kg/inhab./yr (2020)
Residual waste collection per capita	161 kg/inhab./yr (2020)
Bio-waste collection per capita	• KW: 91 kg/inhab./yr (2020) • GW: 1 kg/inhab./yr (2020)

Impurities in bio-waste	4.3 – 5.2 % in KW (2014-2017)
Bio-waste in residual waste or bio-waste diversion rate	84% of KW diversion from residual waste (2015)
Bio-waste treatment	Private anaerobic digestion & composting facility treats the KW and GW from a larger district including the city of Milan
ECONOMICS AND FISCAL	
Collection costs	--
Bio-waste treatment costs	KW: 74 €/t (2013)
Residual waste treatment costs	102.8 €/t (2015)
Product marketing	The anaerobic digestion & composting facility produces (at present) • Biomethane that is pumped into Italy's national grid for natural gas • Compost, mainly sold bulk to farmers
Taxes and fees to households	• Fixed fee for households not depending on quantities of waste generated but based on the size of the apartment and the number of persons per household • Milan is planning to apply PAYT charge on residual waste in the near future to improve MSW management and recycling results
LEGISLATION	
• In 2010 Italy's national legislation about MSW requested all municipalities to reach minimum 65% separate collection and recycling by end 2012 • In 2011, the city of Milan decided to start the separate collection of kitchen waste from households with a D-t-D collection, while KW was already collected from the Ho.Re.Ca. sector since about 10 years • The scheme was implemented and applied to all households between 2012 and 2014 by the public MSW company AMSA	
SOURCE OF INFORMATION AND IMAGES	
• D. Vismara, AMSA, Presentation about Milan's MSW collection scheme at the ISWA 2015 Annual Congress • M. Ricci, M. Giavini, Global Waste Management outlook 2015, UN • ISPRA, MSW data for the City of Milan, various years • Photos: © AMSA, 2015; Marco Ricci, 2016 Further information: • https://www.amsa.it	

3.7 City of Parma

City of Parma (IT)		
POPULATION (inhab.)	**DENSITY (inhab./km²)**	**TYPE**
195,436 (2022)	746	Urban

The city of Parma represents a typical mid-sized town in Europe; its urban structure includes a medieval historic centre, with narrow streets and partial absence of walking paths for pedestrians and a more modern external belt, made of small to medium high-rise building with apartments, flats and offices. In addition to the residents, Parma hosts a foreign population of about 15,000 and a university with about 25,000 students

COLLECTION MODEL

MSW is managed by IREN, a large public multi-utility company. The current MSW collection was introduced by IREN upon input of the city authority of Parma

Kitchen waste

Year of implementation: 2013/2014
Collection scheme: D-t-D & Emergency points at specific location with identification of users to access the containers
Connection rate: 100% of population
Allowed waste fractions: KW only, including cooked food-scraps; GW collected with a separate scheme
Changes of model after implementation: Since the new scheme was applied, the city monitors MSW recycling results. IREN provides quality checks during the D-t-D collection and does not empty the bins with show contamination by plastics and other non-compostable items

Garden waste

Collection scheme: GW from households is collected by bring scheme with R-C besides direct delivery by household to municipal C-C

Residual waste

Collection scheme: D-t-D with small-scale receptable delivered to each household

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**		• **Households**: 2-3 times/wk • **Ho.Re.Ca.**: 6 times/wk
KW	**Emergency points** **Controlled access**		• 24 h/day
GW	**R-C & C-C**		• Open 7 days/wk
Residual waste	**D-t-D**		• **Households**: 1-2 times/wk • **Ho.Re.Ca.**: 1 time/wk

Additional info

- For KW, each household is equipped with a vented kitchen caddy plus a set of compostable bioplastic liners
- Bags/liners are compulsory, certified according to the EN-13432 standard and initially provided by the municipality
- Buckets and bins for KW and residual waste are equipped with identification systems (UHF RFID transponders
- Services are traced by GPS and household can access APP to know how much waste delivered

TREATMENT MODEL

- **KW**: Anaerobic digestion & composting facility
- **GW**: Composting facility
- **Residual waste**: Incineration facility

RESULTS

Residual waste reduction after introducing bio-waste collection	47% (between 2012/2015) Following the new scheme (D-t-D) and PAYT charge
MSW separate collection rate	82% (2021)
MSW production per capita	569 kg/inhab./yr (2021)
Residual waste collection per capita	102 kg/inhab./yr (2021)

Bio-waste collection per capita	• KW: 101 kg/inhab./yr (2021) • GW: 82 kg/inhab./yr (2021)
Impurities in bio-waste	3.3 % in KW (2015)
Bio-waste in residual waste or bio-waste diversion rate	77% of KW diversion from residual waste (2015)
Bio-waste treatment	Private facility treats KW and GW from a larger district including the city of Parma
ECONOMICS AND FISCAL	
Collection costs	Ratio of KW to residual waste collection cost: 0.6 (2015)
Bio-waste treatment costs	• KW: 122 €/t (2015) • GW: 64 €/t (2015)
Residual waste treatment costs	170 €/t (fee includes incineration tax)
Product marketing	Compost is mainly sold bulk to farmers; current average price for bulk compost 6 €/t in Italy)
Taxes and fees to households	Since 2013/14 the city council is applying a PAYT fee on the amounts of residual waste collected at each household. The fee is based on the volume of the bin and service numbers of each bin
LEGISLATION	
• According to Italy's National Waste regulation, the city has to reach minimum 65% of separate collection of MSW by year 2012 • In 2012 the city authority approved its ZeroWaste strategy and highly committed to boost separate collection and minimise residual waste; between 2012/2014 the city changed the previous collection scheme for MSW and introducing a D-t-D collection with PAYT applied to residual waste; with the new scheme most MSW streams including residual waste and food-waste are collected D-t-D • MSW quantities collected are to be reported annually by the City to the Regional (Emilia Romagna) and National (itl. ISPRA) authorities supervising MSW management	
SOURCE OF INFORMATION AND IMAGES	
• Folli-Ricci, Erfahrungen mit der Einführung der Bioabfallerfassung und -verwertung in Parma, Kassler Abfallforum, 2016 • ISPRA, National MSW statistics for years 2021, 2015, 2012 • Pictures © City of Parma; Marco Ricci Further information: • https://wkww.comune.parma.it/ambiente/Rifiuti-zero.aspx	

3.8 City of Bratislava

City of Bratislava (SK)

POPULATION (inhab.)	DENSITY (inhab./km²)	TYPE
475,500 (2022)	1,290	Urban

Bratislava is the capital of Slovak Republic, located along the Danube River; the historic city center is pedestrian-only. The area including the city of Bratislava is the wealthiest and most economically prosperous region in Slovakia and accounts for about 26% of the national GDP

COLLECTION MODEL

In 2021, the city tested an intensive separate collection scheme for KW-only at about 7000 households in Lamac district. Based on the results of the pilot project, the public company managing the MSW, OLO, expanded the separate collection scheme for KW to all households by November 2022

Kitchen waste

Year of implementation: Between 2021 and 2022
Collection scheme: D-t-D
Connection rate: 53% of population
Allowed waste fractions in KW collection: KW including cooked food-scraps. The city is not in charge of collecting waste from commercial producers, hence the pubblic service provided by OLO is not addressing the Ho.Re.Ca. sector
Changes of model after implementation: The city is still expanding the scheme to connect all households with separate collection of KW

Garden waste

Collection scheme: D-t-D scheme at households, upon request; delivery to municipal collection centres is also possible

Residual waste

Collection scheme: D-t-D at single household (about 10% of all households), and R-C at households living in high rise buildings

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**		• **Households:** 1-2 times/wk
GW	**D-t-D**		• **Households**: 2 times/mth only in season with significant production
Residual waste	**D-t-D & R-C**		• **Households**: 1-3 times/wk • Higher frequency depends on request of building manager/owner

Additional info

- For KW each household is equipped with a vented kitchen caddy to be used with compostable bioplastic or paper liners
- An initial set of compostable bioplastic bags has been distrituted to all households
- Compostable bags/liners are compulsory; they are certified according to the EN-13432 standard and provided by the city company managing MSW

TREATMENT MODEL

- **KW**: Anaerobic digestion & composting facility, managed by Zdroje Zeme
- **GW**: Composting facility, managed by EBA s.r.o.
- **Residual waste**: Incineration facility, managed by OLO

RESULTS

Residual waste reduction after introducing bio-waste collection	12% (between years 2019/2022)
MSW separate collection rate	38% (2022)
MSW production per capita	316 kg/inhab./yr (2022)
Residual waste collection per capita	209 kg/inhab./yr (2022)

Bio-waste collection per capita	• KW: 22 kg/inhab./yr (2023 – estimated on 8 months) and 44 kg/inhab./yr considering the quota of households connected • GW: 18 kg/inhab./yr (2022)
Impurities in bio-waste	• Up to 1.3% for KW at single household • Average 2.6% for KW at households in high-rise building (analysis conducted in 2022)
Bio-waste in residual waste or bio-waste diversion rate	26% KW inside residual waste in the zones with KW collection
ECONOMICS AND FISCAL	
Collection costs	KW collection cost 0.7 times residual waste collection (costs 2022)
Bio-waste treatment costs	• KW: 30 €/t (2022) • GW: 48 €/t (2022)
Residual waste treatment costs	63 €/t (2022)
Product marketing	--
Taxes and fees for households	Flat-rate, no PAYT charge is applied. The waste fees apply to all households depending on the number of residents per household

LEGISLATION

- In March 2021, the city of Bratislava approved the Municipal Waste Management Strategy with the aim of transitioning to a circular economy for 2021-2026
- Specific GOALS of the strategy are:
  - By 2035: at least 65% sorting and recycling/material recovery rate (by 2035)
  - By 2026: 45% of municipal waste will be sorted & 40% will be recycled
- The National Act No. 79/2015 referred to as the "Waste Act" imposes the obligation on municipalities to ensure the introduction and implementation of sorted collection of bio waste; this includes biodegradable kitchen waste and biodegradable waste from gardens and parks
- Municipalities also must provide at least once a year, an information campaign aimed at increasing the separate collection of BW according to the Waste Act
- From 2022 the collection bins for bio-waste can be located next to the building of waste producers

SOURCE OF INFORMATION AND IMAGES

- Zenzo, Association for efficient waste collection tools, personal information, 2023
- OLO, MSW management company, personal information, 2023
- City of Bratislava, Waste office, personal information, 2023
- Pictures © City of Bratislava; Zenzo; Altereko sas

Further information:

- https://bratislava.sk/en/environment-and-construction/environment/waste

3.9 Island of Krk

District/Island of Krk (HR)		
POPULATION (inhab.)	**DENSITY (inhab./km²)**	**TYPE**
21,000 (2022)	52	Urban + Touristic
Krk is the largest island of the Adriatic Sea and a tourist destination with about 5 million overnight stays per year		
COLLECTION MODEL		
Since almost 40 years, the public company *PONIKVE EKO OTOK KRK d.o.o.* manages the MSW collection in the district		
Kitchen waste		
Year of implementation: Between 2014 and 2016 **Collection scheme:** D-t-D **Allowed waste fractions:** KW only, including cooked food-scraps; GW collected with a separate scheme **Connection rate:** 95% of population and tourists; 5% managed with bring scheme		
Garden waste		
Collection scheme: Bring scheme at municipal collection centres		
Residual waste		
Collection scheme: D-t-D with buckets or with wheeled bins		

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**		• **Households**: 2-3 times/wk • **Ho.Re.Ca.**: ≤ 6 times/wk
Residual waste	**D-t-D**		• **Households**: 0.5 - 1 times/wk
GW	**C-C**	7 municipal collection centres realised on Krk Island	

Additional info

- For KW, each household is equipped with a vented kitchen caddy plus a set of compostable bioplastic liners provided by collection company
- Collection frequencies increase in summer for KW and residual waste
- Buckets and bins for KW and residual waste are equipped with identification systems (UHF RFID transponders)
- Identification of buckets and bins for KW during quality controls (Eco Patrol) - done by the Ponikve - to reduce physical contaminants collected
- Part of the buckets used by Ponikve are made with the plastics collected separately in Krk Island
- Information about MSW collection provided in 8 languages to address tourists

TREATMENT MODEL

- **KW**: Composting facility owned by Ponikve public company, located on the island
- **GW**: Composting facility owned by Ponikve
- **Residual waste**: Incineration facility, regional plant located out of Krk Island

RESULTS

Residual waste reduction after introducing bio-waste collection	13% (between 2012/2015) Following the new collection scheme (D-t-D)
Separate collection rate of MSW	61% (2022) increasing from 44% of 2013
MSW production per capita	~1,228 kg/inhab./yr (2022)

Residual waste collection per capita	102 kg/inhab./yr (2022)
Bio-waste collection per capita	• KW: 220 kg/inhab./yr (2022) • GW: 90 kg/inhab./yr (2022)
Impurities in bio-waste	7% to 10% in KW (2020-2022)
Bio-waste in Residual waste or Bio-waste diversion rate	--
Bio-waste collection per capita	Composting facility treats about 6,100 t/yr of bio-waste and organic waste generated by the local agro-industry
ECONOMICS AND FISCAL	
Collection costs	--
Bio-waste treatment costs	• KW: 34 €/t (2022)
Residual waste treatment costs	115 €/t (fee includes transport)
Product marketing	• Compost distributed for free to households in 80 L bags • Larger amounts are sold in big-bag or bulk eventually including transport costs • Average price for bulk compost: 33 €/m^3
Taxes and fees for households	Since 2016 the city council is applying a PAYT fee applied to residual waste collection based on the volume of the residual waste bin installed at each household
LEGISLATION	
• According to National MSW legislation (deriving from EU Directive 1999/31/EC) the Island/District has to reduce the amounts of biodegradable waste landfilled by 50% by 2016 • The Waste management plan of the Republic of Croatia for 2023-2028 (NN84/2023) request all districts to reach minimum 50% separate collection of MSA by year 2020 • Ponikve to decide to apply a D-t-D scheme for the whole island, so to target consistent separate collection and reduce the amounts to be disposed	
SOURCE OF INFORMATION AND IMAGES	
• D. Kosic, Ponikve EKO, personal communication, 2023 Further information: • https://www.ponikve.hr	

3.10 District of St. Pölten

District of St. Pölten (AT)

POPULATION (inhab.)	DENSITY (inhab./km²)	TYPE
104,000 (2022)	100	Rural

St. Pölten is a district of the state of Lower Austria, the second-most-populous state located in the north-east of Austria. The district completely surrounds the city of Sankt Pölten, which exists as a separate entity and borders Vienna to the west

COLLECTION MODEL

The association of municipalities *Gemeindeverband für Umweltschutz und Abgabeneinhebung* (GVU) is responsible for MSW management of 37 municipalities in St. Pölten district

Kitchen waste

Year of Implementation: 1993
Collection scheme: D-t-D, with wheeled bins
Connection rate: 51% of households with bio-bin, the rest of them rely on home composting
Allowed waste fractions: KW including cooked food-scraps and some part of GW; bulky GW to be collected with a specific GW collection scheme

Garden waste

Collection scheme: Bring scheme at all municipal C-C or directly brought by households to compost facilities

Residual waste

Collection scheme: D-t-D, with wheeled bins

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**		• **Households**: 2-3 times/mth
GW	**C-C**		• At municipal collection centres
Residual waste	**D-t-D**		• **Households**: min 13 times/yr

Additional info

- For KW collection, all households equipped with vented kitchen caddies. An annual set of compostable bioplastic bags (EN-13432 standard) are delivered to households by GVU; additional bags can be purchased with a reduced price promoted by GVU
- Higher collection frequencies of bins for KW/bio-waste are applied in summer

TREATMENT MODEL

- **KW**: At six small-scale composting facilities, owned and managed by farmers; each facility has an annual capacity not exceeding 1,400 t
- **GW**: Same as KW
- **Residual waste**: Incineration facility belonging to the region

RESULTS

Residual waste reduction after introducing bio-waste collection	--
MSW separate collection rate	74% (2022)
MSW production per capita	448 kg/inhab./yr (2022)
Residual waste collection per capita	118 kg/inhab./yr (2022)
Bio-waste collection per capita	• KW: 66 kg/inhab./yr (2022) • GW: 104 kg/inhab./yr (2022)
Impurities in bio-waste	--
Bio-waste in residual waste or bio-waste diversion rate	--

ECONOMICS AND FISCAL

Collection costs	--
Bio-waste treatment costs	• KW: ~ 53 €/t • GW: ~ 24€/t

Residual waste treatment costs	--
Product marketing	• Most compost is used directly by farmers managing the compost process; about 20%
Taxes and fees for households	Ratio of KW fee to residual waste fee applied to household: 0.60 Variable fee (PAYT) applied to: • Residual waste collection, based on bin volume and service frequency chosen annually • KW collection, based on bin volume and service frequency chosen annually and/or participation in home composting
LEGISLATION	
• The separate collection of bio-waste was introduced following Lower Austria Waste Management Act in 1992 • Contract with farmers to compost separately collected bio-waste were established in 1993	
SOURCE OF INFORMATION AND IMAGES	
• J. Freiler, Präsentation: Waste Management Association of the District "St. Pölten", 2023 • Direct information from the GVU District Association, 2023 Further information: • https://stpoeltenland.umweltverbaende.at/	

3.11 District of Straubing-Bogen

District of Straubing-Bogen (DE)

POPULATION (inhab.)	DENSITY (inhab./km²)	TYPE
150,000 (2022)	88 727 (City of Straubing)	Rural

Straubing is an independent city in Lower Bavaria, southern Germany, capital of the Straubing-Bogen district

COLLECTION MODEL

The district association *Zweckverband Abfallwirtschaft Straubing* (ZAW-SR) is responsible for MSW management in the city Straubing and in about 40 smaller municipalities in the district of Straubing-Bogen

Kitchen waste

Year of implementation: between 1990 and 1995
Collection scheme: D-t-D with wheeled bins
Connection rate: 70% of population
Allowed waste fractions: KW including cooked food-scraps and commingled with some GW (grass, tree clippings and leaves)
KW collected at Ho.Re.Ca. only includes residues from preparing or before cooking; no food/meal residues are allowed from these generators

Garden waste

Collection scheme: Bring scheme at all municipal collection centres

Residual waste

Collection scheme: D-t-D with wheeled bins

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**		• **Households**: 0.5 times/wk • **Ho.Re.Ca.**: 0.5 times/wk
Residual waste	**D-t-D**		• **Households**: 0.5 times/wk
GW	**C-C**		At municipal collection centres

Additional info

- For KW, households can use paper or compostable bioplastic bags (EN-13432 standard), can be purchased at shops, with a reduced price promoted by ZAW-SR.
- Kitchen caddies can be purchased from ZAW-SR
- For GW there is a max amount per month collected free of charge for households

TREATMENT MODEL

- **KW**: Anaerobic digestion & composting facility, owned and managed by the ZAW-SR
- **GW**: Composting facility, owned and managed by the ZAW-SR. Part of the GW is sent to biomass facilities
- **Residual waste**: Incineration facility

RESULTS

Residual waste reduction after introducing bio-waste collection	38% (between years 1990/1995)
MSW separate collection rate	72% (2021)
MSW production per capita	617 kg/inhab./yr (2021)
Residual waste collection per capita	161 kg/inhab./yr (2021)
Bio-waste collection per capita	• KW: 88 kg/inhab./yr (2021) • GW: 113 kg/inhab./yr (2021)
Impurities in bio-waste	1.2 % in KW (2021)
Bio-waste in residual waste or bio-waste diversion rate	--

ECONOMICS AND FISCAL	
Collection costs	Ratio of KW to residual waste collection cost: 0.63
Bio-waste treatment costs	Not available, self-owned facility
Residual waste treatment costs	115 €/t
Product marketing	• Compost produced from KW+GW is sold to farmers • Compost produced from GW only is sold in bulk to local population and to commercial companies • Average price for compost: 12.50 €/t
Taxes and fees for households	Variable fee (PAYT) applied to residual waste collection, based on the volume of the bin and the frequency of emptying

LEGISLATION

- The separate collection of bio-waste was introduced in the ZAW-SR between 1995 and 2000 on a voluntary basis
- Since then, the MSW scheme has not undergone significant changes regarding the scheme for collecting bio-waste, GW and residual waste

SOURCE OF INFORMATION AND IMAGES

- ZAW-SR, Abfallwirtschaftsbericht 2021
- Direct information from ZAW Straubing, 2023
- Direct information from CARMEN Straubing, 2023

Further information:

- https://wkww.zaw-sr.de/

3.12 City of Münster

City of Münster (DE)		
POPULATION (inhab.)	**DENSITY (inhab./km²)**	**TYPE**
319,441 (2022)	1,037	Urban + Rural

Münster is the 20th largest city in Germany and is considered to be the cultural centre of the Westphalia region. The city is home to many industries such as those of public authorities, consulting companies, insurance companies, banks, computer centres, publishing houses, advertising and design

COLLECTION MODEL

The organisation *Abfallwirtschaftsbetriebe Münster* (AWM) is responsible for MSW management in the City of Münster.

Kitchen waste

Year of implementation: 1991
Collection scheme: D-t-D via wheeled bins
Current connection rate: 80% of households
Allowed waste fractions in bio-waste bin: Mixed KW and GW including all food waste, grass, leaves, small tree clippings

Garden waste

Collection scheme: there are three options for households: D-t-D commingled with KW, D-t-D with additional bags for GW only and bring scheme to municipal recycling centres

Residual waste

Collection scheme: D-t-D with wheeled bins

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**		• 1 time/wk
Residual waste	**D-t-D**		• 0.5 times/wk
GW	**D-t-D**		• 1 time/wk
	C-C		• 11 decentralised municipal recycling centres all over the city (less than 3 km distance for each resident)

Additional info

Households are allowed to use paper bags or paper to wrap kitchen waste. Plastic bags including those made of compostable polymers are not accepted

TREATMENT MODEL
• **Bio-waste**: Wet anaerobic digestion (managed by AWM) –
• **GW**: Composting. Two separate models: only GW composted and GW mixed with digestate from anaerobic digestion of KW (managed by AWM)
• **Residual waste**: Mechanical pre-treatment (managed by AWM) + incineration of sorting residues (third-party, Twence NL)

RESULTS	
Residual waste reduction after introduction bio-waste collection	37% (comparison 1991 and 2000)
MSW separate collection rate	72% (2020)
MSW production per capita	422 kg/inhab./yr (2020)
Residual waste collection per capita	• 120 kg/inhab./yr (2020)
Bio-waste collection per capita	• 55 kg/inhab./yr via bio-waste bin (2020) • 48 kg/inhab./yr via GW collection + bring system (2020)
Impurities in bio-waste	• Total: 4.2% (Average of 6 analyses in 2020) • Plastics: 1.3% (2020)
Bio-waste in residual waste or	• 30.4% inside residual waste (2020)

bio-waste diversion rate	• 74% diversion of total generated (KW+GW, 2020)
ECONOMICS AND FISCAL	
Collection costs	Ratio of bio-waste to residual waste: 0.97 Ratio of GW to residual waste: 0.48
Bio-waste treatment costs	109 €/t
Green waste treatment costs	61 €/t
Residual waste treatment costs	--
Product marketing	Most of the compost is sold directly to gardening and landscaping as well as to soil producers. Private gardeners can obtain the compost at AWM premises: • Green waste compost: 1.40 €/t (average) • Mixed compost: - 12.10 €/t (average)
Taxes and fees to households	• Variable rate based on number of bins and bin sizes for bio-waste and residual waste • GW tariff based on purchased bags. Delivery to bring point for free up to 1 m^3
LEGISLATION	
• The German Circular Economy Act, amendment of 10.08.2021, regulates waste, waste management hierarchy, the mandate of separate collection, treatment and quality assurance. The mandatory separate collection of bio-waste is in place since 2015. The Act is the National adaption of the European Waste Framework Directive • The German Biowaste Ordinance, amendment of 28.04.2022, regulates the collection, treatment and use of bio-waste derived products on land used for agriculture, forestry and horticulture. It regulates input and output material quality requirements. The last amendment added limiting thresholds for total and plastic impurities in separately collected bio-waste • The Federal Circular Economy Act, amendment of 12.09.2023, of Nordrhein-Westfalen supplements the German Circular Economy Act. It further regulates responsibilities, waste management planning and waste specific treatment • The Federal Waste Management Plan of 2014 of Nordrhein-Westfalen regulates recycling targets and measures to achieve them • The Waste statute 70.02, amendment of 16.09.2019, of the city of Münster regulates the local implementation of the German Circular Economy Act and the Federal Circular Economy Act of Nordrhein-Westfalen. It includes the mandatory separate collection of bio-waste since 1991 with the exception by proof of home composting • The Waste fee statute 70.02.1, amendment of 20.12.2021, of the city of Münster regulates waste fees	

- The Waste management concept of 2023 of the city of Münster regulates the local measures to achieve targets formulated in the German Circular Economy Act. The update period is regulated by the federal state

SOURCE OF INFORMATION AND IMAGES

- Abfallbilanz_AWM-Münster, 2020
- Abfallwirtschaftskonzept_AW; Münster, 2016 & 2023
- Abfallwirtschaft Münster, personal communication, 2023 (C. Baumann)

Further information:

- https://awm.stadt-muenster.de/verwertung-entsorgung

3.13 District of Kempen

District of Kempen (BE)

POPULATION (inhab.)	DENSITY (inhab./km²)	TYPE
533,227 (2020)	346	Rural

The Kempen area is located east of Antwerp in the north-eastern part of Belgium (Flanders region)

COLLECTION MODEL

IOK Afvalbeheer is the district's public company responsible for MSW management of 29 municipalities located in the Kempen area

Kitchen waste

Year of implementation: 1990
Collection scheme: D-t-D with wheeled bins
Coverage rate: >70% of population
Allowed waste fractions in KW collection: all food waste and some fractions of small GW (grass, leaves, small tree clippings), abbreviated with GFT in Dutch
Changes of model after implementation: Gradual implementation of PAYT fee started in 2006

Garden waste

Collection scheme: Bring scheme to municipal recycling centres. Bulky and "soft" garden waste should be kept separately.

Residual waste

Collection scheme: D-t-D, with wheeled bins

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**		• 0.5 times/wk
Residual waste	**D-t-D**		• 0.5 times/wk
GW	**C-C**		At municipal collection centres

Additional info

- Households are allowed to use paper bags or biodegradable plastic bags only with the IOK branded logo. Conventional plastic bags are forbidden

TREATMENT MODEL

- **KW**: Dry anaerobic digestion plant (managed by IOK)
- **GW**: Composting plant. mixed with digestate from the anaerobic digestion (in-house)
- **Residual waste**: Mechanical biological treatment (managed by IOK, biological drying and sorting of recyclables) with the production of secondary fuel

RESULTS

Residual waste reduction after introducing bio-waste collection	44% (comparison 1990 and 1997)
MSW separate collection rate	73% of MSW (2020)
MSW production per capita	492 kg/inhab./yr (2020)
Residual waste collection per capita	83 kg/inhab./yr (2020)
Bio-waste collection per capita	• KW: 61 kg/inhab./yr (2020) • GW: 65 kg/inhab./yr (2020)
Impurities in bio-waste	4.98% (average of Flanders region, 2020)
Bio-waste in residual waste	34.1%
Bio-waste diversion rate	81% of total generated (KW + GW)

ECONOMICS AND FISCAL	
Bio-waste collection costs	Ratio of bio-waste to residual waste collection cost: 1
Bio-waste treatment costs	
GW treatment costs	A PAYT fee for GW collection is charged to households
Residual waste treatment costs	--
Product marketing	Most of the compost is sold directly to professional users such as fertilisers producers and potting soil manufacturers. Private gardeners can obtain the compost at IOK premises. It is sold between 13 and 23 €/t.
Taxes and fees to households	PAYT scheme based on weight per collection for bio-waste, GW and residual waste • KW: 0.10 €/kg • GW: 0.10 €/kg • Residual waste: 0.26 €/kg

LEGISLATION

- The Flemish Lokaal Materialenplan 2023 - 2030 regulates regional waste management of households and similar commercial activities. on the plan addresses also waste prevention, the reduction of residual waste to 100 kg/inhab/yr by 2030 and the mandatory separate collection of bio-waste by 2024
- The Flemish Actieplan voedselverlies en biomassareststromen circulair 2021-2025 regulates the circular use of FW and biomass residues and sets specific recycling targets for these waste streams

SOURCE OF INFORMATION AND IMAGES

- Jaarverslag_IOK-Afvalbeheer, 2020
- VLACO, personal communication, 2023 (E. Vandaele, W. v. Auweele)

Further information:

- https://www.iok.be/

4 Regional Best Practice Cases

This section includes the factsheets of the 2 regional best practice cases investigated.

4.1 Region of Catalonia

Region of Catalonia (ES)		
POPULATION (inhab.)	**DENSITY (inhab./km²)**	**TYPE**
7,977,132 (2023)	250	Rural, semirural and urban

TERRITORY

Catalonia has 947 municipalities in its 43 counties and a population of about 8 million inhabitants. Catalonia is the second most populated autonomous community in Spain, one of the most competitive economies in Southern Europe and a top international tourist hub

LEGISLATION

Regional waste regulation:

- Law 9/2008, of 10th July, amending the Law 6/1993 of 15th July regulating waste, establishes the separate collection of municipal waste in all towns and villages of Catalonia (Law 6/93 included the same obligation but only for the municipalities with more than 5,000 inhab.)

Member State waste regulation:

- Spanish Waste Law 7/2022, dated April 8, on waste and contaminated soils for a circular economy, states that in the collection stage, it is necessary to collect separately bio-waste of domestic origin, including domestic or community composting, before June 30, 2022 for local entities with more than five thousand inhabitants, and before December 31, 2023 for the rest. It is also mandatory to separate commercial and industrial waste, both managed by local authorities and directly by authorised managers, at source before 30 June 2022 (1). Additionally, for the first-time conditions are raised on the quality of bio-waste, establishing a maximum percentage of impurities of 20% from 2022 and 15% from 2027, and leaving the door open for a further reduction in the future

Drivers for quality output

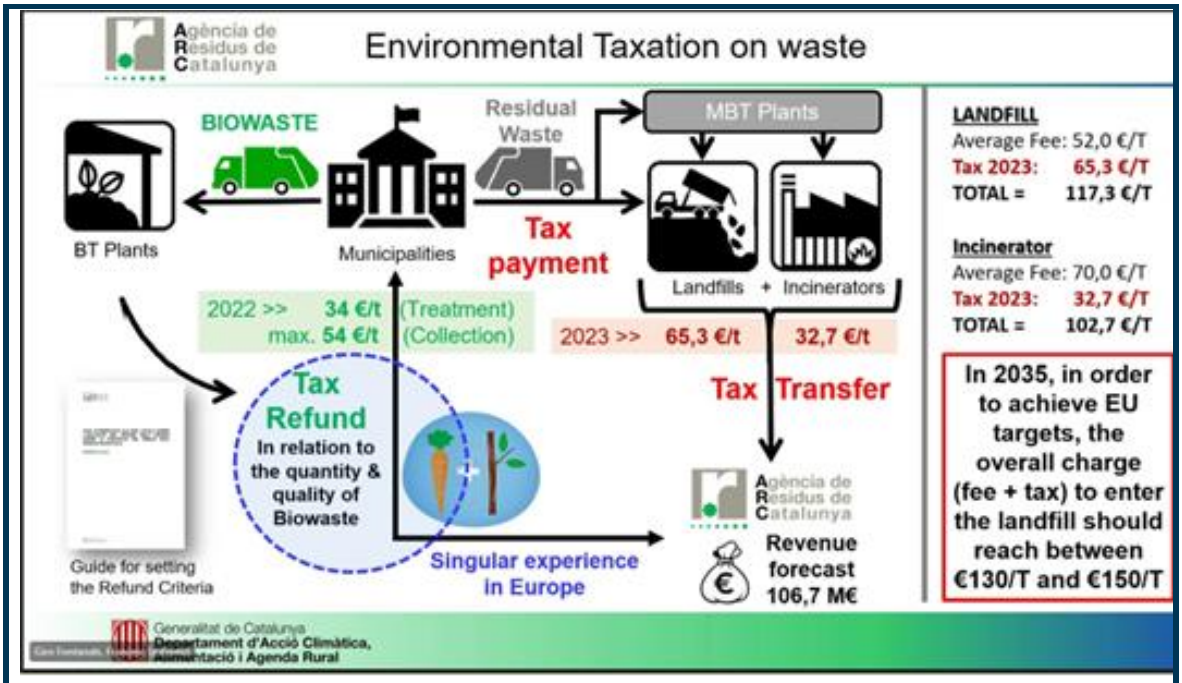
Catalonia's planning and legislation incorporate different drivers to promote the collection of bio-waste with low levels of impurities

- PRECAT2020 (Waste management programme of Catalonia) reassesses the quality of the separate collection of municipal bio-waste to reach less than 10% of impurities by weight by 2020
- Landfill and incineration tax refund system according to the quality and quantity of bio-waste with a threshold for the % of impurities to receive the payback that is being reduced from year to year (12.5% in 2023) and a payment calculation method based on a % of impurities correction coefficient and the net tonnes of bio-waste flow (discounting impurities)
- The new Catalan law on waste (in preparation) will include a 5% limit of impurities for bio-waste collected by 2030

Regional economic incentives

a) Landfill tax and tax refund system

- Catalan Law 16/2003, of 13th June repealed by Catalan Law 8/2008, of 10th July, concerning the financing of waste management infrastructures and final waste disposal taxes: Law 16/23 established a landfill tax of 10€/tonne of municipal waste sent to landfill, and Law 8/08 established an incinerator tax of 5€/t 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. In the recent years, the evolution of the tax fee has been agreed and pre-established for a specific period
- Tax refund system: funds collected via the tax are returned to local authorities in accordance with the criteria established by the Waste Management Fund Board. One of the most important concepts is the quality and quantity of the municipal bio-waste collected and treated. Local authorities can use these financial resources to cover management costs and/or carry out activities to promote and improve the bio-waste collection and treatment. A tax refund system guideline is annually approved with the refund criteria and amounts for the different fractions or treatments considered

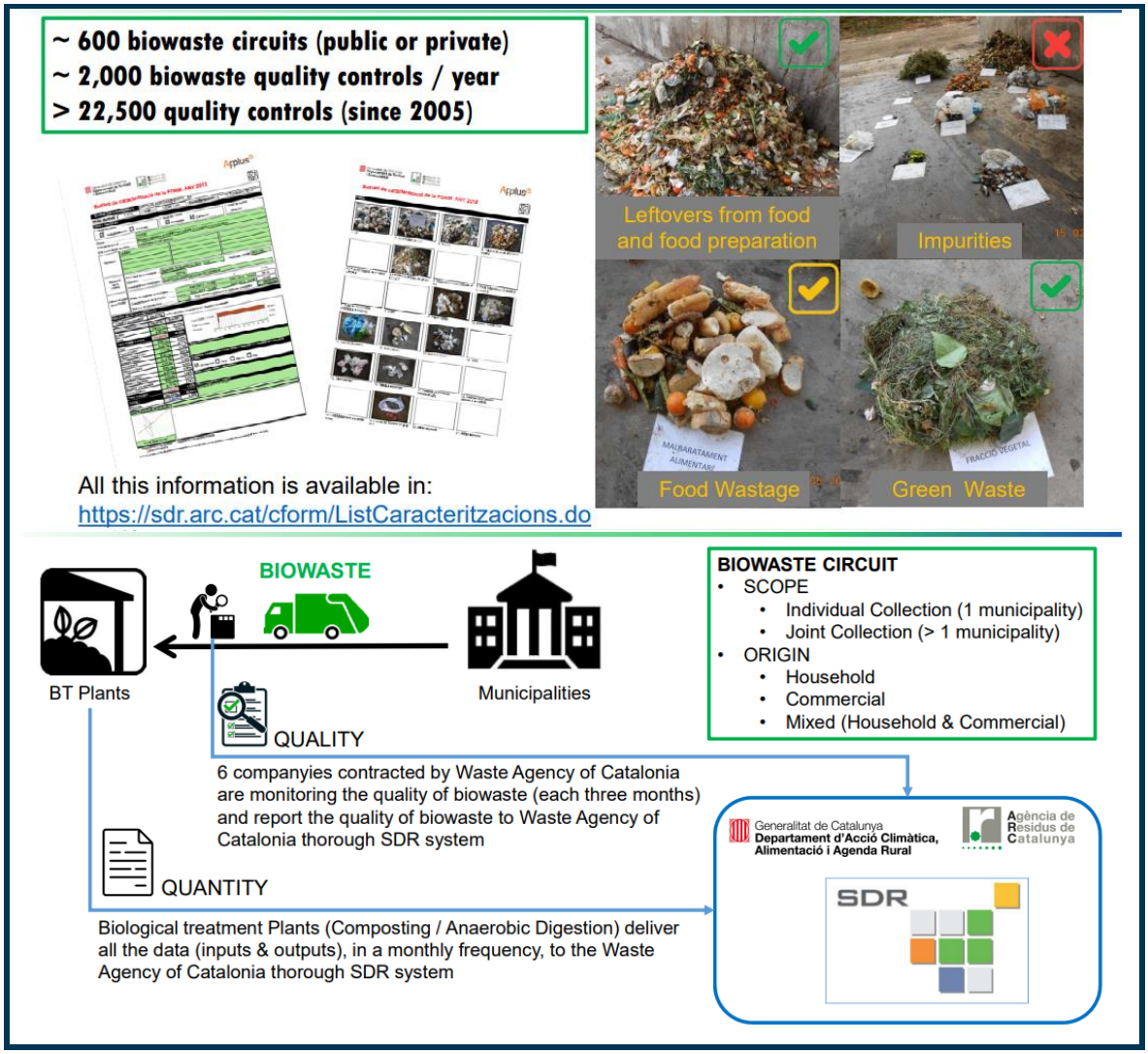


Quality monitoring for bio-waste

A quarterly reporting system of municipal food waste characterisations is established for each municipality or grouped municipalities (when bio-waste is collected in a joint collection route). This is linked to the calculation of the landfill tax refund for the bio-waste concepts. The characterisation results are published on a public web portal

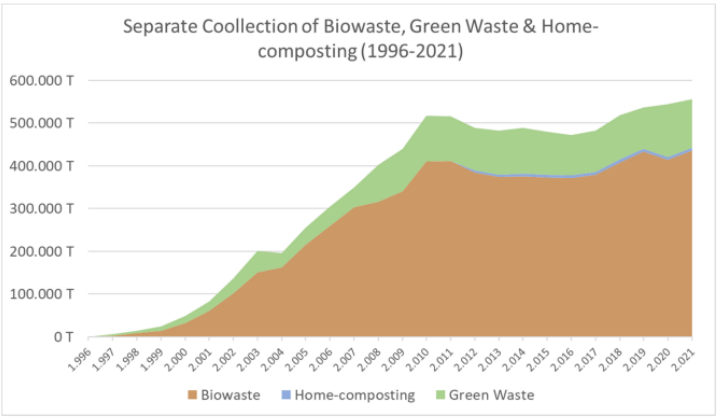
For traceability of the bio-waste collected by private operators, the ARC has a specific register for private commercial circuits in which the producers, tonnes and composition studies are reported and monitored

In 2021, a total of 1,840 characterisations of organic fraction of public municipal circuits and 125 of private circuits were carried out



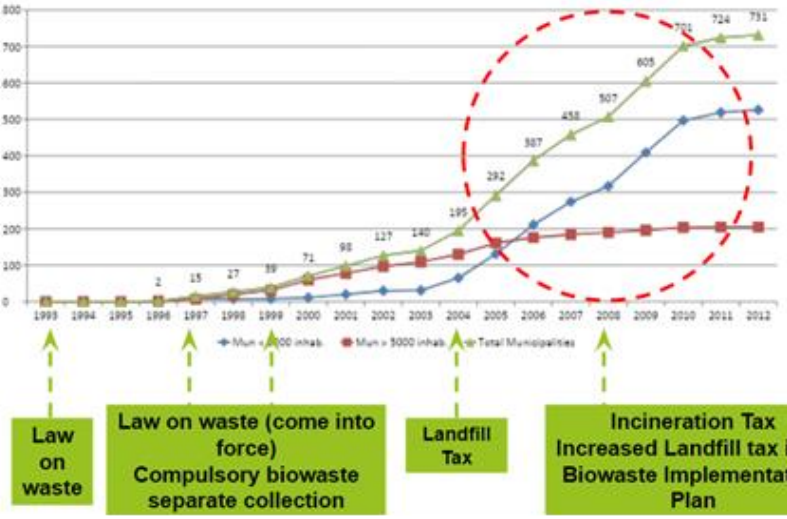
RESULTS	
Residual waste reduction after introducing bio-waste collection	19% (from 1995-2013)
MSW separate collection rate	46.6% (2021)
MSW production per capita	519 kg/inhab./yr (2021)
Residual waste collection per capita	277 kg/inhab./yr (2021)
Bio-waste collection per capita	• KW: 56 kg/inhab./yr (2021) • GW: 15 kg/inhab./yr (2021)
Impurities in bio-waste	• Average 8.5% in KW (2021) • D-t-D: 4.7% in KW (2020) Characterisation system that analyses bio-waste composition for each public collection route each trimester

Bio-waste in residual waste or bio-waste diversion rate	32% diversion (2021)
Other results	Estimation of bio-waste managed by home or community composting: 7,136 t (2021)

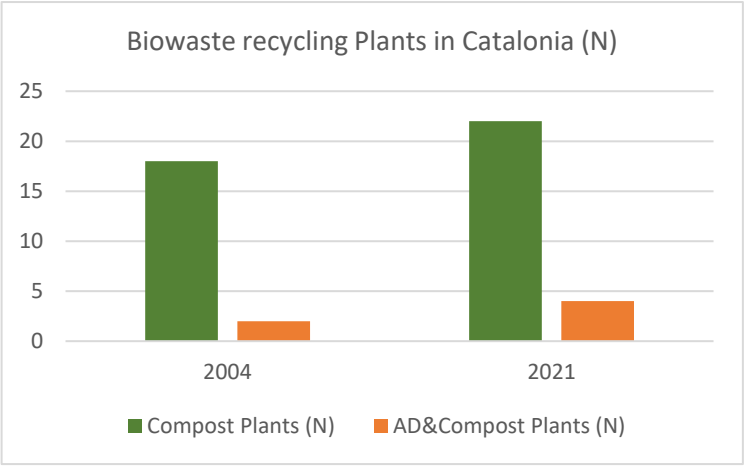


1996-2021	2021
1.8 M tons Green Waste	114,000 t Green Waste
6.7 M tons Biowaste*	435,000 t Biowaste
↓	↓
0,8 M tons Compost Class A (22%) Class B (76%)	39,000 t Compost
	21 M m³ Biogas

* 65,000 tons Home-composting



Outcomes. Evolution of Catalan municipalities with biowaste separate collection implemented



COLLECTION MODEL

The standard model collects MSW at bring points with open containers or bins. In recent years there has been an increase of individualised models. 311 municipalities apply D-t-D collection and about 79 introduced containers with controlled access (2022-23)

Kitchen waste

Year of Implementation: Between 1996 and 2021 (approx.)

Collection scheme: D-t-D and R-C for KW and small GW

Connection rate: 100% of population (95% collection service+5% self-composting)

Allowed waste fractions in KW collection: KW including cooked food-scraps; KW is also collected at Ho.Re.Ca. facilities

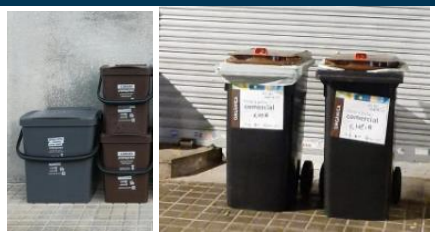
Changes of model after implementation: Currently the tendency is to change from B-P to individualised models, especially D-t-D collection services

Garden waste

Collection scheme: Bring scheme at all municipal collection centres. Municipalities with D-t-D schemes offer households to collect also GW at the doorstep with sacks or bins. Some municipalities with bring points schemes also develop this kind of collection in case of large number of GW producers. In some cases, the service is provided upon request

Residual waste

Collection scheme: The same models mentioned for KW collection

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY* *Data averages
KW & Residual waste	**D-t-D**		• **KW - Households:** 3 times/wk • **KW - Ho.Re.Ca.:** 3-4 (-5) times/wk
	D-t-D		• **RW:** 1 times/wk (more used) or fortnightly
KW & Residual waste	**R-C**		• **KW:** 3-4 times/wk emptying
	R-C		• **RW:** 6-7 times/wk emptying

GW	**C-C**		
	D-t-D	 	• 1-3 times/wk (depending on single municipalities)

Additional info

- For KW, households are equipped with a vented kitchen caddies
- Compostable bioplastic bags or liners (EN-13432 standard) are highly recommended. Many municipalities distribute compostable liners to households and large producers. Some municipalities made them compulsory

TREATMENT MODEL	
• **Bio-waste**: 22 composting plants (2021) • **Bio-waste**: 4 anaerobic digestion & composting plants (2021). • **Total bio-waste treatment capacity:** 550,000 t/yr (2021) • **Residual waste:** 12 MBT, 4 incineration facilities and 22 landfills (2021)	
ECONOMICS AND FISCAL	
Collection costs	--
Bio-waste treatment costs	Max. 140 €/t, average 83 €/t, min. 40 €/t for KW. (calculation considering average tariff per facility applied to flows under 15% of impurities for 20 facilities). Most of the facilities apply variable gate fees depending on the % of impurities (using ranges of impurities to assign a specific fee)
Residual waste treatment costs	• Landfill: 52 €/t (average fee)+65.3 €/t tax (2023) • Incinerator: 70 €/t (average fee)+32.7 €/t tax (2023)
Product marketing	• 42,100 t of compost from municipal bio-waste are produced in Catalonia (2021) • Compost is sold in bulk mainly to local farmers and gardeners. Average price for bulk compost 4 €/t (2022). In some cases, it is for free (agreements with farmers) • Some facilities sell it in sacks with a premium price

Taxes and fees for households	• The waste fees for households are generally flat, sometimes based on the size of the apartment and the number of inhab. per household • In 2020 only 3 municipalities applied PAYT (with pre-paid bags for residual and light packaging) and 1 municipality applied a save as you throw (SAYT) scheme with discounts for the number of deliveries (by ranges) of bio-waste and light packaging • Some municipalities are starting variable taxes: SAYT schemes are frequently applied to bio-waste and less frequently for light packaging. In a few municipalities, PAYT schemes are applied to residual waste

SOURCE OF INFORMATION AND IMAGES

- Information from Waste Agency of Catalonia: statistical data, statistical reports, annual memory, specific presentations and normative documents
- Additional information from Fundació ENT staff's knowledge of the management in Catalonia

Further information:

- Inicio. Agència de Residus de Catalunya (gencat.cat)

4.2 Region of Sardinia

Region of Sardinia (IT)

POPULATION (inhab.)	DENSITY (inhab./km2)	TYPE
1,600,000 (2022)	66	Rural and Urban

TERRITORY

The Island of Sardinia has 377 municipalities, including 4 cities with populations between 50,000-150,000 inhabitants. Annually, about 15 million tourists visit the island, mainly in the summer season (i.e. from June to September)

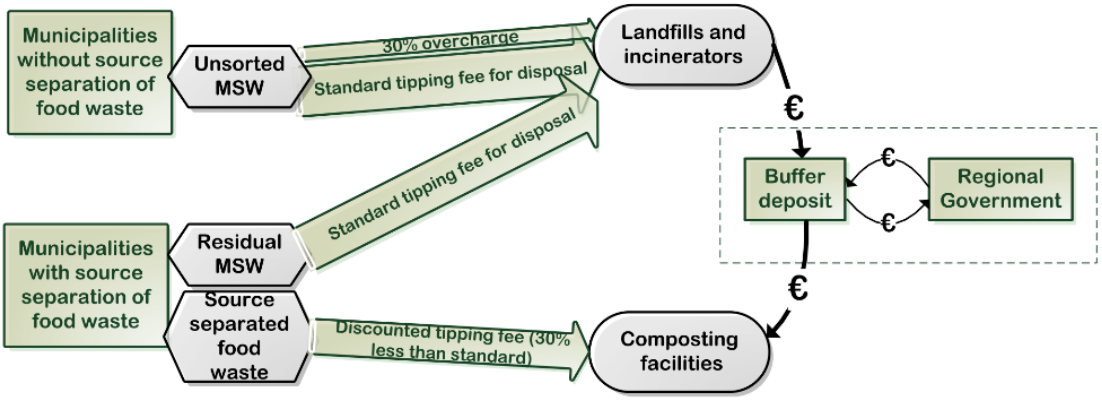
LEGISLATION

Regional waste regulation:

- Sardinia's Regional Plan on Waste Management of 1998 aimed to reduce residual waste to less than 35% of MSW by 2012. In 2004, Sardinia was among Italy's regions with lowest separate collection and recycling rates (less than 6% collected separately); the regional government decided to focus on the development of separate collection of KW

Drivers:

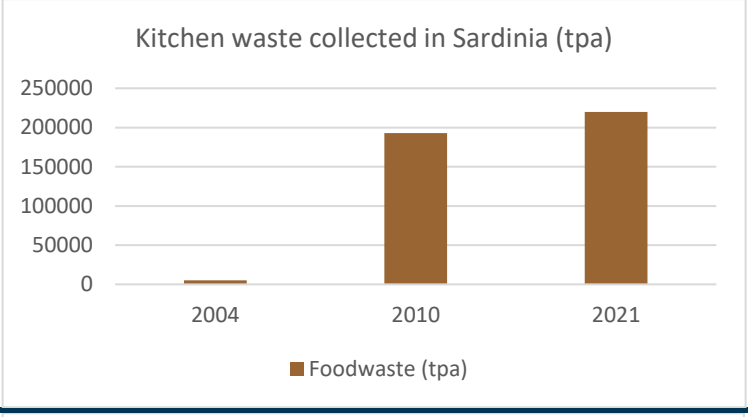
- An economical driver was applied from 2004/2005 onwards to rapidly enhance the growth of separately collected KW and guarantee the quality of separate collection, and by supporting the network of composting plants by developing the market for quality-compost
- The instrument worked with a penalty/premium mechanism applied to all municipalities; from 2017, the economic mechanism applies as follows:
    - an additional levy on residual waste disposal, for those municipalities which did not result in significant separate collection; the levy applied for separate collection below 65%
    - a discount/premium on waste disposal for those municipalities which complied with separate collection and quality targets; if separate collection exceeds 70%, a 25% discount is applied on the gate fee; the discount increases up to 50% for separate collection rates exceeding 80%

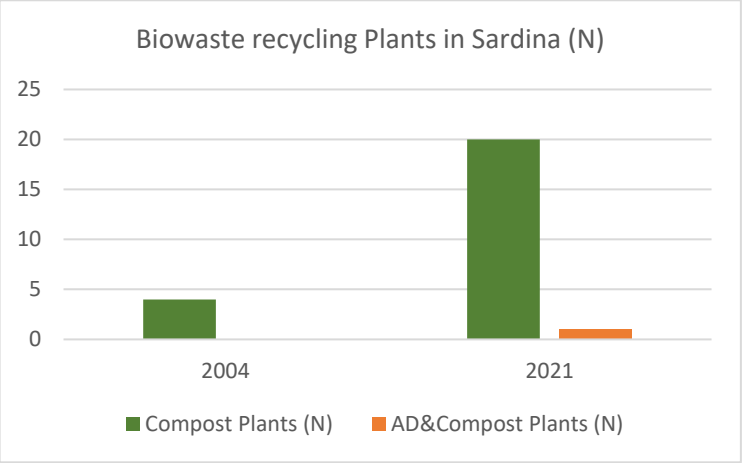


- The instrument worked with a penalty/premium mechanism applied to all municipalities; from 2017, the economic mechanism applies as follows:
  - an additional levy on residual waste disposal, for those municipalities which did not result in significant separate collection; the levy applied for separate collection below 65%
  - a discount/premium on waste disposal for those municipalities which complied with separate collection and quality targets; if separate collection exceeds 70%, a 25% discount is applied on the gate fee; the discount increases up to 50% for separate collection rates exceeding 80%
- Strong advertising and communication activities have been carried out to encourage participation in separate collection of KW; after 5 years with the scheme a quota of 90% of municipalities have applied SS for KW and about 93% of the residents are involved. Of these municipalities, 91% deploy D-t-D schemes to assure high quality and significant collection rates for KW

RESULTS	
Residual waste reduction after introducing bio-waste collection	46% (between years 2004/2010)
MSW separate collection rate	• Increase to 20% in year 2006 following the penalty/premium mechanism • In year 2021 about 75% of all MSW
MSW production per capita	437 kg/inhab./yr (2021)
Residual waste collection per capita	106 kg/inhab./yr (2021)
Bio-waste collection per capita	• KW: 138 kg/inhab./yr (2021) • GW: 73 kg/inhab./yr (2021)
Impurities in bio-waste	3.3% in KW (2017) Data are assessed regularly on a large set of municipalities

Bio-waste in residual waste or bio-waste diversion rate	85% diversion (2017)





COLLECTION MODEL

In case of Sardinia, almost all municipalities apply a D-t-D collection scheme for KW and residual waste as well as large cities such as Cagliari

Kitchen waste

Year of Implementation: Between 2004 and 2010
Collection scheme: D-t-D
Connection rate: 100% of population
Allowed waste fractions in KW collection: KW only including cooked food-scraps; KW collected also from the Ho.Re.Ca. sector

Garden waste

Collection scheme: Bring scheme at all municipal collection centres

Residual waste

Collection scheme: D-t-D; where PAYT applied, waste receptables are equipped with passive UHF RFID micro-tags

WASTE	SYSTEM	RECEPTACLE	COLLECTION FREQUENCY
KW	**D-t-D**	 	• **Households**: 2-4 times/wk • **Ho.Re.Ca.**: 2-6 times/wk
Residual waste	**D-t-D**		• **Households:** 1 times/wk
GW	**C-C**		

Additional info

- Each household is equipped with a vented kitchen caddy (for KW) and a bucket (20-30 L) for delivery of KW to the collection service; high-rise buildings equipped with wheeled bins
- For KW household can use paper or compostable bioplastic bags (certified according to the UNI-EN-13432 standard), many municipalities distribute compostable liners to households

TREATMENT MODEL
In 2004 there were only 4 composting plants in Sardinia. The increase of KW collected was coupled with the development of a network of small and medium scale recycling facilities in Sardina. At present (2021) there are: • **Composting plants**: 21 • **Anaerobic digestion & composting plants**: 1 • **Residual waste disposal**: 1 Incineration facility and various landfills

ECONOMICS AND FISCAL	
Collection costs	
Bio-waste treatment costs	~97 €/t for KW
Residual waste treatment costs	~172 €/t
Product marketing	• About 66,000 t/yr of compost produced (2021) • Compost is sold in bulk mainly to local farmers (56% of the production) and hobby gardeners (17%) • Average price for compost: 10 €/t (2017)

	• The regional authority carries out in cooperation with CIC – Italian Composting and Biogas Association, annual initiatives towards farmers and other potential users of compost that can benefit from using quality compost to restore soil organic matter and soil fertility   
Taxes and fees for households	• The waste fees are based on the size of the apartment and the number of persons per household • Some municipalities, including larger cities use fees applied to residual waste collection (PAYT), based on the volume and the frequency of waste collected

SOURCE OF INFORMATION AND IMAGES

- Ricci M., Intensive collection schemes for MSW with a specific focus on the strategic role of biowaste in the Regional Island Sardinia (Italy), Waste In Progress Conference, 2018
- CIC-Italian Compost and Biogas Association, Secondo Rapporto Compost Sardegna, 2019
- ISPRA, Annual data 2021 for MSW collection in Italy, Rome, 2022
- Pictures ® Marco Ricci, 2012, 2020

Further information:

- www.regione.sardegna.it

5 Comparing Best practice cases

This section includes the assessment of the best practice cases by means of a series of Key Performance Indicators proposed within a former activity of the project (**WP2 Definition of bio-waste indicators and data analysis**).

The following Table 5 and Table 6 show the short description of each KPI used for the cases evaluation, being the first one related to the collection and transport and the second one linked to the treatment. Further information and details can be found in the **LIFE BIOBEST D2.1 Improved and homogenised datasets on municipal bio-waste management in the EU**.

Table 5. KPIs for collection and transport

Type of data	KPI (Collection)	Function & Description
Quantitative KPI01	Quantity of bio-waste/food-waste collected (kg/person/year). KPI1 shows only KW amounts, when detailed by the BP case	Compares locally collected quantities with regional and national performances
Qualitative KPI02	Are commercial activities (e.g. restaurants, canteens, etc.) included in KPI01	Tracks information about the waste generator or the origin of the waste
Qualitative KPI03	Range of organic waste fractions allowed to be collected in KPI01	Number of bio-waste items allowed in the separate collection stream
Quantitative KPI04	Population connection rate to bio-waste/ food-waste collection scheme (% of total population)	Degree of implementation of a bio-waste collection scheme. The percentage indicates the share of the population that has a bio-waste bin at their home or is connected to a bring scheme
Quantitative KPI05	Contaminants inside bio-waste/food-waste collected (% of total bio-waste)	Quality of bio-waste as the degree of purity. Shows recycling potential at a treatment facility
Quantitative KPI07	Reduction of mixed/residual waste (% reduction with baseline year in kg/person/year)	Impact of bio-waste collection (and its setting) on mixed/residual waste quantities
Quantitative KPI08	Quantity of bio-waste inside residual waste (kg/person/year)	Allows to assess diversion of bio-waste towards recycling if KPI01 is known.
Qualitative KPI09	Ratio of collection frequency of bio-waste to mixed/residual waste collection (-)	Highlights the convenience of bio-waste collection compared to residual waste collection
Qualitative KPI10	Ratio between collection costs for bio-waste vs. collection costs for mixed/residual MSW (-)	Compares the cost for a municipality to collect bio-waste with the one for collecting mixed/residual MWS

Type of data	KPI (Collection)	Function & Description
Quantitative KPI11	Diversion rate of bio-waste/food-waste (% of bio-waste generated)	Describes quota of bio-waste/food waste collected separately vs. total generated. Specifies the effectiveness of the separate collection scheme set up, according to the quantities of bio-waste collected separately and non-separately. The percentage shows the part that is sent to recycling.
Quantitative KPI23	Economic incentives to promote separate collection of bio-waste or disincentives to dispose "bio-waste rich" residual waste	Shows if economic drivers are in place to interact with waste producers.

Table 6. KPIs for recycling and selling of compost or digestate

Type of data	KPI (Collection)	Function & Description
Quantitative KPI12	Ratio between rejects/total inputs (% of total input)	Describes recycling efficiency of a biological treatment facility
Quantitative KPI14	Ratio between treatment cost for bio-waste collected separately and cost for treating mixed /residual MSW (-)	Highlights the economic viability of bio-waste separately collected and sent to recycling compared to unsorted MSW disposal
Quantitative KPI15	Average price for compost/digestate sold (€/t)	Describes the average value of a compost/digestate product specific for a treatment facility
Quantitative KPI16	Premium price for compost/digestate sold (€/t)	Describes the premium value of a compost/digestate product specific for a treatment facility
Quantitative KPI20	Limit on contaminants for bio-waste accepted at composting/anaerobic digestion facilities	Assesses the amount of physical contaminants such as glass, metal, plastics allowed in collected bio-waste. Expressed as fresh matter

Table 7. Results from the best practice cases in the different KPIs

KPI type	KPI (Description)	Maia (PT)	Hernani (ES)	County of Bergueda (ES)	County of Debagoiena (ES)	Mataró (ES)	Catalunja Region (ES)	Sardinia Region (IT)	Milan (IT)	Parma (IT)	Bratislava (SK)	Krk Island (HR)	District of St. Pölten (AT)	District of Straubing (DE)	Münster (DE)	District of Kempen (BE)
Quantitative KPI01	Quantity of bio-waste/food-waste collected (kg/person/year)	44	90	125*1	26	42	56	138	91	101	44	220	66	88	55	61
Qualitative KPI02	Are commercial activities (e.g. restaurants, canteens, etc.) included in KPI01?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes		Partially	No	No
Qualitative KPI03	Range of organic waste fractions allowed to be collected in KPI01	All FW	All FW	All FW	All FW	All FW	All FW	All FW	All FW	All FW	All FW	All FW	All FW	All FW	Most FW & GW	Most FW & GW
Quantitative KPI04	Population connection rate to bio-waste/ food-waste collection scheme (% of total population)	43%	80%	90%	100%	100%	100%	100%	100%	100%	53%	100%	51%	70%	80%	70%
Quantitative KPI05	Contaminants inside bio-waste/food-waste collected (% of total bio-waste)		<1%	3%	5%	6%		3,3%	5,4%	3,3%	2,0%	8,5%		1,2%	4,2%	5,0%
Quantitative KPI07	Reduction of mixed/residual waste (% reduction with baseline year in kg/person/year)	-4%	-86%	-71%		-17%	-19%	-46%	-31%	-47%	-12%	-13%		-38%	-37%	-44%
Quantitative KPI08	Quantity of bio-waste inside residual waste (kg/person/year)	75	1	6	19	51	118	22	19	28,5	54				32	28
Qualitative KPI09	Ratio of collection frequency of bio-waste to mixed/residual waste collection (-)	8/1	3/1	3/1	3/1	3/7	3/1 D-t-D 4-3/6-7 R-C	3/1	2/1	2/1	2/1	2/0,5	2/1	1/1	2/1	1/1
Qualitative KPI10	Ratio between collection costs for bio-waste Vs. collection costs for mixed/residual MSW (-)		1,9		1,2	0,4					0.7			0,6	1,0	1
Quantitative KPI11	Diversion rate of bio-waste/food-waste (% of bio-waste generated)	37%	99%		84%	46%	32%	85%	84%	77%					74%	81%
Quantitative KPI12	Ratio between rejects/total inputs (% of total input)		40%			35%				23%				3%	10%	
Quantitative KPI14	Ratio between treatment cost for bio-waste collected separately and cost for treating mixed /residual MSW (-)	0,0	0,8	1,0	0,7	1,7		0,6	0,7	0,7	0,5					
Quantitative KPI15	Average price for compost/digestate sold (€/t)	55,0	15,0	6,0	15,0		4,0	10,0				33,4		12,5	7,5	18,0
Quantitative KPI16	Premium price for compost/digestate sold (€/t)		40,0	100,0										45,0		23,0
Quantitative KPI22	Limit on contaminants for bio-waste accepted at compost/AD facilities						20%									
Qualitative/ Quantitative KPI23	Economic incentives to promote separate collection of bio-waste or disincentives to dispose "bio-waste rich" residual waste	PAYT on residual waste					Premium/ Penalty scheme	Premium/ Penalty scheme		PAYT on residual waste		PAYT on residual waste	PAYT on residual & kitchen waste	PAYT on residual waste	PAYT on residual & kitchen waste	PAYT on residual & kitchen & garden waste

Note: *1 = FW + GW

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