



LIFE  
**BIOBEST**



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# LIFE BIOBEST

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

## D2.1: Improved and homogenized datasets

WP2: Definition of bio-waste indicators and data analysis

T2.1: Identification and analysis of existing data

JULY-AUGUST 2023

Public Report



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# 1 Document attributes

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## 1.1 Document Management Control Sheet

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Lead Authors:	Vera Brambilla (CIC), Irina Krutova (CIC), Eva Maria Lopez (CIC), Michele Giavini (CIC), Marco Ricci (CIC), Alberto Confalonieri (CIC)
Other Partners Involved:	ACR+, ECN, ZWE, ENT Steffen Walk (ECN) – Section 9
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Table 1. Document Management Control Sheet

## 1.2 Document Revision History

Version Number	Date	Version	Short Description of the Changes	Editor
0.1	10/07/23	1 <sup>st</sup> Draft	Document created as first version to be distributed	CIC
0.2	21/07/23	2nd Draft	Peer reviewers' contributions in track changes	ECN, ZWE
0.3	31/07/23	3rd Draft	Project coordinator revision in track changes	ENT
0.4	23/07/23	4th Draft	Linguistic and format revision in track changes	ENT
0.5	28/08/23	Definitive/ Approved	Updated version with the partners contributions, linguistic and format final revision  Definitive and approved version to be submitted	CIC
0.6	31/08/23	Submitted	Submitted to Participant portal in PDF	ENT

Table 2. Document Revision History

## 2 Executive summary

The target of this deliverable is to create an improved and homogenised dataset about municipal bio-waste management, as a result of an investigation on the current status of data collection and reporting across the European Union (EU), both at national and, whenever easily accessible, at lower jurisdictional level, including municipal.

The narrative section of this deliverable describes the methodology used and the main results achieved. Data were searched for by looking at official and open sources such as national institutes of statistics, environmental agencies, etc., but also at regional and municipal levels in order to find the most detailed information available.

The methodology included the organization of two Mirror Groups with relevant national and EU stakeholders and with a number of EU Umbrella Organisations engaged in Municipal Solid Waste (MSW) collection, recycling and the promotion of the circular economy. The research revealed main issues and barriers regarding data availability and reporting. The outcomes of these groups are described in an annex to the document.

As a summary, the main result was the creation of a database with all basic information and boundary conditions for bio-waste collection and treatment for almost all the 27 EU Member States, and a detailed dataset with more than 100,000 records, detailing the collection per capita of food waste and garden waste at municipal level for Italy, Denmark and Catalonia. The dataset and related tables are included as annexes to this document and will be used for a further statistical analysis to identify specific correlations, clusters and trends to be reported in D2.2.

During the investigation, it became clear that, besides overall bio-waste collection and recycling data requested by the EC for EUROSTAT, almost no Member State has implemented a consistent data management and reporting scheme aimed at gathering key parameters such as the distinction between food waste and garden waste, impurities, details about the treatment plants and the rejects delivered by the recycling process.

About the barriers and challenges identified, it's important to point out that, first of all, many Member States are lagging behind in separate collection of bio-waste, and as a consequence are not so well organised in data reporting and accessibility. The lack of coordination between public entities, governance, lack of standardisation, low willingness in showcasing data at municipal level are important barriers identified and to be overcome. Moreover, research reveals that Member States are not currently prepared to incorporate the new calculation method of preparation for reuse and recycling, which will have to be carried out excluding the amount of rejects generated during the composting and/or anaerobic digestion process.

Even though the situation shown in the 27 Member States is far from optimal, LIFE BIOBEST has identified two good examples in data availability and completeness to be considered as best practices to be replicated. One example is at the national level from Italy, where a

comprehensive dataset is publicly available including detailed information about collection, costs and treatment data. The other example is at the regional level from Catalonia, in which quarterly food waste characterization data at municipal level are published on a web portal. Both cases make their data available online, in one unique dataset and updated at least once per year.

Finally, Key Performance Indicators (KPI) have been defined and suggested to guide the European institutions that cover the aspects regarding national legislation about bio-waste management and consider the new EU – wide recycling targets calculation methodology, thereby focusing on the performances of separate collection and of the recycling plants. These KPIs have been conceived to be applicable both at the local level (e.g. per municipality or per facility) and the national level and will be used in the follow-up activities of the LIFE BIOBEST project.



### 3 Table of Acronyms

Acronym	Term
ARC	Waste Agency of Catalonia
CSV	Comma-separated values
dm	Dry Matter
DtD	Door-to-Door
EC	European Commission
EEA	European Environment Agency
EoW	End of Waste
EPA	Environmental Protection Agency
EPR	Extended Producers Responsibility
EU	European Union
EWC	European Waste Code
EXPRA	Extended Producer Responsibility Alliance
g	Gram
GFT	Vegetable, fruit and garden waste (Netherlands)
INE	National Statistics Institute (Spain)
ISPRA	Italian Institute for Environmental Protection and Research
JRC	Joint Research Centre
JSON	JavaScript Object Notation
kg	Kilogram
KPI	Key Performance Indicator

Acronym	Term
MBT	Mechanical Biological Treatment
MITECO	Ministry for the Ecological Transition and the Demographic Challenge (Spain)
MoE	Ministry of Environment
MSW	Municipal Solid Waste
NACE	Nomenclature of Economic Activities
NGO	Non-Governmental Organisation
PAYT	Pay As You Throw
QAS	Quality Assurance Scheme
SC	Success Case
SGI	Services of General Interest Europe
t	Metric Ton
VAT	Value Added Taxes
WEEE	Waste from Electrical and Electronic Equipment
WFD	Waste Framework Directive
WtE	Waste to Energy (e.g. incineration)
XML	Extensible Markup Language

Table 3. Table of Acronyms

## 4 LIFE BIOBEST Project Summary

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

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

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 Best Practices and management instruments to promote efficient collection and subsequent recycling of bio-waste into quality compost and digestate.

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

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

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

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

## 5 Background and scope

### 5.1 Regulatory framework on municipal bio-waste management and necessity for data collection and reporting

The regulatory background pushing EU Member States to a proper municipal bio-waste management is as follows:

- **Waste Framework Directive (WFD):** The WFD is the main piece of legislation governing waste management in the EU. It was adopted in 2008 and has been revised several times since then. The WFD sets out a number of requirements for Member States, including the need to collect and report data on waste generation and management.
- **Landfill Directive:** The Landfill Directive is another major regulatory instrument in the field of municipal waste management. It was adopted in 1999 and sets out a number of requirements for Member States, including the need to reduce the amount of waste (and, in particular, biodegradable municipal waste) sent to landfill.
- **Circular Economy Action Plan:** The Circular Economy Action Plan is a policy document adopted by the EC in 2020. It sets out several measures that the EU is taking to move towards a more circular economy. One of the key measures in the plan is the need to reduce food waste and increase bio-waste recycling.

In order to meet the requirements of the WFD, the Landfill Directive and the Circular Economy Action Plan, Member States are required to gather data on bio-waste management and to report it to the European Commission (EC) on an annual basis, which publishes it on the Eurostat's website<sup>1</sup>.

Bio-waste data reporting is an essential requirement for several reasons. Firstly, it helps to track progress in reducing food waste and increasing bio-waste recycling. Secondly, it allows to identify areas where further improvements can be made. Thirdly, it provides evidence of the effectiveness of policies and measures aimed at reducing food waste and increasing bio-waste recycling.

The Waste Statistics Regulation (EU) 2002/2150, amended by Regulation (EC) No 221/2009, sets out the specific information that Member States have to collect and report on municipal waste generation and management. The scope is to improve the quality and comparability of data. Currently, the information that Member States are required to gather regarding municipal bio-waste includes exclusively:

- The amount of bio-waste collected.

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<sup>1</sup> <https://ec.europa.eu/eurostat/web/waste/overview>

- The recycling method (e.g. composting, anaerobic digestion) and quantities recycled.
- The amount of bio-waste going to energy recovery or other recovery methods.

In addition, the EC is working to improve the quality of data on bio-waste management by developing a harmonized calculation method for bio-waste recycling focused on the flows effectively recycled and returned to soil<sup>2</sup>, improving the reporting of data and raising awareness of the importance of data collection and their evaluation.

To complement all these instruments, the EC has developed a number of policy support tools to help Member States to improve their bio-waste management systems, directly or in the framework of EU-funded projects. These are called the Bio-waste Management Policy Support Tools, which include guidance on bio-waste prevention, management planning and treatment. LIFE BIOBEST project is one of the projects (LIFE preparatory project) supported by the EC to provide guidance on implementing successful bio-waste recycling in EU Member States. In WP5 the project will identify policy and regulatory barriers to provide recommendations for closing the gap from bio-waste to soil.

## 5.2 Scope of LIFE BIOBEST research

Aiming at supporting EU policies by providing figures about the situation of Member States on the municipal bio-waste data collection and reporting, LIFE BIOBEST project has carried out research on existing datasets and best practices focusing on different territorial conditions across the EU, at different levels and with diverse contextual conditions.

The results from this datasets research are reported in Annex 1 (country/regional based) and Annex 2 (municipal based).

Barriers and challenges identified during the research activities and within discussions with stakeholders are included in a specific section 7.3.

In addition, a description of two existing best practices to be followed by Member States in order to ensure a correct municipal bio-waste data collection and reporting are included inside this document in section 8.

Finally, a set of KPIs has been proposed in order to guide European institutions on the most relevant parameters to be elaborated when drafting the bio-waste strategies out of collected data.

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<sup>2</sup> [https://publications.jrc.ec.europa.eu/repository/bitstream/JRC131531/JRC131531\\_01.pdf](https://publications.jrc.ec.europa.eu/repository/bitstream/JRC131531/JRC131531_01.pdf) JRC 2023. Chapter 4.4.

## 6 Methodology

### 6.1 Definition of indicators searched

In order to estimate the gap from bio-waste generation to recycled products, LIFE BIOBEST project has gathered data about the following quantitative and qualitative indicators at the national, and in some cases the regional, level.

Quantitative indicators are normally applicable to numerical parameters such as collected amounts and costs. However, a lot of qualitative indicators have been searched for because they represent the boundary conditions, sometimes called “enabling factors” which foster the proper and effective management of bio-waste. Their effect will be taken into account in subsequent tasks such as the statistical analysis of task 2.2.

- Legislation, Prescriptions (qualitative):
  1. Legal prescription/obligation in general for separate collection
  2. Legal prescription/obligation to sort for bio-waste specific waste generators
  3. Targets for separate collection (of bio-waste or MSW)
  4. Economic incentives to promote separate collection of bio-waste
  5. Economic disincentives to dispose bio-waste
- Reporting obligation (qualitative):
  6. Obligation to report data about bio-waste collection and recycling
  7. Frequency of reporting obligation
  8. Obligation to report data about bio-waste recycling facilities related to performances in recycling and quality of outputs
- Urbanisation:
  9. Type of urbanisation (% urban population) in 2021
  10. Number of inhabitants in 2021
  11. Fluctuant population (as % of resident population)
  12. Density of inhabitants (inhabitants per square kilometre)
- Main MSW key data:
  13. Year of most recent data on MSW
  14. Total MSW collected (tonnes)
  15. Separate collection (%)
  16. Total bio-waste collected separately (tonnes)
  17. Quota of population connected to bio-waste separate collection (%)
  18. Total MSW collected separately and sent to recycling (tonnes)
  19. Recycling rate of MSW (%)
  20. Municipal waste sent to composting/anaerobic digestion treatment (tonnes)
  21. Detailed data about MSW (e.g. composition)

22. Presence of regional data about bio-waste (yes/no)
- Description of bio-waste collection scheme:
    23. Collection model for bio-waste/food waste
    24. Collection model for green waste
    25. Collection model for residual waste
    26. PAYT on residual waste collection (yes/no)
    27. PAYT on bio-waste/food waste collection (yes/no)
    28. PAYT on green waste collection (yes/no)
    29. Frequency of collection for bio-waste/food waste
    30. Frequency of collection for bio-waste/green waste
    31. Frequency of collection for residual waste
    32. Type of waste generator involved in collection of food waste (qualitative)
  - Results of bio-waste collection:
    33. Quantities of bio-waste/food waste collected (kg/capita/year)
    34. Quantities of green waste collected (kg/capita/year)
    35. Quantities of residual collected (kg/capita/year)
    36. Impurities inside bio-waste/food waste collected (%)
    37. Impurities inside green waste collected (%)
    38. Percentage of bio-waste inside residual waste (%)
    39. Diversion rate of bio-waste/food waste (collected/generated) (%)
    40. Diversion rate of green waste (collected/generated) (%)
  - Costs for collection and treatment:
    41. Collection costs for bio-waste/food waste (€/capita)
    42. Collection costs for green waste (€/capita)
    43. Collection costs for residual waste (€/capita)
    44. Treatment costs (gate fee) for bio-waste/food waste (€/t)
    45. Treatment costs (gate fee) for green waste (€/t)
    46. Treatment costs (gate fee) for residual waste (€/t)
  - Bio-waste recycling (type of techniques, legislation):
    47. Bio-waste treatment facilities (number)
    48. Detail of recycling data (qualitative)
    49. Biodegradable waste to disposal (landfill or incineration) (tonnes, kg/capita/year or %)
    50. Recycling efficiency of treatment facility reject/input (%)
    51. Recycling efficiency of treatment facility compost/rejects (%)
    52. Dragging factor (% of rejects / % input contaminants)
  - Bio-waste recycling products (qualitative):
    53. Legislation about compost, End of Waste (EoW) status, standards
    54. Legislation about digestate, EoW status, standards

- 55. Existence of regional or national Compost/Biogas organisations
- 56. Data on compost quality
- 57. Data on digestate quality
- 58. Quota of compost/digestate produced under voluntary Quality Assurance Scheme (QAS) (%)
- Bio-waste management as a whole:
  - 59. Presence of quality assurance scheme QAS covering input, process and output requirements (qualitative)
- Barriers (qualitative):
  - 60. Regulatory/policy barriers to separate collection of bio-waste
  - 61. Level at which regulatory/policy barriers for separate collection manifest the most
  - 62. Other types of barriers to separate collection of bio-waste
  - 63. Regulatory/policy barriers to bio-waste recycling through composting and anaerobic digestion
  - 64. Level at which regulatory/policy barriers for bio-waste recycling manifest the most
  - 65. Other types of barriers to bio-waste recycling
- Others:
  - 66. Other relevant information

At the municipal level, LIFE BIOBEST has aggregated data of at least:

- Quantity of bio-waste collected per capita, divided into food waste and garden waste
- Inhabitants
- Population density
- Costs

Section 7.2 includes a detailed description of the datasets created.

## 6.2 Extent of data searched

In order to ensure the quality of the work during the assessment of the databases, it was decided to follow this decision-making process:

- Extensive research has been carried out on databases and framework background information openly available at national, regional and municipal level across the EU.
- Not only quantitative indicators but also qualitative ones (such as the presence of a regulatory framework promoting bio-waste collection and treatment) are the focus of



this research and have been included at national level (in some cases also at regional level).

- When databases at municipal level were available and highly detailed, they have been organised in a way to be further subject of a statistical analysis to be reported in D 2.2. “Statistical Analysis identifying best practices, successful and less successful cases”.
- In case no data was available or a difficulty in understanding certain information existed, direct conversations have been carried out by email or through personal/online meetings.
- Mirror Groups were organised so as to confirm the findings from the research and with the scope of gathering additional feedback about strategies to overcome the current barriers and data gaps identified on data collection and reporting (see Annex 3).
- In parallel, a set of existing and newly proposed indicators (LIFE BIOBEST KPIs) has been defined in the framework of the calculation of the new EU – wide recycling targets and a better evaluation of the results achieved for bio-waste recycling at the municipal, regional or national level.

### 6.3 Public data accessed

There are several places where open data about municipal waste management in the EU are available. They represent a valuable resource for a variety of stakeholders, including policymakers, researchers and industry stakeholders. Some of the most popular sources of open data about waste management in the EU include:

- **Eurostat:** Eurostat is the statistical office of the EU. It collects and publishes a wide range of data on a variety of topics, including waste management. Eurostat’s data on waste management are available in a variety of formats, including Comma-Separated Values (CSV), Extensible Markup Language (XML), and JavaScript Object Notation (JSON).
- **The European Environment Agency (EEA):** This Institution is an independent EU agency that provides information on the environment. The EEA uses information from Eurostat to generate secondary datasets on waste management, including data on waste generation, waste treatment and waste recycling.

In addition to the ones mentioned above, there are some other local sources of open data about waste management in the EU that have been investigated for the purpose of this task. These sources include:

- **National statistical offices:** Each Member State of the EU has a national statistical office that collects and publishes data on a variety of topics, including waste management. The data from national statistical offices are often available in a variety of formats.

- **Regional Governments or Environment Agencies:** many frontrunning regions host in their web portals a section on waste management which includes the possibility to export and download data.
- **Waste management companies:** Waste management companies sometimes collect and publish data on waste management.
- **Research organizations:** Several research organizations collect and publish data on waste management. These data can be a good source of information on waste management trends, waste management practices and waste management policies.

The table below shows the sources of open data at national level for all the EU 27 Member States and 2 at regional level (due to the existence of data on municipal level for these 2 regions), consulted for the preparation of the spreadsheets included in Annex 1 to this deliverable.

Member State	Summary page (web)	Direct link to the document/database	Reference year	Aggregation (N – national; R – regional; M – municipal)	Notes
AT		<a href="#">link 1</a>	2020	R	
BE	<a href="#">web</a>	no database	2020	N	Just national total "animal" and vegetable waste
BG	<a href="#">web</a>	<a href="#">link 1</a>	2020	N	No data on bio-waste
CY	<a href="#">web</a>	<a href="#">link 1</a>			To be translated and downloaded
CZ	<a href="#">web</a>	<a href="#">link 1</a>	2021	N	Waste code 200108 and 200201
DE	<a href="#">web</a>	<a href="#">link 1</a>	2021	R	Regional statistics also available on the <a href="#">map</a>
DK	<a href="#">web</a>	<a href="#">link 1</a> <a href="#">link 2</a>	2020	M, N	To be translated. More detailed statistics on this <a href="#">link</a>
EE	<a href="#">web</a>	<a href="#">link 1</a>	2021	M	
EL	<a href="#">web</a>		2020	N	No distinction between municipal and industrial waste. Only overall quantities by Nomenclature of Economic Activities (NACE) codes
ES	<a href="#">web</a>	<a href="#">link 1</a> <a href="#">link 2</a>	2020	N, R	Better report is the Ministry for the Ecological Transition and the Demographic Challenge (MITECO) report compared to National Statistics Institute (INE) data. Regional data and by treatment plant
FI	<a href="#">web</a>	<a href="#">link 1</a>	2021	N	
FR	<a href="#">web</a>	<a href="#">link 1</a> <a href="#">link 2</a>	2020	N	
HU	<a href="#">web</a>	<a href="#">link 1</a>	2020	R	Queries allow to filter for European Waste Codes (EWC) such as 200108 (food waste) and 200302 (garden waste)
IE	<a href="#">web</a>	<a href="#">link 1</a>	2020	N	The Environmental Protection Agency (EPA) collects data from all the collection companies but publishes only national summaries. Some summary statistics on <a href="#">this link</a> . Waste characterizations report on <a href="#">this link</a>
IT	<a href="#">web</a>	<a href="#">link 1</a>	2021	M	Detailed CSV database

Member State	Summary page (web)	Direct link to the document/database	Reference year	Aggregation (N – national; R – regional; M – municipal)	Notes
LV	<a href="#">web</a>	<a href="#">link 1</a>	2019	N	Detailed by waste code and treatment operation
LT	<a href="#">web</a>	<a href="#">link 1</a>	2021	N	Waste composition reports (mixed waste) on <a href="#">this link</a> . Some charts by region on <a href="#">this link</a>
LU	<a href="#">web</a>	<a href="#">link 1</a> <a href="#">link 2</a>	2020	M	Also detailed frequency data on sheet 4.1.6.1.2 of <a href="#">this file</a>
MT	<a href="#">web</a>	<a href="#">link 1</a> <a href="#">link 2</a>		N (M on request)	Disclaimer: Micro-data is not shared on a regular basis and it is only made available for ad hoc requests. The dataset is accessible as microdata broken down by EWC codes which are aggregated into the waste categories used for data dissemination
NL	<a href="#">web</a>	<a href="#">link 1</a>	2021	M	Vegetable, fruit and garden waste (commingled food and garden, no meat and fish, Dutch scheme) (GFT). Other queries can be done on <a href="#">this link</a> . Data on waste collection model and Pay As You Throw (PAYT) on <a href="#">this report</a> . Data on waste characterization on residual waste on <a href="#">this link</a>
PL	<a href="#">web</a>	<a href="#">link 1</a>	2021	M	Very detailed database and aggregates at municipal level (rural, city, county, etc.)
PT	<a href="#">web</a>	<a href="#">link 1</a>	2020	M	Include all Nomenclature of Territorial Units for Statistics (NUTS) to download the municipalities in 2020. Also the % of separate collection. Other queries can be done (per capita etc.)
RO	<a href="#">web</a>			N	ONLY national average recycling rate. Look under SDG12 – Target 3 on <a href="#">this link</a>
SK	<a href="#">web</a>		2021	R	Kitchen waste separated from biodegradable waste. More queries can be performed
SI	<a href="#">web</a>	<a href="#">link 1</a>			NO DATA on bio-waste collection, neither national nor local
SE	<a href="#">web</a>	<a href="#">link 1</a>		N	Statistics on <a href="#">this link</a> but no detail on municipal bio-waste (only code 9.1 "vegetable and animal waste")
Catalonia-ES	<a href="#">web</a>		2021	M	Separate data for home composting, kitchen waste (small amount of green waste allowed), garden waste and commercial generators.
Flanders-BE	<a href="#">web</a>		2021	M	Only residual waste is available on municipal level

Table 4. Sources of open data for 27 EU Member States and for 2 Regions

## 7 Results

### 7.1 Availability of data

The extensive research carried out by LIFE BIOBEST on databases openly available at municipal, regional and national level across the EU has shown that the current data collection and reporting performed by Member States is poor.

In some cases, the reason behind is the low level of implementation of separate collection of bio-waste; since many Member States are currently lagging behind in its implementation, data collection and reporting is scarce. In others, the lack of awareness among waste managers and policy-makers about the importance of data collection and reporting implies that this type of information is not being collected at all. This has already been addressed by the Early Warning Reports<sup>3</sup> issued by the EC.

The availability of national information on the EUROSTAT database is also scarce. It only includes the quantities of bio-waste (included under “food waste collected per capita”<sup>4</sup> and under “Total tons of animal and mixed food waste generated in households”<sup>5</sup>) and the quantities of bio-waste recycled (by composting and by anaerobic digestion)<sup>6</sup>.

It should also be highlighted that countries currently report to European Commission the amounts of bio-waste incinerated and recovered in other ways (e.g. MBT and other treatments not being composting and anaerobic digestion), but these data are currently not published by Eurostat.

The evaluation carried out by LIFE BIOBEST showed that economic data about MSW in general and specifically on bio-waste management are generally neither published nor available even, in some cases, for local authorities responsible for municipal waste management.

In addition, local authorities do not quote the comparison between the total cost for managing MSW and the coverage by revenues from waste taxes or fees, hence a

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<sup>3</sup>[https://environment.ec.europa.eu/publications/waste-early-warning-report\\_en](https://environment.ec.europa.eu/publications/waste-early-warning-report_en)

<sup>4</sup>[https://ec.europa.eu/eurostat/databrowser/view/CEI\\_PC035/default/table?lang=en&category=en.v.env\\_was.env\\_wasst](https://ec.europa.eu/eurostat/databrowser/view/CEI_PC035/default/table?lang=en&category=en.v.env_was.env_wasst) Indicator Food waste, online data code: CEI\_PC035

<sup>5</sup>[https://ec.europa.eu/eurostat/databrowser/view/ENV\\_WASGEN\\_custom\\_6724178/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/ENV_WASGEN_custom_6724178/default/table?lang=en) Filter only Households as generators. Under “Waste Category”, Animal and mixed food waste can be selected (W091) and Vegetal waste (W092)

<sup>6</sup>[https://ec.europa.eu/eurostat/databrowser/view/ENV\\_WASMUN\\_custom\\_4659616/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/ENV_WASMUN_custom_4659616/default/table?lang=en) In the field called Waste management operation select the option “recycling: composting and digestion” indicator RCY\_C\_D

fundamental factor for evaluating the sustainability of specific management solution cannot be assessed.

## 7.2 Datasets created

Annex 1 gathers the dataset created by LIFE BIOBEST from the evaluation of the indicators established in section 6.1 for the 27 Member States and 2 regions. Only the information that is publicly available is included in the report.

Annex 2 shows the dataset at municipal level for Italy (data from 2010 to 2021), Catalonia (Spanish Region; data from 2010 to 2021) and Denmark (data from 2016 to 2020) reporting:

- i. Quantity of bio-waste collected per capita, split into food waste and garden waste (kg/person/year)
- ii. Inhabitants
- iii. Population density
- iv. Separate collection model (only for Veneto Region from 2021)
- v. Costs of collection and treatment (only for Italy, historical data from 2011 to 2021)

This dataset at municipal level counts with 108,062 records and 10 years of data and will serve to the statistical analysis to be performed in Task 2.3 of the LIFE BIOBEST project. The only online available set of data with impurities level at municipal detail is from Catalonia.

## 7.3 Barriers

The barriers regarding data accessibility on bio-waste management in EU to be highlighted are the following:

- **Fragmented Data Sources:** One of the challenges is the fragmentation of data sources across different data holders and between EU Member States and regions. Each jurisdiction may have its own system for data collection, storage, and reporting, leading to inconsistencies and difficulties in aggregating and comparing data at the EU level.
- **Lack of Standardization:** The absence of standardized data collection methods and definitions – at all levels from municipal to regional – can hinder data accessibility. Different Member States might use varying criteria for categorising and measuring bio-waste, making it challenging to harmonise and analyse data on a broader scale.
- **Limited Transparency:** In some cases, there might be limited transparency in sharing bio-waste data. Data related to waste management practices, recycling rates, and treatment technologies may not be readily accessible to the public or researchers, making it difficult to assess the effectiveness of bio-waste management strategies and identify areas for improvement, also considering the mandatory requirement for the output products to be beneficial for the soil. A typical example about this is the absolute lack of public data about impurities in food waste collected, except the best practice case of Catalonia. Other missing data refer to the amount of bio-waste inside residual

waste. Both information is crucial for the calculation of the new recycling targets of the EU.

- **Data Privacy Concerns:** Bio-waste management involves handling some sensitive data related to waste treatment plants economics. Striking a balance between data accessibility and privacy protection is crucial. Commercial and marketing privacy concerns are also an issue.
- **Technical Challenges:** Data accessibility can be hindered by technical challenges, such as outdated or incompatible data systems across different regions of the same Member State. Inefficient data collection processes, inadequate data infrastructure and limited interoperability between systems can impede data sharing and hinder accessibility.
- **Capacity and Resources:** Some Member States or regions may face resource constraints, such as limited financial and human resources, to implement robust data collection and management systems. This is specifically the case for bio-waste, which does not benefit from any Extended Producers Responsibility (EPR) scheme unlike packaging waste, which can support financially also data collection and reporting. Insufficient capacity to collect, analyse and disseminate data can impede accessibility and hinder evidence-based decision-making. A specific incentive scheme for bio-waste (such as a landfill tax linked to benefits for bio-waste collection and treatment) is needed.
- **Governance and Coordination:** Effective data accessibility often requires strong governance and coordination mechanisms at both national and EU levels. Challenges may arise due to differing priorities, policies and approaches to data management among Member States, potentially hindering collaboration and information sharing.

Almost no Member State is prepared to provide readily available data with respect to the new EU calculation method of effective recycling which is based on the subtraction of rejects generated during the treatment process.

The stakeholders participating in Mirror Group A (see full information in Annex 3) recommended to address two main barriers to have unified data describing bio-waste collection and recycling, namely:

1. the lack of obligation for local authorities to report the data to a regional or national institutions, and
2. the lack of infrastructures/websites to collect these data besides understaffed authorities responsible to coordinate the data management.

This was also suggested by the experts participating in Mirror Group B, which identified the lack of coordination among data holders, followed by the lack of obligation for local authorities and recycling plants to report data to regional/national institutions as the main barriers to overcome.

Regarding the lack of standardization for data definition and collection, experts of Mirror Group B further suggested Eurostat to make public the full level of data they receive from EU Member States, noting the data at the level of municipalities, as well as the provision of an EU guide on how data should be reported, identifying the requirements for different level of local authorities.

## 8 Best Practices in data collection and reporting

The Best Practices in the availability of data regarding MSW management in general and specifically related to the bio-waste collection and recycling were investigated at the national or at the regional level; this level is basically the same addressed by both EU regulatory targets and by the structure of national MSW legislation that generally delegates waste management responsibility and proximity of treatment to regions.

The identified Best Practices are characterised by including:

- Data about MSW generation and bio-waste collection with a detail at the local, regional and national level.
- Data about different types of bio-waste streams collected, distinguishing the quantities for garden/park waste, food waste, etc. at the local, regional and national level. In some cases, also data from different types of waste producers (i.e. non households)
- Data about costs for MSW collection, treatment and recycling with a detail at the local, regional and national level.
- Data about the quality/contaminants inside bio-waste at the local level or at the level of single recycling facilities.
- Data about the inputs, outputs and rejects at the level of single recycling facilities.

All data mentioned are updated once per year, hence with a frequency fully in line with the timing of the reporting obligation established by the EU legislations. The datasets are also easily accessible online on a unique database. The following subsections show one Best Practice at national level (Italy) and one at regional level (Catalonia-Spain).

The whole dataset included header translated into English are summarised into the XLS databases (Annex 2).

### 8.1 Best Practice from the Italian Institute for Environmental Protection and Research (ISPRA) (IT)

The Italian open data portal on waste management<sup>7</sup> is a Best Practice with respect to the level of detail about bio-waste collection and treatment. Data can be downloaded in .csv spreadsheets with details of all bio-waste treatment facilities and municipal level open information on food waste and garden waste captures for the last 10 years. Also detailed

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<sup>7</sup> <https://www.catasto-rifiuti.isprambiente.it>



waste management costs are available at municipal level. Screenshots showing the high level of detail are included below.

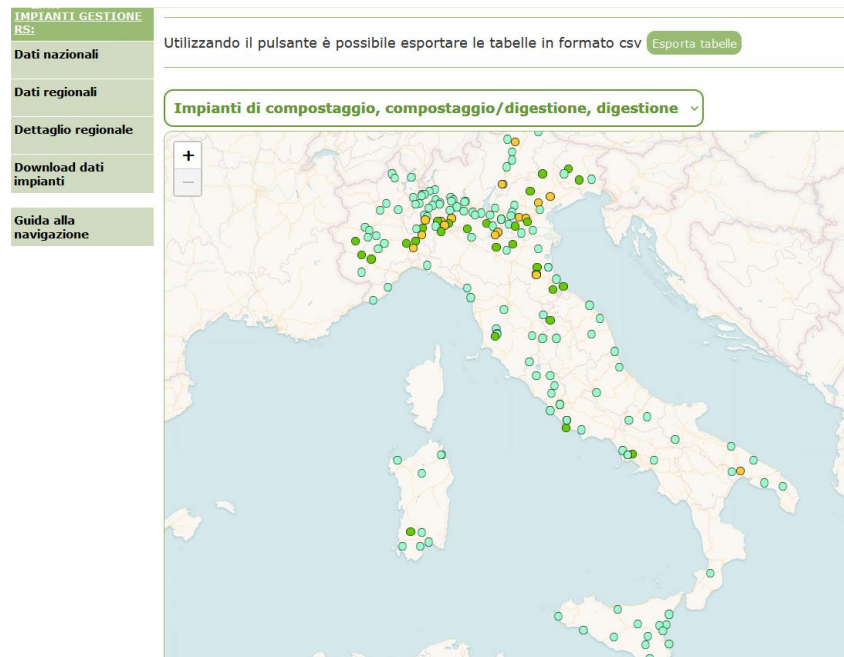


Figure 1. Map of the Italian composting (blue), anaerobic digestion plants (orange) and combination of both processes (green). Details can be downloaded as spreadsheets.

Produzione e raccolta differenziata su scala comunale anno 2021 (ISPRA)																								
IstatComune	Regione	Provincia	Comune	Popolazione	Dato riferito a	Frazione umida(t)	Verde (t)	Carta e cartone (t)	Vetro (t)	Legno (t)	Metallo (t)	Plastica (t)	RAEE (t)	Tessili (t)	Selettiva (t)	Rifiuti da C e D (t)	Pulizia stradale recupero (t)	Ingombranti a recupero (t)	Altro (t)	Totale RD (t)	Ingombranti a smaltimento (t)	Indifferenziato (t)	Totale RU (t)	Percentuale RD (%)
01001001	Piemonte	Torino	AGLIE'	2549	Comune	262,711	226,06	92,881	98,494	46,688	13,572	45,593	11,828	16,483	0,75	6,377	5,489	48,296	1,868	877,09	-	532,873	1.409,96	62,21%
01001002	Piemonte	Torino	AIRASCA	3653	Comune	175,045	136,057	166,025	104,487	101,768	11,385	105,002	8,459	10,8	3,92	13,76	-	100,718	-	937,426	-	786,49	1.723,92	54,38%
01001003	Piemonte	Torino	ALA DI STURA	467	Comune	2,68	12,207	32,94	55,736	0,151	0,898	6,131	0,044	1,29	0,008	0,147	-	34,945	0,005	147,181	-	250,3	397,481	37,03%
01001004	Piemonte	Torino	ALBIANO D'IVREA	1628	Comune	160,384	22,861	68,255	64,745	69,482	9,361	38,625	10,446	10,94	1,494	24,555	-	18,535	3,508	503,191	-	207,436	710,627	70,81%
01001005	Piemonte	Torino	ALMESE	6310	Comune	458,327	1.015,30	367,29	276,557	171,265	44,719	191,173	41,743	4,03	10,603	95,325	49,503	133,175	6,851	2.865,87	-	803,105	3.668,97	78,11%
01001006	Piemonte	Torino	ALPETTE	240	Comune	1,954	-	14,05	17,917	1,7	0,953	10,963	0,04	-	0,212	-	-	16,993	0,13	64,912	-	81,601	146,513	44,31%
01001007	Piemonte	Torino	ALPIGNANO	16438	Comune	1.239,81	663,07	1.023,71	-	715,499	23,17	504,162	69,808	35,17	23,206	205,06	201,708	258,33	8,32	4.971,02	-	2.492,63	7.463,65	66,60%
01001008	Piemonte	Torino	ANDEZENO	2029	Comune	197,41	113,024	118,28	86,981	38,396	9,763	76,094	4,535	0,335	2,322	18,038	9,54	33,462	0,842	709,022	-	267,145	976,167	72,63%
01001009	Piemonte	Torino	ANDRATE	474	Comune	44,266	-	13,255	40,981	7,448	4,623	11,375	3,909	1,06	0,378	1,752	-	10,532	0,49	140,069	-	66,645	206,714	67,76%
01001010	Piemonte	Torino	ANGROGNA	825	Comune	7,548	36,872	22,816	29,036	25,183	2,362	17,32	2,501	1,53	0,93	2,926	-	19,328	-	168,352	-	112,3	280,652	59,99%
01001011	Piemonte	Torino	ARIGNANO	1071	Comune	125,47	7,443	44,851	43,296	12,403	5,531	38,887	2,224	-	1,398	10,125	1,98	9,677	0,485	303,77	-	131,5	435,27	69,79%
01001012	Piemonte	Torino	AVIGLIANA	12328	Comune	979,869	876,513	766,429	612,953	299,422	71,794	395,454	63,217	40,15	16,985	139,513	111,487	216,381	8,601	4.598,77	-	2.440,57	7.039,34	65,33%
01001013	Piemonte	Torino	AZEGLIO	1236	Comune	129,491	1,796	74,558	44,191	43,642	8,69	39,169	6,786	10,367	0,875	15,287	-	19,372	1,582	395,806	-	162,569	558,375	70,89%

Figure 2. ISPRA database at municipal level with details of separately collected fractions ("Frazione umida" = food waste; "Verde" = Green waste).

Costi comunali pro capite - Regione Italia - anno 2021 (ISPRA)												
(i dati sui costi sono espressi in (Euro/abitante*anno))												
IstatComune	Comune o Aggregazione	Provincia	Numero di Pop.(abita	CRTab	CTSab	CRDab	CTRab	CSLab	CCab	CKab	Altri costi	CTOTab
19084001	Agrigento	Agrigento	1	55.636	14,9	26,27	79,6	41,83	20,1	55,85	49,25	287,8
19084004	Bivona	Agrigento	1	3.226	5,39	20,66	26,96	39,52	-	25,35	3,1	120,98
19084007	Caltabellotta	Agrigento	1	3.221	14,55	32,63	48,62	26,44	-	24,88	15	162,13
19084010	Campobello di Licata	Agrigento	1	9.093	27,16	21,89	54,49	25,04	23,83	59,54	118,69	330,64
19084015	Cianciana	Agrigento	1	3.099	10,6	25,45	66,09	21,41	9,68	15,57	34,87	183,68
19084017	Favara	Agrigento	1	31.601	39,76	42,97	39,59	7,42	48,44	23,3	9,85	230,38
19084018	Grotte	Agrigento	1	5.223	24,79	8,73	51,45	26,7	15,25	57,58	44,02	280,45
19084021	Licata	Agrigento	1	34.341	43,13	67,37	14,65	17,13	12,15	46,17	17,65	218,25
19084024	Montallegro	Agrigento	1	2.369	16,99	54,33	84,7	53,37	28,48	12,13	12,13	262,14

Figure 3. Details at municipal level of waste collection and treatment costs ("CRT: Cost collection of mixed waste"; "CTS: treatment cost for mixed waste"; "CRD: collection cost for recyclables"; "CTR: treatment cost for recyclables"; "CSL: street sweeping cost"; "CC: other common costs"; "CK: capital investment costs").

*Gestione dei rifiuti urbani*

**Tabella 3.17 – Impianti di compostaggio dei rifiuti (tonnellate) – Lombardia, anno 2021**

Provincia	Comune	Quantità autorizzata	Totale rifiuti trattati	Tipologie del rifiuto trattato				(2) Tecnologia fase di bioossidazione	Output dell'impianto					
				Frazione umida	Verde	Fanghi	(1) Altro		Quantità dei prodotti in uscita					Totale output
									(3) acv	(4) acm	(5) acf	altro	scarti	
VA	Bodio Lomnago	500	444	-	444	-	-	cr	444	-	-	-	-	444
VA	Castelseprio	11.150	10.777	-	10.663	-	114	cr	3.412	-	-	-	5	3.417
VA	Comabbio	980	700	-	700	-	-	cr	700	-	-	-	-	700
VA	Gallarate	32.000	18.688	-	15.928	-	2.760	csa	6.222	-	-	-	5.553	11.775
VA	Galliate Lombardo	200	140	-	140	-	-	cr	140	-	-	-	-	140
VA	Galliate Lombardo	3.000	2.960	-	2.960	-	-	cr	2.960	-	-	-	-	2.960
VA	Luino	9.000	8.602	-	8.600	-	2	cr	4.520	-	-	-	553	5.073
VA	Solbiate Arno	400	49	-	49	-	-	cr	49	-	-	-	-	49
VA	Somma Lombardo	250	22	-	22	-	-	cr	22	-	-	-	-	22
VA	Tradate	21.000	18.537	-	18.537	-	-	cr	16.046	-	-	-	12	16.058

Figure 4. Annual report from ISPRA detailing the amounts licensed (“Quantità autorizzata”), treated (“Totale rifiuti trattati”), composting technology (“Tecnologia fase di bioossidazione”), total output (“Totale Output”), output category (“ACV”, “ACM”, “ACF”, “altro”) and rejects generated (“scarti”).

Tabella 3.19 - Impianti di digestione anaerobica dei rifiuti – Lombardia, anno 2021

Provincia	Comune	Quantità autorizzata (t/a)	Totale rifiuti trattati (t/a)	Quantità di rifiuto trattato (t/a)				Digestato prodotto (t/a)	Scarti (t/a)	Biogas prodotto (Nm <sup>3</sup> )	Recupero energetico (MWh/anno)			Biometano prodotto (Nm <sup>3</sup> )
				Frazione umida	Verde	Fanghi	(1) Altro				Energia elettrica	Energia termica	Cogenerazione energia elettrica e termica	
CO	Mozzate	36.135	32.660	32.660	-	-	-	(2) 5.320	6.170	3.652.300	-	-	8.193	-
PV	Vellezzo Bellini	120.000	112.043	-	-	104.638	7.405	(3) 124.591	6	4.499.943	9.249	9.471	-	-
PV	Voghera	27.000	11.852	7.796	-	-	4.056	(4) 2.473	718	768.627	2.050	-	-	-
CR	Castelleone	30.400	30.379	26.529	-	-	3.850	(3) 91.910	5.123	6.425.803	-	-	12.519	-
MN	Pegognaga	30.830	3.525	-	-	3.525	-	(5) 4.548	29	2.388.860	4.217	2.623	-	-
MN	San Benedetto Po	24.300	24.195	24.195	-	-	-	(6) 21.408	5.563	4.001.935	8.006	-	-	-
LO	Ospedaletto Lodigiano	57.100	51.461	-	-	48.082	3.379	(4) 3.717	-	2.876.431	6.787	6.678	13.465	-
LO	Villanova del Sillaro	29.900	19.391	18.740	-	-	651	(6) 12.492	3.594	2.236.331	-	2.978	-	(7) 747.057
<b>Totale</b>		<b>355.665</b>	<b>285.506</b>	<b>109.920</b>	<b>0</b>	<b>156.245</b>	<b>19.341</b>	<b>266.459</b>	<b>21.203</b>	<b>26.850.230</b>	<b>30.309</b>	<b>21.750</b>	<b>34.177</b>	<b>747.057</b>

Figure 5. Annual report from ISPRA detailing for the anaerobic digestion plants: the amounts licensed (“Quantità di rifiuto trattato”), the amount of rejects produced (“Scarti”), the energy produced (“Recupero energetico”) and the biomethane generated (“Biometano prodotto”).

## 8.2 Best Practice from the Waste Agency of Catalonia (ARC) (ES)

The Catalanian waste data collection is a Best Practice both in terms of publicly available data about municipal collection (see Figure 6) and most importantly because of the reporting system of municipal food waste characterizations, quarterly based and also linked to the refund of the landfill tax. The results are published on an open web portal<sup>8</sup>, so they are available to the public (see Figure 7); in this portal, every single characterization report can be downloaded including the set of pictures taken during the sampling (such as the types on contaminants, the types of avoidable food waste and others), as well as the amount of food waste measured. Interestingly enough, all this analysis and reporting system is completely financed by the landfill and incineration tax, which also funds a reimbursement to municipalities based on the amount and the quality of food waste collected and treated<sup>9</sup>.

Estadística de la recollida selectiva bruta i generació de residus municipal a Catalunya, ANY 2022											
Codi DNE	Població	Autocompostatge	Matèria orgànica	Pedra i jardineria	Suma selecció Recollida Selectiva	R.S. / R.M. % selecció	Kg / hab / any selecció	Total Recollida Selectiva	R.S. / R.M. % total	Kg / hab / any total	
BADALONA	080155	223.506	0,00	5.668,36	897,33	6.565,69	6,82	29,38	26.168,10	28,33	117,08
BADIA DEL VALLÈS	089045	13.163	3,00	599,66	210,59	813,25	14,54	61,78	1.854,87	34,43	140,92
BARBERÀ DEL VALLÈS	082520	33.082	2,80	1.628,76	337,69	1.969,25	14,34	59,53	5.629,94	43,28	170,18
BARCELONA	080193	1.636.193	142,20	106.731,92	7.329,95	114.204,07	15,23	69,80	299.896,08	40,30	183,26
BEGÜES	080207	7.450	26,20	184,46	912,13	1.122,79	22,06	150,71	2.407,33	53,98	323,13
CASTELLBISBAL	080543	12.735	28,80	798,42	516,20	1.343,42	20,32	105,49	2.998,62	48,52	235,46
CASTELLDEFELS	080569	67.307	87,60	2.847,02	3.196,31	6.130,93	17,22	91,09	14.341,82	42,09	213,08
CERDANYOLA DEL VALLÈS	082465	57.291	0,00	2.908,64	650,14	3.558,78	14,41	61,12	9.406,53	38,99	164,19
CERVELLÓ	080689	9.307	3,00	141,88	134,47	276,35	5,01	30,02	1.208,17	23,02	129,81
CORBERA DE LLOBREGAT	080728	15.210	40,20	1.132,72	943,80	2.116,72	31,61	139,17	3.735,63	58,95	245,60
CORNELLÀ DE LLOBREGAT	080734	89.039	109,00	2.535,96	160,98	2.805,94	8,04	31,51	11.207,46	33,05	125,87
ESPLUGUES DE LLOBREGAT	080771	46.414	4,60	1.786,86	463,44	2.254,90	12,14	48,58	6.904,08	38,14	148,75
GAVÀ	080898	46.974	30,80	1.707,97	1.459,26	3.198,13	13,93	68,08	8.959,83	38,48	182,44
HOSPITALET DE LLOBREGAT, L'	081017	265.444	5,50	5.356,67	182,88	5.545,05	5,26	20,89	27.997,58	27,27	105,47
HOLINS DE REI	081234	26.242	1,40	1.137,73	198,51	1.337,64	11,77	50,97	4.045,53	37,17	154,16
MONTCADA I REIXAC	081252	36.666	16,40	2.056,12	123,21	2.195,73	17,99	87,18	7.424,77	43,81	202,50
MONTGAT	081265	12.277	19,50	796,24	243,31	1.059,05	21,37	86,28	2.439,56	59,70	198,71
PALLEJÀ	081574	11.593	29,60	591,40	500,06	1.121,06	16,97	96,70	2.823,70	49,99	252,20
PALMA DE CERVELLÓ, LA	089050	3.026	5,40	236,84	9,02	241,26	19,77	79,73	560,04	46,56	185,08
PAPIOL, EL	081580	4.274	3,40	312,22	76,06	391,68	17,95	91,64	992,92	51,30	232,32
PRAT DE LLOBREGAT, EL	081691	65.030	0,00	2.781,66	772,63	3.554,29	11,79	54,66	10.757,17	37,64	165,42
RIPOLLIT	081803	39.031	6,80	1.902,78	35,48	1.945,06	13,38	49,83	6.093,43	44,49	156,12
SANT ADRIÀ DE BESÒS	081944	36.918	0,00	622,52	213,46	835,98	5,33	22,64	4.196,05	27,06	113,66
SANT ANDREU DE LA BARÇA	081960	26.965	3,50	801,51	330,99	1.136,00	9,27	42,13	3.775,58	31,84	140,02
SANT BOI DE LLOBREGAT	082009	83.371	62,40	2.861,75	300,37	3.224,52	8,85	38,68	12.960,35	34,92	144,66
SANT CLIMENT DE LLOBREGAT	082042	4.170	0,00	144,87	7,53	152,40	8,82	36,55	543,09	33,97	130,24
SANT CUGAT DEL VALLÈS	082055	95.725	189,30	6.631,34	2.068,34	8.888,98	22,76	92,86	19.154,02	49,82	200,09
SANT FELIU DE LLOBREGAT	082114	45.642	36,10	1.346,24	308,95	1.691,29	9,90	37,06	6.260,60	37,94	137,17
SANT JOAN DESPÍ	082172	34.039	15,10	1.715,77	311,18	2.042,05	15,26	59,99	5.369,61	41,32	157,75
SANT JUST DESVERN	082212	19.806	36,90	1.733,05	491,33	2.261,28	24,85	114,17	5.152,38	59,45	260,14
SANT VICENÇ DELS HORTS	082634	28.079	0,00	983,15	252,19	1.235,34	8,56	44,00	4.474,42	33,84	159,35
SANTA COLOMA DE CERVELLÓ	082444	8.309	26,70	266,72	146,96	440,38	10,90	53,00	1.499,43	41,01	180,46
SANTA COLOMA DE GRAMENET	082457	117.981	0,00	1.567,01	895,68	2.162,69	4,74	18,33	11.014,61	24,76	93,36
TIANA	082824	9.110	38,60	784,80	401,52	1.224,92	26,22	134,46	3.301,50	78,79	362,40
TORRELLES DE LLOBREGAT	082896	6.186	38,50	388,26	251,24	678,00	27,92	109,60	1.298,76	58,55	209,95
VILADECANS	083015	66.720	66,00	1.775,19	642,01	2.483,20	8,68	37,22	9.222,50	33,76	138,23
<b>Total Selecció</b>		<b>3.304.275</b>	<b>1.079,30</b>	<b>166.456,47</b>	<b>25.675,30</b>	<b>193.211,07</b>	<b>13,49</b>	<b>58,47</b>	<b>544.846,06</b>	<b>38,06</b>	<b>164,89</b>
<b>Desglossament de la selecció:</b>											
- Comercials <sup>1</sup>		0	0,00	11.402,37	0,00	11.402,37	0,00	0,00	34.643,82	0,00	0,00
- Domèstics		0	0,00	0,00	25.675,30	25.675,30	0,00	0,00	198.044,25	0,00	0,00
- No desglossat <sup>2</sup>		0	1.079,30	155.054,10	0,00	156.133,40	0,00	0,00	312.157,99	0,00	0,00
<b>Total Catalunya</b>		<b>7.792.611</b>	<b>7.189,60</b>	<b>439.262,97</b>	<b>115.827,80</b>	<b>562.280,37</b>	<b>56,228.036,94</b>	<b>72,16</b>	<b>1.740.359,52</b>	<b>45,33</b>	<b>223,33</b>

\* Totes les quantitats són tones

\*\* Les dades de població corresponen als habitants empadronats.

\*\*\* El sistema de recollida de Residu Mínim no es considera Recollida Selectiva des de l'any 2022 per no reunir els requisits que estableix la Ley 7/2022, de 8 de abril, de residuos y suelos contaminados en el seu Article 25.2 sobre la recollida separada de materials, i per incomplir les condicions establertes a l'article 25.6 i 7 per l'exempció de la obligació de recollir per separat els residus.

\*\*\*\* En concordància amb la normativa sobre el càlcul d'objectius de reciclatge, a partir de l'any 2020 la runa no es comptabilitza dins de la recollida selectiva dels residus municipals

<sup>1</sup> Per Matèria orgànica: tones recollits en circuits comercials privats. Per Vidre, Paper i Envàsos: tones recollits en circuits comercials públics

<sup>2</sup> Residus domèstics i comercials recollits conjuntament en circuits públics

Vegeu també el document Metodologia d'obtenció de dades estadístiques dels residus municipals a Catalunya.

Figure 6. Type of municipal collection data openly accessible on the web portal of the Waste Agency ARC. In the bottom rows a detail on generators (commercial, households, commingled) is available.

<sup>8</sup> <https://sdr.arc.cat/cform/ListCaracteritzacions.do>

<sup>9</sup> [https://www.decisive2020.eu/wp-content/uploads/2019/12/02-Separate-collection-system-in-Catalonia\\_TGuerrero-NSansebasti%C3%A1n-ARC.pdf](https://www.decisive2020.eu/wp-content/uploads/2019/12/02-Separate-collection-system-in-Catalonia_TGuerrero-NSansebasti%C3%A1n-ARC.pdf)

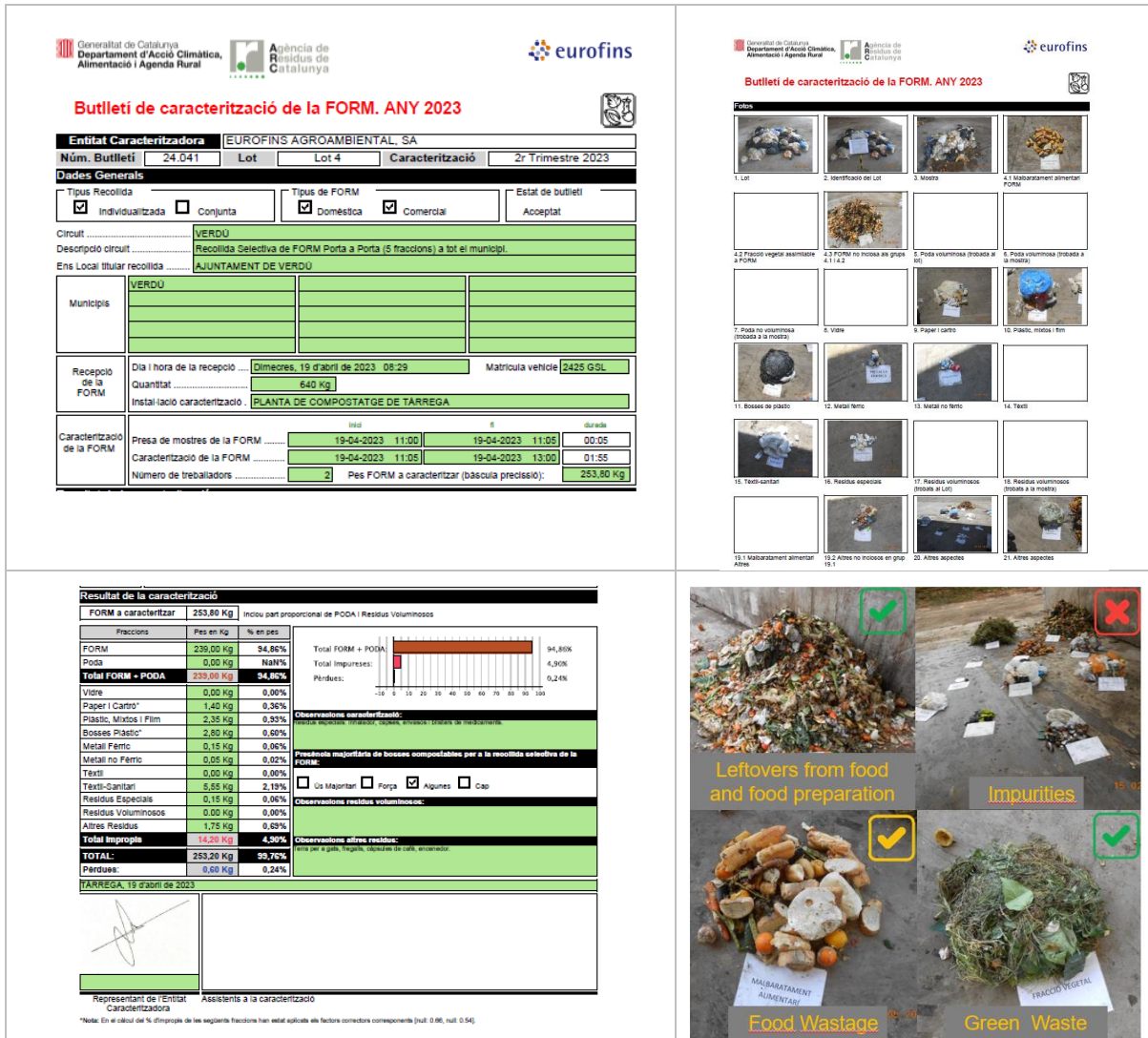


Figure 7. Example of a municipal food waste characterization report performed in Catalonia, openly accessible on the web portal of the Waste Agency of Catalonia.



## 9 Key Performance Indicators identified

A set of Key Performance Indicators (KPIs) have been identified starting from the data mining and collection process and the preparation of databases. They are considered by the LIFE BIOBEST project as the reference indicators that facilitate the assessment of the bio-waste management situation of a territory and the design of future strategies. They are presented in section 9.1 to 9.3. The section 9.4 is dedicated to list the success cases that have been identified with project partners and that is currently under assessment.

KPIs are divided into three distinct groups, representing the relevant and basic steps of the bio-waste recycling supply chain:

- Collection (& transport)
- Recycling (Composting, Anaerobic Digestion (AD) or combined)
- Enabling legislation or regulation

Each KPI has been further described as “Quantitative” or “Qualitative” depending on the type of information it provides or assesses.

The KPIs related to the enabling legislation addressing collection and recycling have been defined so as to be applicable to different types of organic waste streams such as garden/park waste, food waste or other bio-waste streams collected (i.e. vegetable, fruit and garden waste). Hence, they can be assessed for collection schemes performed in all EU Member States investigated by the LIFE BIOBEST project. These KPIs are neutral regarding the type of housing structure or the type of urbanisation (i.e. urban vs rural areas).

The KPIs related to recycling are applicable to different types of plants for recycling bio-waste (i.e. composting, anaerobic digestion or combined). The indicators address the technical performance of single facilities in terms of compost or digestate yields and the economics of recycling compared to local cost for disposing MSW, which include Mechanical Biological Treatment (MBT), Waste to Energy (WtE) or direct landfilling of MSW/residual waste.

The technical information necessary to assess the KPIs mentioned above typically comes from local municipalities responsible for MSW management and from the recycling facilities. The aim of the KPIs is to assess the data on the most local possible level since averages generated on a district or more regional level cannot fully describe the differences, especially in collection systems that potentially define a best practice example.

## 9.1 Key Performance Indicators for collection and transport

Type of data	KPI (Collection)	Function & Description	Comment
Quantitative KPI01	Quantity of bio-waste/food-waste collected (kg/person/year)	Compares locally collected quantities with regional and national performances	Comments on quantitative data by describing which waste producers are included into the scheme. Does not include information on the actual composition of the waste stream Data (fresh matter) including contaminants. Comments on if home/decentralised composting was promoted and to which extent Important to know KPI02 for the comparison of quantities
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	Specifies if amounts of KPI01 include only waste from households or also municipal quantities collected systematically at commercial producers (e.g. restaurants, canteens, etc.) Collection of bio-waste at these producers may bias the data per capita Possible answers: Yes/Partially/No
Qualitative KPI03	Range of organic waste fractions allowed to be collected in KPI01	Number of bio-waste items allowed in the separate collection stream	Indicates if the collection scheme is likely to collect a certain range of food residues thus potentially having an impact on the quantity of putrescible material in residual waste Possible options: <ol style="list-style-type: none"> <li>1. Food/kitchen waste only</li> <li>2. Food waste without meat &amp; fish</li> <li>3. Food waste limited to Vegetable Garden Fruit (VGF) = including only plant-based items</li> <li>4. Bio-waste= Food/kitchen waste and garden waste</li> </ol>
Quantitative KPI04	Population connection rate to bio-waste/food-waste collection	Degree of implementation of a bio-waste collection scheme. The percentage indicates the share of the population that	Percentage should be assessed on a local level (e.g. municipality, region or intermunicipality)



Type of data	KPI (Collection)	Function & Description	Comment
	scheme (% of total population)	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	<p>Requires a waste composition analysis. Assessment on a fresh matter basis. Needs to include definition of which materials are considered as contaminants</p> <p>Consider contaminants as: metals, glass, conventional plastics, Waste from Electrical and Electronic Equipment (WEEEs), tyres and other bulky waste. Biodegradable and compostable plastics should also be mentioned separately regardless, if allowed or not</p> <p>Potentially relies on KPI03. Specify if contaminants relate to either food waste or green waste (mixed bio-waste collection might have lower impurities due to dilution effect)</p>
Quantitative KPI06	Ratio of conventional plastic bags to biodegradable plastic bags (-)	Percentage of bags that comply or do not comply with the sorting instructions on the use of carrier materials for bio-waste collection	<p>Compostable bags = paper or bioplastics complying with EN13432 standard</p> <p>Express result as a fraction (e.g. 4/1) or %</p>
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	<p>Can be used to assess the effects of bio-waste separate collection introduction or changes in the collection system (e.g. change of collection fee, introduction of a PAYT fee system). A steady reduction over a longer period or a sharp decrease in residual waste can be an indicator for a successful waste management plan</p> <p>Can be used to identify Best Practice cases that are worth a more detailed investigation</p> <p>The considered baseline year with the result should be indicated</p>
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.	<p>Requires a waste composition analysis. (Possibly specify what methodology has been applied to perform the waste composition analysis)</p> <p>Fundamental to correctly assess the diversion rate</p>

Type of data	KPI (Collection)	Function & Description	Comment
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	Describes the level of convenience towards bio-waste collection compared to residual waste collection KPI to be applied mainly to schemes with fraction delivery calendar like door-to-door (DtD) schemes To be assessed on a local level (municipality). Average can be used on a regional level Express result as a fraction (e.g. 3/1)
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	Allows to assess the cost efficiency of the two main schemes for MSW collection Cost shall include Value Added Taxes (VAT) if VAT is a cost for local authorities Express result as a fraction (e.g. 4/2)
Quantitative 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	This indicator can be approached on 2 sub-levels by calculating it with different information depending on their availability with increasing level of detail: <ol style="list-style-type: none"> <li>Using KPI01 and KPI08 (gross diversion rate) This level can be used if only an analysis of residual waste composition is available:</li> <li>Using KPI01, KPI05 and KPI08 (net diversion rate) This level can be used if an analysis of both, bio-waste and residual waste composition is available</li> </ol> <p>In general, both levels allow to analyse specific diversion rate of either total bio-waste but also food waste or green waste separately. Only the second level in combination with reporting on KPI05 gives a feedback on the success of bio-waste separation as the contaminants are discounted</p>

Table 5. KPIs for collection and transport

## 9.2 Key Performance Indicators for recycling

Type of data	KPI (Recycling)	Function & Description	Comment
Quantitative KPI12	Ratio between rejects/total inputs (% of total input)	Describes recycling efficiency of a biological treatment facility	A global indicator referring to the quality (purity) of input bio-waste and the technical performance of the process
Quantitative KPI13	Dragging factor at a recycling facility: Ratio between total rejects and physical contaminants in input bio-waste (% of contaminants in input bio-waste)	Assesses the material recovery performance of different treatment facilities accepting same or similar types of bio-waste	May be difficult to measure, but it's key to measure the real net recycling according to the new EU calculation method
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	KPI to be assessed starting from the gate fees in €/ton for the two treatment options considered. The cost must include disposal taxes Express result as a fraction (e.g. 2/5)
Quantitative KPI15	Average price for compost/digestate sold (€/t)	Describes the average value of a compost/digestate product specific for a treatment facility	To be assessed per facility. Average can be used on a regional level
Quantitative KPI16	Premium price for compost/digestate sold (€/t)	Describes the premium value of a compost/digestate product specific for a treatment facility	To be assessed per facility. Average can be used on a regional level
Quantitative KPI17	Plastic residues in compost (g/kg dm)	Assesses the load factor of plastic-physical contaminants brought back to soils	Quality of the compost which relies on the input material quality (KPI05) and pre-treatment technology Data should be stated including the minimum particle size of the plastic residues assessed (according to national regulatory requirements or QAS schemes)

Type of data	KPI (Recycling)	Function & Description	Comment
Quantitative KPI18	Plastic residues in digestate (g/kg dm)	Assesses the load factor of plastic- physical contaminants brought back to soils	Quality of the digestate which relies on the input material quality (KPI05) and pre-treatment technology Data should be stated including the minimum particle size of the plastic residues

Table 6. KPIs for recycling

### 9.3 Key Performance Indicators for enabling legislation

Type of data	KPI (Enabling legislation)	Function & Description	Comment
Qualitative KPI19	Legal prescription/ obligation to sort for bio-waste specific waste generators	Provides evidence of existing legal drivers for local authorities to set up separate collection schemes for bio-waste	The KPI does not assess enforcement
Quantitative KPI20	Targets for separate collection (of bio-waste)	Provides evidence of specific targets for local authorities to set up separate collection schemes for bio-wastes that are efficient	The target can address different types of MSW producers, of organic waste or municipalities by size Express result as % of generated or kg/person/year
Quantitative KPI21	Main targets for separate collection or recycling of MSW	Drives local authorities to set up separate collection schemes for packaging/dry recyclables and/or bio-waste	Quote if target is applied at national or regional or municipal level
Quantitative KPI22	Limit on contaminants for bio-waste accepted at compost/AD facilities	Drives local authorities to collect bio-waste with schemes and procedure that ease the recycling step and minimise rejects from the recycling process	Quote if target is applied at national or regional level Express result as % to input flow
Qualitative/ Quantitative KPI23	Economic incentives to promote separate collection of bio-waste or disincentives to dispose "bio-waste rich" residual waste	Indicates existing specific legislation or regulation addressed at local authorities and recycling plants	These types of instruments help local authorities to divert economics from MSW disposal to bio-waste management. Economic incentives should not include PAYT fees but rather penalty/premium schemes to be applied to municipalities (not to waste producers)

Table 7. KPIs for enabling legislation

## 9.4 Evaluation of Success Cases through KPIs

A set of local Success Cases (SC) in managing the bio-waste in different EU Member States was identified to undergo an assessment of the selected KPIs. They all present separate collection schemes for bio-waste and were selected according to a set of criteria:

- Single case or Region/ Intercommunal
- Level of urbanization
- A Touristic area or not

The project is currently undergoing a detailed assessment of the data about bio-waste management for each success case by contacting regional and local authorities, MSW management companies or local experts. The table below shows the number of cases being evaluated per Member State and from them how many will be cities, regions (or comparable units) and how many are characterised by a high level of tourism affluence.

EU Member State	Number of total cases identified	Cities/ single municipalities	Region/ Intercommunal	Touristic
AT	3	2	1	2
BE	1		1	
CR	1		1	1
DE	9	2	7	2
DK	1	1		
ES	6	2	3	3
FR	2		2	
IE	1			
IT	4	1	2	1
PT	2	1		2
RO	2		1	
SI	1	1		
SK	1	1		
<b>TOTAL</b>	<b>34</b>	11	18	11

Table 8. Success cases identified by EU Member State and currently being assessed

## 10 Conclusions

The project investigated publicly available data from 27 Member States and 2 regions. From this set of data, information from 3 cases was selected for the creation of the historical detailed dataset at municipal level, due to a relevant level of detail available regarding the collection of bio-waste, the quality of the sorted fraction, the costs of MSW management and the details about the recycling performance of the facilities.

The investigation phase performed in the framework of this deliverable allowed to create a consistent database which will be used to perform subsequent statistical analyses (reported in deliverable D2.2), including relevant historical assessments concerning the evolution of separate collection of bio-waste.

During the course of the research, it became clear that, apart from the overall data on the bio-waste collection and recycling required by the EC for Eurostat, almost no Member State has implemented a coherent data management and reporting system to collect key parameters such as the distinction between food waste and garden waste, impurities, details of treatment facilities and the rejects generated by the recycling process.

The two Mirror Groups performed, with an indicative participation of national and EU-wide experts and stakeholders, allowed to: firstly, showcase the Best Practices included in this document about data collection, coordination and availability; and secondly, to identify with the participants a number of barriers to collect and report data on bio-waste management, such as a missing obligation – in many Member States – for local authorities to report the data to a regional or national institutions, and lack of infrastructures (including technical tools such as websites or software and staff in local/regional or national authorities) to collect these data.

However, it has been even more clear that many Member States are lagging behind in separate collection and treatment of bio-waste, and almost none are prepared to have readily available data with a view to the new EU calculation method of effective recycling which is based on the subtraction of rejects – generated during the treatment process – from the calculation.

A set of KPIs has been defined to be applied by local decision-makers as well as national and regional authorities to evaluate quantitative and qualitative “performances” of different schemes for the separate collection of bio-waste. To complement this, another set of KPIs has been suggested to ease the evaluation of how efficiently and effectively bio-waste recycling facilities perform and thus help local authorities to assess the recycling according to the new EU calculation methods. Last but not least, KPIs have been also defined to describe the existence of enabling regulatory conditions.

Ideally, economic data about MSW management at the local or regional level should be made available with the same frequency as data about waste production and recycling, detailing the expenditures for collection, transport, treatment of waste and recycling. This

information should be available especially for bio-waste and residual waste which represent the largest share of all MSW generated and managed in EU Member States.

LIFE BIOBEST is currently undergoing the assessment of 34 success cases at different administrative level through these KPIs and results will be reported in this Deliverable or others related to WP3 as soon as the work is completed.



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## 13 References

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2. [https://publications.jrc.ec.europa.eu/repository/bitstream/JRC131531/JRC131531\\_01.pdf](https://publications.jrc.ec.europa.eu/repository/bitstream/JRC131531/JRC131531_01.pdf) JRC 2023. Chapter 4.4.
3. [https://environment.ec.europa.eu/publications/waste-early-warning-report\\_en](https://environment.ec.europa.eu/publications/waste-early-warning-report_en)
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5. [https://ec.europa.eu/eurostat/databrowser/view/ENV\\_WASGEN\\_custom\\_6724178/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/ENV_WASGEN_custom_6724178/default/table?lang=en) Filter only Households as generators. Under "Waste Category", Animal and mixed food waste can be selected (W091) and Vegetal waste (W092)
6. [https://ec.europa.eu/eurostat/databrowser/view/ENV\\_WASMUN\\_custom\\_4659616/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/ENV_WASMUN_custom_4659616/default/table?lang=en) In the field called Waste management operation select the option "recycling: composting and digestion" indicator RCY\_C\_D
7. <https://www.catasto-rifiuti.isprambiente.it>
8. <https://sdr.arc.cat/cform/ListCaracteritzacions.do>
9. [https://www.decisive2020.eu/wp-content/uploads/2019/12/02-Separate-collection-system-in-Catalonia\\_TGuerrero-NSansebasti%C3%A0n-ARC.pdf](https://www.decisive2020.eu/wp-content/uploads/2019/12/02-Separate-collection-system-in-Catalonia_TGuerrero-NSansebasti%C3%A0n-ARC.pdf)

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- Annex 2: Municipal dataset
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