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for the Environment, Nature Conservation
and Nuclear Safety

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Guide for Greek municipalities with steps to be taken to introduce separate collection of bio-waste

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BLACKFOREST
SOLUTIONS

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Background

The Greek government asked the European Commission (EC) for support in specific areas (including the improvement of municipal waste management, regulatory issues of the waste sector, the management of specific waste categories) in order to raise the quality and quantity of recycling, to improve data quality and to effectively use economic instruments. To achieve the aforementioned goals, the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) provides "Technical support for the implementation of the National Waste Management Plan (NWMP) of Greece" from 2018 to 2020. The project is jointly co-financed by the European Union (EU), via the Structural Reform Support Programme (SRSP) and the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU) and implemented by GIZ and the Hellenic Ministry of Environment and Energy (YPEN), in cooperation with the European Commission.

GIZ commissioned BlackForest Solutions GmbH (BFS) which formed a consortium including international and national experts from Envero GmbH, INFA GmbH, Ressource Abfall GmbH, BlackForest Solutions GmbH and I. Frantzis & Associates Ltd. to provide specific technical expertise to GIZ and YPEN from July 2019 to mid-2020 by supporting four areas of intervention (AI) linked to the optimization of municipal waste management in Greece. The areas of intervention are:

AI 1. Separate collection of municipal waste
AI 2. Improvement of cost accounting in municipal waste management
AI 3. Use of economic instruments for waste management
AI 4. Separate collection of bio-waste

The present guide for Greek municipalities with steps to be taken to introduce separate collection of bio-waste was prepared as the final deliverable for AI 4 of the contract '*Optimizing municipal waste management in Greece - introducing effective separate waste collection and cost-accounting, and making use of economic instruments*'.

The guide incorporates steps to be taken to introduce separate collection of bio-waste, using lessons learnt and recommendations for different context areas (urban / rural / remote / insular).

The information of this guide could be complemented by the deliverable "Guide on separate collection of municipal waste in Greece" for municipalities, which can be found published on the Ministry's webpage. The direct link to download the guide can be find here.

Disclaimer

BlackForest Solutions GmbH has taken due care in the preparation of this report to ensure that all facts and analysis presented are as accurate as possible within the scope of the study.

This document was produced with the financial assistance of the European Union. The views expressed herein can in no way be taken to reflect the official opinion of the European Union.

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BW	BIO-WASTE
EC	EUROPEAN COMMITTEE
EDSNA	SOLID WASTE MANAGEMENT ASSOCIATION OF ATTICA REGION
EPR	EXTENDED PRODUCER RESPONSIBILITY
EU	EUROPEAN UNION
FODSA	SOLID WASTE MANAGEMENT ASSOCIATION
HERRCO	HELLENIC RECOVERY RECYCLING CORPORATION
INH	INHABITANT
IWMF	INTEGRATED WASTE MANAGEMENT FACILITY
ΚΥΣΟΙΠ	ΚΥΒΕΡΝΗΤΙΚΟ ΣΥΜΒΟΥΛΙΟ ΟΙΚΟΝΟΜΙΚΗΣ ΠΟΛΙΤΙΚΗΣ
GCEP	GOVERNMENT COUNCIL FOR ECONOMIC POLICY
LWMP	LOCAL WASTE MANAGEMENT PLAN
JMD	JOINT MINISTERIAL DECISION
MBT	MECHANICAL BIOLOGICAL TREATMENT
MRF	MATERIAL RECOVERY FACILITY
MSW	MUNICIPAL SOLID WASTE
NGO	NON-GOVERNMENT ORGANIZATION
NSRF	NATIONAL STRATEGIC REFERENCE FRAMEWORK
NWMP	NATIONAL WASTE MANAGEMENT PLAN
PD	PRESIDENTIAL DECREE
PR	PUBLIC RELATION
RWMP	REGIONAL WASTE MANAGEMENT PLAN
SAS	SEPARATION AT SOURCE
SSO	SOURCE SEPARATED ORGANICS
WFD	WASTE FRAMEWORK DIRECTIVE
YPEN	MINISTRY OF ENVIRONMENT AND ENERGY

1. Introduction

Under the European legislation, all member states are bound to take action on reducing, reusing and recycling in order to close the loop on waste materials, with special provision for the organic fraction and its potential for high-quality compost production and energy recovery.

The national policy on bio-waste, adapting to the EU framework, focuses on the introduction of sorting at source and composting schemes at the municipal level in combination with the development of central composting or anaerobic digestion facilities and sets a high target of 40% related to separate collection of bio-waste to reach this potential.

Local authorities, as the main implementing stakeholders of bio-waste policy, need to step up their effort to effectively organize and implement bio-waste management activities, with the aim to protect the environment and raise awareness among citizens, as well as to reduce management costs to the benefit of the public.

1.1 Definition of bio-waste

As defined in Greek Law 4042/2012 (e-Nomothesia, 2012), bio-waste includes biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. Bio-waste depending on their nature or origin and the deriving waste streams, can be categorised in household, commercial and industrial bio-waste. Bio-wastes are classified under the “municipal waste” of the European Waste Catalogue (EWC).

1.2 Policy context

EU level

WFD Directive 2018/850/EC (amending Directive 1999/31/EC on the landfill of waste) (EU, 2018), WFD Directive 2018/851/EC (amending Directive 2008/98/EC) (EU, 2018). Key elements are:

- A common EU target for recycling 65% of municipal waste by 2030
- The preparing for re-use and the recycling of municipal waste shall be increased to a minimum of: 55 % by 2025 / 60% by 2030 / 65% by 2035
- Reduce landfill to maximum of 10% of municipal waste by 2030
- Promotion of economic instruments to discourage land filling
- Simplified and improved definitions and harmonised calculation methods for recycling rates throughout the EU
- Concrete measures to promote re-use and stimulate industrial symbiosis –turning one industry's by-product into another industry's raw material
- Economic incentives for producers to put greener products on the market and support recovery and recycling schemes

Member States shall ensure that, by **31 December 2023**, bio-waste is either separated and recycled at source, or is collected separately and is not mixed with other types of waste.

Member States shall also take measures to:

- Encourage the recycling, including composting and digestion, of bio-waste in a way that fulfils a high level of environment protection and results in output which meets relevant high-quality standards
- Encourage home composting
- Promote the use of materials produced from bio-waste

National level

- Law 4042/2012 (Greek Government Gazette 24/A/13-2-2012) (e-Nomothesia, 2012): bio-waste definition, set specific targets for bio-waste collection (Separate collection of bio-waste, at least 10% of the total quantities produced until 2020) and introduce a landfill tax for bio-waste disposed of without pre-treatment, starting in 2014 at 35 €/t – annually increasing by 5 €/t – maximum 60 €/t
- Law 4555/2018 (Greek Government Gazette A' 133/19.07.2018): sets municipalities responsible for the implementation of LWMPs (including the setup and implementation of bio-waste separate collection, treatment, etc.), and sets SWM Unions (FODSA) responsible for the overall implementation of RWMPs (having as priority the setup of central and disposal facilities)
- Law 4609/2019 (Greek Government Gazette 67/A/3-5-2019): establishes the financial contribution of SWM Unions (FODSA) to circular economy actions and initiatives (including bio-waste)
- National Waste Management Plan (NWMP) 2020-2030 (JMD 185/A/29-9-2020). In the new NWMP the following are mentioned: Set up separate bio-waste collection schemes by **31 December 2022.**

1.3 Facts / data

According to the new NWM plan 2020-2030 (2020), out of the 5,523Mtn/yr of MSW, the generated waste's composition, 44.3% of the produced municipal waste consist of bio-waste, 22.2% of paper & cardboard, 13.9% of plastics, 3.9% of metals, 4.3% of glass and 11.4% of the rest recoverable materials, and non-recoverable materials.

Therefore, there is a considerable potential of bio-waste from MSW in Greece, equal to 2.45 Mtn/yr – at present, the SaS of bio-waste in Greece is only at 5.7% (0.14 Mtn/yr), the recycling rate is 0.28Mtn/yr and the recovery is 0.33Mtn/yr, meaning that there are 1.87 Mtn/yr are buried to landfill instead of their exploitation. The most important savings from separate collection and treatment of the thrown away bio-waste are given below:

- Saving GHG emissions of around 888,000 tons CO^2 eq /yr (eq to 193,000 cars or electricity for 150,000 households)
- Saving landfill space of around 4,440,000 m^3/yr
- Producing more than 550,000 tons of quality organic fertilisers/soil improver with market value of around 23-28 Mio. EUR
- Savings costs from transportation and landfill 41-46 Mio. EUR
- Job creation of around 700-750 new posts
- Contributing to renewable energy: Biogas for green power and bio-methane
- Contributing to the bioeconomy: Bio-based products (bio-chemicals, bioplastics, fibres, etc.)
- Potential of complying with the national legislation

2. Guideline for planning and implementation separation collection of bio waste

The purpose of this Guide is to present to the Greek municipalities the series of steps that have to be taken in order to introduce separate collection of bio-waste, using lessons learnt and recommendations for different context areas (urban / rural / remote / insular).

The main steps to be taken are described in the following paragraphs (in ascending order):

Definition of goals and development of a short and long-term phase concept

Goal setting involves a comprehensive planning and implementation of separate collection of bio-waste. When done correctly, goal setting is effective and often critical to success. Goals give us direction by focusing attention on goal-relevant behaviour and away from irrelevant tasks. The steps to be taken to achieve the goals mentioned in the chapter 1.2 are:

- Analyse the composition of waste in your municipality (sorting analysis of household waste; volume flows of organic waste from the industry; green waste)
- Adapt your waste management concept and the waste fee system to the current and future situation
- All measures must be backed up by decisions of the local government
- Ensure the financial support for the pilot projects and accompanying measures (public relations, etc.)

Planning and implementation of appropriate pilot project

In a pilot project, local authorities and its inhabitants are to gain initial experience with the separate collection of bio-waste. The way to achieve this is via the following steps:

- Define a part of the municipality as the first separate collection area. The area should already be able to offer many possible types of waste (bio-waste from households, canteen waste, green waste, and commercial bio-waste)
- Prepare a technical and economic study for this pilot area (locations for collection bins, type and number of collection bins, collection vehicles and staff; operating costs, public relations).
- Discuss the results of the study in the local council and with the residents and consider meaningful ideas
- Publicise the adapted study and start public relations work to implement the study (introduction of separate bio-waste collection)
- Purchase of collection bins and vehicles; staff training
- Implementation of the pilot project in the selected collection area
- Regular control of the collection quantity and quality

Evaluation of the pilot project and identification of weak points, optimization and expansion

Check the success of the separate collection regularly:

- Bin usage and capacity utilization
- Quality of the collected bio-waste by sorting analyses at the treatment plant
- Collection frequency synchronisation to the amount of waste generated and the climate

- Document and check the costs of the pilot project and ensure financing
- As part of the public relations work, check the acceptance of separate collection by the residents
- Publication of the results of the pilot project with strengths and weaknesses (in news media and as information leaflets)
- Constant error correction and adaptation of the procedure and use of the experience gained
- Extension of the "separate collection" project to other parts of the municipality

Development of the legal and organizational municipal framework related to the experiences and local conditions

The local authorities should continuously customize their legal and organizational framework based on the gained experience and local conditions of the pilot project

- Adaptation of the bio-waste management concept (on-site handling, storage and processing; bio-waste collection; transfer and transport of bio-waste; and bio-waste treatment and final disposal)
- Adjustment of waste charges based on the experience of the pilot project (both for residents and for business)
- Adaptation of municipal planning to legislation requirements (expansion of the collection area)
- Adapting the structure and organisation to separate collection (persons responsible for separate collection and treatment)
- Documentation of waste quantities, material flows and monetary flows
- Information and update of the public on the status of the introduction of separate collection scheme

Planning and implementation of the concept for optimizing and increasing the added value

Continuous data collection and monitoring during pilot implementation is a key tool to evaluate the progress of the program, assess its effectiveness and above all optimize it to the local conditions. More specific:

- Regular monitoring of the system (quantity and quality of the separately collected bio-waste, costs, public relations)
- Need for adaptation and optimisation to increase the collected bio-waste quantity and quality (reduction of the impurities)
- Assessment of the environmental impact of separate collection (reduction of CO2 emissions)
- Cost optimisation via optimization of procurement practices, adaption of technology, supplier competition, adaption of negotiation strategies, bundling of services, etc. - – there are available tools that can be used i.e. the full cost accounting tool (YPEN, 2020)
- Added value in the local community through the recycling of organic waste (composting of green waste and/or of kitchen waste)
- Possibilities of composting the green waste directly on site in the municipality

2.1 What belongs to the brown bin?

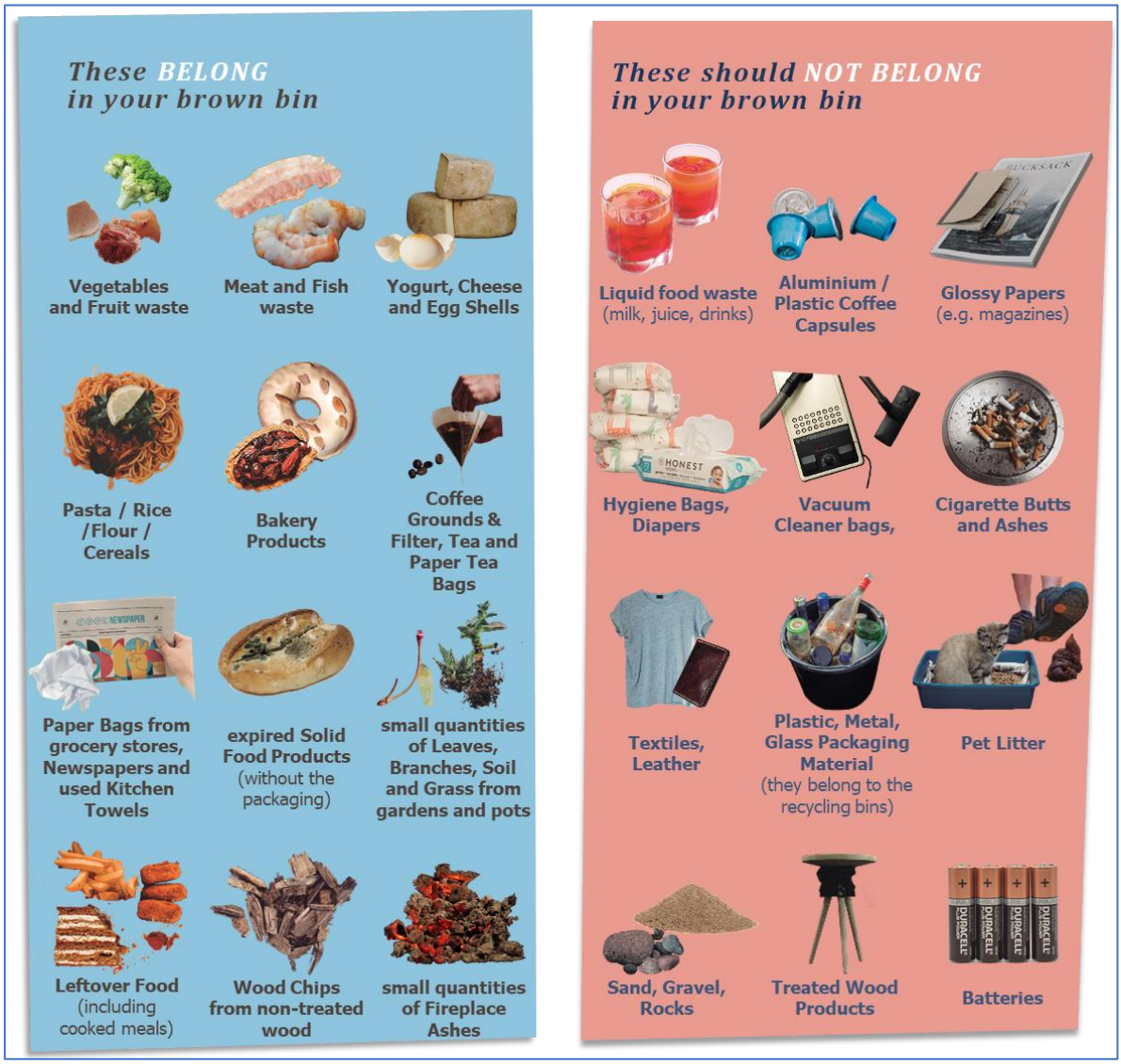


Figure 1: waste that belong/not belong to the brown bin (BFS, 2020)

Make sure that only appropriate biodegradable/compostable bags (meet the requirements of EN standard 13432) are used.

2.2 Success factors

Optimal solutions for separate bio-waste collection depend on numerous factors:

Bin size

Bio-waste collection is highly recommended to take place in small bin sizes (up to 240 litre) due to high density of bio-waste by nature, which make filled bins too heavy and more prone to damage. In addition, smaller bin sizes deter users from throwing inside bulkier non-organic fractions of waste.

Collection frequency

The frequency of collection must be adjusted to the local conditions of the project (weather condition, amount of waste, behaviour of the users, etc.). In relation to weather conditions, for example during

winter time, the collection frequency can be decreased, while during summer time, the frequency should be increased, along with the cleaning of the bins as often as possible in order to avoid discomfort and hygienic risks. In relation to the amount of waste, it is of top priority to have in place an efficient monitoring scheme to keep proper record of collected quantities and sources of generation. In this way, having consisting records, re-adjustments could be made i.e. either increase collection frequency or increase bins capacity by adding more bins at specific points.

Waste fees adjustment

The disposal of recyclable waste and bio-waste must be cheaper than the disposal of residual waste. In the future the waste fee should be adjusted to the waste type. For example, in Europe the costs for treatment of residual waste is about 80-100 €/ton, but for bio-waste 25-50 €/ton.

The following figure clearly demonstrates that with increasing separate collection rates (mostly driven by increasing adoption of kerbside collection, including separate collection of food waste for maximising collection rates) the total cost of collection (indicated with green bars) per person remains unchanged in most of the municipalities i.e. the additional costs of introducing separate collection of bio-waste in an operationally optimised way are offset by the savings on collection of residual mixed waste); the costs for processing / treatment / disposal (indicated with blue bars) steadily decrease, due to lower amounts of waste being (Favoino, 2015).

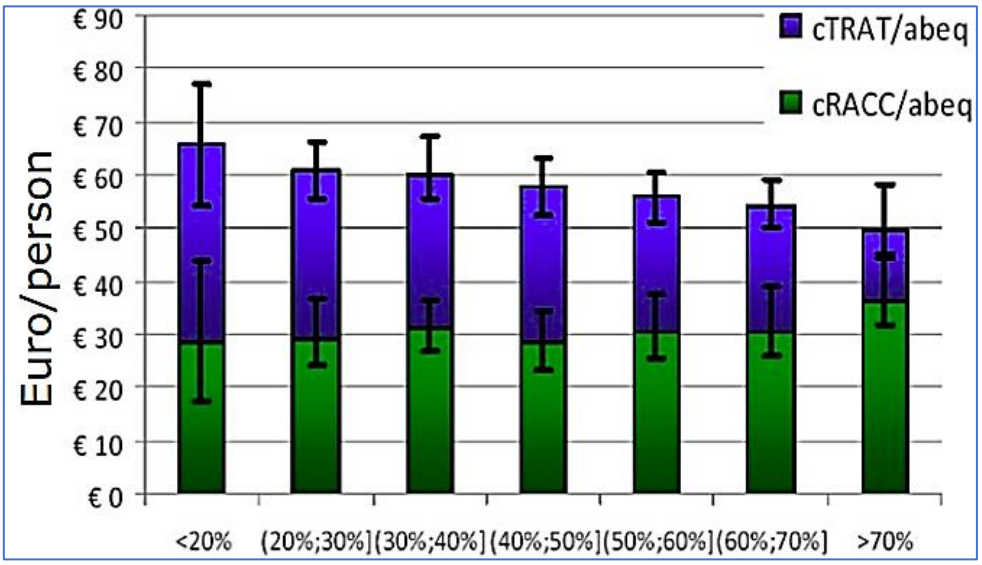


Figure 2: Cost optimisation (Lombardy, population 10 million, 1500 municipalities), cost of collection (green bars) and cost of treatment (blue bars) (Favoino, 2015)

Information and awareness campaigns

These should work continuously to explain bio-waste collection, as well the advantages of separate collection. The Municipality should monitor the progress of the pilot scheme and continuously receive reliable data. All project results such as savings, performance, etc. should be verified and then communicated with the public, in the framework of a continuous campaign. i.e. update project website/social media, brochures/leaflets, events etc.

Green waste collection

Enable central collection of green waste service with a charge or free of charge in case the user makes his/her own arrangements to get it collected or take it to a recycling centre / green point. Alternatively, home composting should be available as an option. The latter can be supplied by the Municipality to the users at a reduced cost.

Collaboration of all involved parties

It is recommended that the Municipality should work in close collaboration with the bio-waste treatment facility at local / regional level. The Municipality should ask officially the Operator of the treatment plant for detailed feedback on the quality/quantity of the collected bio-waste, as well the compost products i.e. compost classification. The Municipality will evaluate all received feedback and then it will be able to take corrective measures (if necessary) on its part.

Final product assurance

The production of high-quality compost and the utilisation of the compost must be ensured. Without reasonable utilization of the compost products, bio-waste collection makes no sense. To minimise such kind of risks, it is recommended that the Municipality should work in close collaboration with the bio-waste treatment facility at local / regional level. The Municipality should always request for official information about the compost classification in order to provide its users with confidence via communication and awareness activities that the quality compost from source-segregated bio-waste they purchase and/or take free of charge conforms to an approved/certified standard.

Quality is always a key issue: bio-waste with more than 10% of impurities (almost considered as mixed waste) makes valorisation hardly feasible as this degrades the value of the produced fertilizers (Association Fertile Auro, 2019). On average, bio-waste collected via local collection points i.e. underground and/or kerb-side bins, has a higher share of contaminants than bio-waste collected through door-to-door systems. Door-to-door systems are highly recommended as the choice for separate collection of bio-waste, because it is well proven from international experience that there are the only systems that can achieve adequate capture rates at the required quality (less than 2 % of impurities). In city centres, underground and/or kerb-side bins can be an option but require intensified follow-up to improve the quality of the collected fractions. The following figure clearly demonstrates that high quality of material is achieved when collection at the door step is implemented (Favoino, 2015).

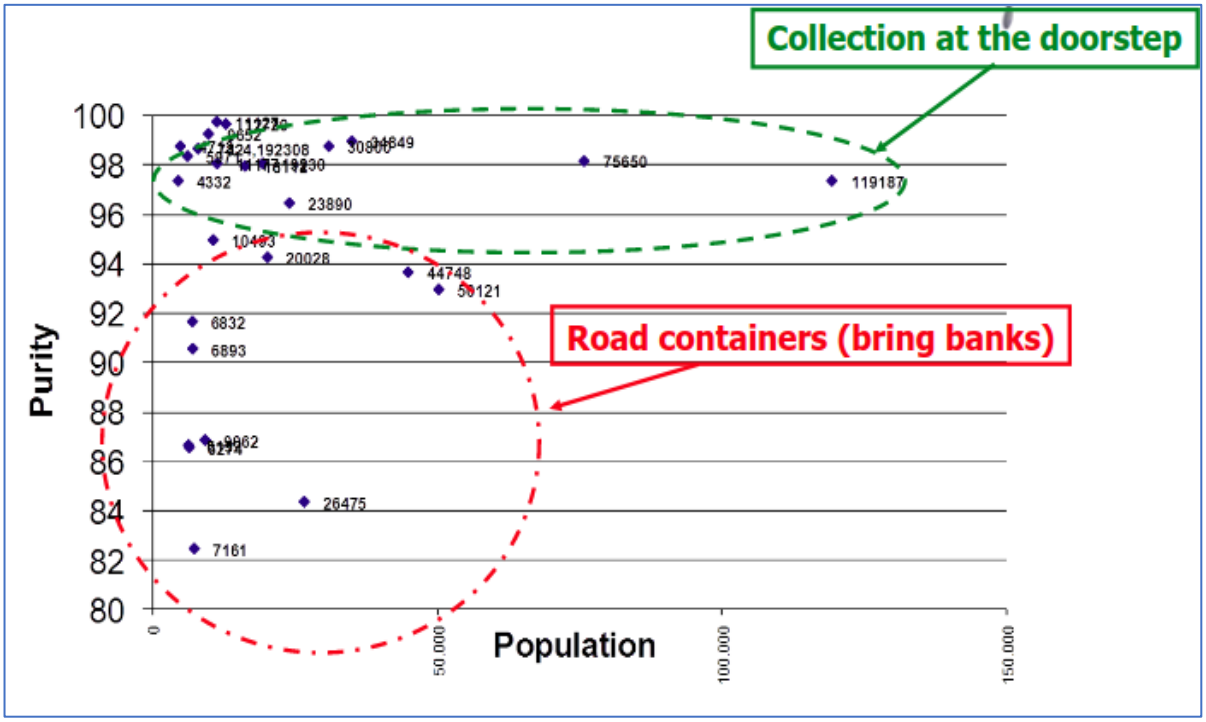


Figure 3: Comparison of purity against population increase. (Favoino, 2015)

Optimal solutions depending on geographic and/or demographic conditions

In general, optimal solutions for collection of bio-waste depend on geographic and demographic conditions such population density and types of housing. In general, due to no previous and/or limited experience (mainly from pilot projects having small service coverage and low density of collection points), it is assumed that in the initial period of the separate bio-waste collection, the majority of the Greek municipalities (independently of settlement structures i.e. low density areas and/or highly populated areas) would have <45% of potential separately collected bio-waste (<60kg/cap x yr)[1].

More specific:

In **low density areas (rural/insular)** great distances have to be covered per amount collected which increases the costs and reduces the overall environmental benefit. The density of collection points is typically found to be less than 1 per 160 inhabitants, while it decreases to 1 per 100 inhabitants for the case of areas with high tourist impact i.e. islands. The recommended collection frequency is once per week in summer and winter, while for the case of areas with high tourist impact i.e. islands in the summer should increase to twice per week (in the winter remains once per week). In the initial period of the separate bio-waste collection, the quantity of separately collected waste in low density areas is expected to be <60kg/cap x yr. The rate could be improved through the implementation of home / community composting and/or small composting plants built for several villages / communities, allow treatment in the place of origin. The new National Waste Management Plan (NWMP) 2020-2030

[1] The average organics waste composition in Greece is approximately upto 44% from the total waste generation (5,780,000 tn/yr). Combined with an average of 504 kg/(cap x yr) of waste generation, this leads to a potential of about 223 kg/(cap x yr) for bio-waste. Considering the final aim of the WFD of a reduction of 65% of total recycling of MSW and taking a scenario of a reduction rate of 65% of bio-waste to be recycled, based on the new Landfill Directive (850/2018) – nearly 145 kg/(cap x yr) should be recycled for Greece.

foresees an adequate network of bio-waste treatment facilities. The rate of separately collected bio-waste can be significantly improved via public campaigns concerning good quality and quantity and continuous monitoring and evaluation of the system.

In **highly populated areas**, door-to-door collection is optimal and more cost effective. However, living space especially in high-rise buildings, may not allow for storage of several waste streams, inhibiting source separation. In many cases, this is solved through customized systems for separate collection of bio-waste. The density of collection points is typically found to be less than 1 per 100 inhabitants. The recommended collection frequency is once per week in winter and two times per week in summer. In the initial period of the separate bio-waste collection, the quantity of separately collected waste in high density areas is expected to be <60kg/cap x yr. The rate could be improved through implementation of home / community composting in parks. The new National Waste Management Plan (NWMP) 2020-2030 foresees an adequate network of bio-waste treatment facilities[2]. The rate of separately collected bio-waste can be significantly improved via public campaigns concerning good quality and quantity, and continuous monitoring and evaluation of the system.

[2] For Attica region, there are 5-8 treatment facilities foreseen – these may be more i.e. 12-15 treatment facilities based on a feasibility study (under preparation) carried out by Attica prefecture.

3. Economic data and evaluation

Equipment cost estimation per unit

According to the market prices analysis that was performed during the elaboration of the Feasibility Study entitled "Implementation of a pilot bio-waste separate collection and treatment scheme in 6 Municipalities of West Attica", it was found that the indicative type, size and market prices (without VAT) of bins to be used in the separate bio-waste collection schemes are as follows:

Table 1: Indicative type, size and market prices of bins to be used in the separate bio-waste collection schemes

Type	Unit price (€)
Home-composting bins 300 litres	70
Bags 10 litres	0.11
Bags 120 litres	0.7
Bags 240 litres	0.8
Kitchen bins 10 litres	9
Brown bins 120 litres	35
Brown bins 240 litres	50
Brown bins 660 litres	350

Estimated cost for awareness activities

According to the market prices analysis that was performed during the elaboration of the Feasibility Study entitled "Implementation of a pilot bio-waste separate collection and treatment scheme in 6 Municipalities of West Attica", it was found that the indicative cost for the awareness activities are as follows:

Table 2: Indicative cost for the awareness activities

Type	Unit Price (€)
Logo	500
On-line campaign	1,000
Information kiosk	1,500
Awareness events	1,500
Printed material (leaflets, posters etc.)	1
Bin stickers	1
Letters	0.15

Operational cost estimation

Operational costs related to a separate bio-waste collection scheme are divided into the following components:

- Personnel cost – typically 1 driver and 2 workers per collection vehicle
- Fuel cost – estimated by average routing distance taking into account the distance from collection area to the nearest treatment facility and the foreseen number of collection routes

- Maintenance and depreciation cost – estimated as a percentage of equipment investment cost (typically 5% per year). Depreciation cost similarly accounts for the 10% of investment cost for a 10-year lifespan

Estimated collection cost from 1st to 10th year

A case-specific economic evaluation of a bio-waste separate collection scheme should be prepared – the following assumptions are recommended:

- Full implementation in a 10-year time horizon to achieve bio-waste separate collection target: 1st year – pilot implementation (indicative population: 2,000 - 5,000 inhabitants), 2nd year – coverage of the 50% of the remaining population, 3rd year – full-scale implementation
- The mixed MSW collection cost per tonne should remain at the same level as of now, based on the assumption that although the quantity of mixed MSW will decrease, so will the total mixed MSW collection cost (fewer collection routes will be required, which is translated in reduced personnel costs and fuel consumption)
- The supply of the equipment is implemented at regular intervals during the afore-mentioned time-period. The total number of mobile equipment (bins and vehicles) required for full-scale implementation should be foreseen from the beginning. The total collection cost (CAPEX, OPEX) varies per year of implementation.
- The anticipated treatment costs are based on the new pricing policy and the assumptions presented in the guide published ‘Methodology for the development of a municipal system for bio-waste management’ by the MOU. The current treatment cost is considered equal to 50 €/ton

4. Good practice examples

4.1 Vrilissia Municipality (Greece)

Population	30,660 inhabitants (15,000 households)
Municipal Waste	15,463 ton/yr (2018)
Separate bio-waste scheme	Started as pilot during the mid of year 2014. In the beginning, bio-waste was only collected from farmers' markets. Then it was expanded by collecting green waste from parks and houses / buildings with gardens (door-to-door collection with a frequency of 2-3 times per week) and lastly, community bins were introduced for use by the households (a network of more than 300 bins with a capacity of 1,100 litres with a collection frequency of 6 days per week). Door-to-door awareness campaign took place firstly at the farmers' market (producers and consumers) and then at the households of the pilot area. To all the users, kitchen bins (10 litres and 30 litres including free biodegradable / compostable bags) were distributed. Lately, neighbourhood composting was introduced in 5 parks (https://rethink-project.gr) and home composting programs (home composters of 450 litres) were distributed. Participation for both neighbourhood and home composting is on voluntarily base. In addition, an on-line platform (https://followgreen.gr/vrilissia) was set up linking recycling and composting with local stores and businesses, through the point credit system that corresponds to reward coupons which are redeemed at the local market. Citizens declare their recycling and companies assist by promoting their products and services for sale, by providing special discounts and offers.
Results	From a total of 15,463 tons of municipal waste (2018), 5,579 tons were collected separately at the source, i.e. representing 36% of the mixed waste. Of the remaining mixed waste quantity, 9,884 tons were discarded in the green bin and 5,851 tons were taken to the Mechanical Recycling and Composting Plant (EMAK) of EDSNA. Only 4,033 tons were sent directly for final disposal at the landfill. In total, it is estimated that more than 8,250 tons of materials were recovered from SaS and Mechanical Processing, i.e. more than 53% of the Vrilissia waste was reused, while only 7,236 tons were landfilled, a quantity corresponding to less than 47% of municipal waste. In addition, there was a 25% reduction of the municipal fee for cleaning and WM services. In 2018 compared to 2017, the amount of mixed collection (green bin) decreased in Vrilissia by 8.7%. In a period of 2 years (since 2016), it is reduced by 17%. In a period of 4 years (since 2014), it exceeds 25%, which means gradual minimization of land filling.
Success factors	• Local authority is fully committed to the project • Clear and fruitful co-operation between the public and private organisations • Continuous and innovative communication with the users (door-to-door distribution of brochures, flyers, posters, etc., set up of on-line platform (https://fisikolipasma.gr), organisation of events, workshops, training of personnel and users, follow-up etc.)

	• Set-up and use of the inter-municipal reward recycling platform "Follow green" (https://followgreen.gr/vrilissia)
Photos	
Contact info	Postal address: Spyrou Loui 5 & Vrilissou Tel. 210 613 0917 Website: https://www.fisikolipasma.gr E-mail: kathariotita@vrilissia.gr

4.2 Peristeri Municipality (Greece)

Population	139,981 inhabitants (71,448 households)
Municipal Waste	65,509 ton/yr (2019)
Separate bio-waste scheme	Started as pilot in 2016. In the beginning, bio-waste was only collected green waste and in 2017 the program was expanded to big producers and farmers' markets (using bins with capacity of 360 litres and 770 litres and 1 collection truck). The Local Authority already started to expand the separate bio-waste collection system to the area of "Kipoupoli" (serving 1,000 households). To all the participants, kitchen bins (10 litres and 30 litres including free biodegradable / compostable bags) were distributed. The collected material is driven to composting facilities to produce high quality fertilizer (compost), which will then be used by the municipality and the citizens in parks, gardens and crops. In addition, an on-line platform (https://followgreen.gr/peristeri) was set up linking recycling and composting with local stores and businesses, through the point credit system that corresponds to reward coupons which are redeemed at the local market. Citizens declare their recycling and companies assist by promoting their products and services for sale, by providing special discounts and offers.
Results	In 2017, 60 tons of bio-waste was collected from farmers' markets. This quantity was increased to 88 tons in 2018.

	In 2017, 99 tons of bio-waste was collected from big producers. This quantity was increased to 265 tons in 2018.
Success factors	• Local authority is fully committed to the project • Continuous and innovative communication with the users (door-to-door distribution of brochures, flyers, posters, etc., an up-to-date municipality website, use of various social media, organisation of events, training of personnel and users, follow-up etc.) • Set-up and use of the inter-municipal reward recycling platform "Follow green" (https://followgreen.gr/peristeri)
Photos	 ΑΤΟΜΙΚΟΣ ΚΑΔΟΣ (ΚΟΥΖΙΝΑΣ-ΒΕΡΑΝΤΑΣ) ΒΙΑΠΟΔΟΜΗΣΙΜΗ ΣΑΚΟΥΛΑ ΣΥΛΛΟΓΗΣ  
Contact info	Postal address: Agiou Vasileiou 62 Website: http://www.peristeri.gr/index.php/leftmenu-99/leftmenu-100

4.3 Chalandri Municipality (Greece)

Population	74,192 inhabitants
Municipal Waste	33,345 ton/yr (2015)
Separate bio-waste scheme	In the mid of year 2016, a 3-year separate bio-waste collection program entitled "Waste4Think" (under the Horizon 2020 EU program) was launched. Initially, 1,000 residents (registered for the program voluntarily) participated and 4,000 residents in the area of "Agia Varvara" were added in 2019. To all the users, kitchen bins (30 litres including free biodegradable / compostable bags) were distributed. Brown bins of 120 litres were stationed in the pilot area with a ratio of 1 bin of

	120 litres to every 3 households. The 120 litres bins were locked with the users of the pilot area receiving access with keys in order to minimise content contamination. The collection is being made twice a week with a garbage truck that weighs each bin and sends information. The collected organic waste is used either to produce food residue biomass (FORBI) for biogas production or compost in open windrows.
Results	The local authority achieved approximately 300 kg being collected daily from the pilot area and the upscaling area (Agia Varvara). The biogas produced from FORBI has being fuelling the collection trucks, which have been specifically converted to run with biogas leading to significant savings on fuelling costs. The collected material (green waste and FORBI) are composted in open windrows in 40 days.
Success factors	• Local authority is fully committed to the project • Continuous and innovative communication with the users (door-to-door distribution of brochures, flyers, posters, etc., an up-to-date municipality website, available collection timetable, use of various social media, organisation of events, workshops, training of personnel and users, follow-up etc.) • Introduction of GPS and informatics systems for the optimisation of the collection system
Photos	 
Contact info	Postal address: Agio Georgiou 30 & Aristeidou Website: https://www.chalandri.gr/yphresies/perivallon-aeiforia/waste4think/ E-mail: helpdesk@halandri.gr

4.4 Vari-Voula-Vouliagmeni Municipality (Greece)

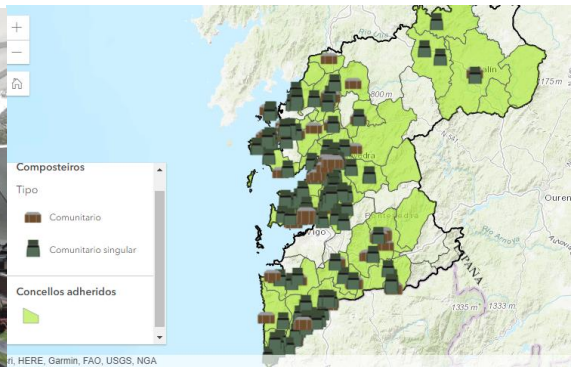
Population	48,399 inhabitants
Municipal Waste	40,739 ton/yr (2018)

Separate bio-waste scheme	In 2017, a separate collection of green waste and bio-waste program was launched. In 2019, the Municipality runs a pilot program "Zero waste" of separate collection of 5 waste streams (financed by own resources and EU Interreg Programme) including bio-waste in the area of "Pigadakia" (1,000 inhabitants). Paper bags for bio-waste were distributed for free to the users. Brown bins (120 litres and 240 litres) were distributed for separate bio-waste collection using kerb-side collection or door-to-door collection. A time schedule was created and communicated to the users. Within the pilot area, PAYT (pay as you throw) schemes and BAS (benefit as save) are implemented. The program addresses residents as well as business (160 brown bins with capacities of 60 litres, 120 litres and 660 litres to 66 business) The contents of the brown bins are collected by a collection vehicle and are transferred to a composting unit where is turned to a certified compost product (under the brand name "Vita Green"), which is suitable for use in organic agriculture in agreement with the requirements of Reg. (EU) 834/2007 and 889/2008.
Results	In 2018, 14.65 t of bio-waste from business and 5,000 t of green waste were collected. By the end of 2019, the local authority diverted more than 35% of its co-mingled waste from landfill. The local authority constructed a greenhouse growing flowers to be used for the green public spaces using the certified compost product. The successful production of "Vita Green" product, led to the production of "Vita Green Plus" (20,000 bags of 50 litres) produced from green and organic waste of A+ quality.
Success factors	• Local authority is fully committed to the project. • Continuous and innovative communication with the users (door-to-door distribution of brochures, flyers, posters, final products, etc., special communication line, an up-to-date municipality website, available collection timetable, use of radio and television media, organisation of events, workshops, training of personnel and users, follow-up etc.). • Transparency of all actions and costs through their official publication in the website of the local authority • Introduction of GPS and informatics systems for the optimisation of the collection system
Photos	 

Contact info	Postal address: Leoforos Karamanli 18, Voula Tel. 213 202 00002 Website:http://www.vvv.gov.gr/index.php/environment-and-planning/waste-and-recycling/kafe-kadoi E-mail: kathariotita@vvv.gov.gr

4.5 Pontevedra Province (Spain)

Population	360,000 inhabitants (60 Municipalities), only the rural areas
Municipal Waste	2,052 tonnes/yr (2016)
Separate bio-waste scheme	The project is deployed in 60 out of the 61 municipalities in Pontevedra, with the biggest city in the province not included due to the fact that the 300,000 residents live within a densely populated area, in vast contrast to the rest of the region. Among the 60 municipalities for which "Revitaliza" was intended for, 44 have now joined the process. In 2015, in order to comply with EU recycling obligations and to provide an adapted bio-waste management system for the Province, Pontevedra started "Revitaliza" with the aim of diverting the organic waste stream away from simply being disposed. The objective was not only to shift away from burning or landfilling and towards composting instead, but it was designed to create a decentralised, community-led system of bio-waste management. Revitaliza fully relies on a decentralised composting system to treat bio-waste, composed of 3 key factors: (a) A balanced input of materials that ensure a proper composting process can take place. (b) A suitable location for the com-posting process to be conducted at, which has to be adapted to the area's specific needs and context. (c) The design and implementation of an effective monitoring system to ensure the success of the process, by identifying and solving issues that arise throughout the implementation phase. Three composting options are offered to the region's inhabitants depending on the density of the area: (a) Individual composting (COIN): This consists of home composters for households with enough space to host them. They are distributed to households in scattered areas with a population size between 100 and 1,000 inhabitants. (b) Community composting (CCC): These are made of composting boxes (called UMC) and a community will have access to either 3, 5, 6 or 10 composting boxes together in one location, depending on the community's size, to ensure sufficient space for a proper composting process to take place. Community composting sites are set up in densely populated areas (between 100 and 1,000 people, or beyond 1,000). (c) Local Composting Plants (PCC): For areas too densely populated for home com-posting or community composting, small scaled composting plants have been established to treat biowaste. Those plants are limited by two factors: no more than 2.000 tonnes per year and less than 45 km from bio-waste producers.

	Specific monitoring and data collection processes were established for both community and home composting to address the different specifics of each system. For community composting, professionals from Revitaliza are in charge of common tasks such as data collection on the filling level, the temperature of composting sites or even on potential incidents that are likely to happen, such as bad smells, larvae or rodents etc.. **To ensure that an effective data collection and database is created, master composters collecting this information now use a smartphone app.** For home composting the process is almost the same. Once the household receives the home composter, workers from Revitaliza provide explanations on how it is operated. Once settled, households receive visits from workers to monitor the composting process and collect data using the same model as for community composting. When the quality of the compost is good enough (usually after one year), monitoring visits - they can go up to 4 visits - stop and the household autonomously manages its compost.
Results	After three and a half years of implementation, the project already shows good results. The size of the covered territory increased annually with 44 councils out of 61 joining the project. This has resulted in more than 80 community composting sites spread across 26 municipalities in the Province of Pontevedra. The project has allowed a total of 2,052 tonnes of bio-waste to be composted since the project started, therefore diverting this same amount away from either incineration or landfilling. Two thirds of the 2,052 tonnes was kitchen waste, with garden waste making up the final third.
Success factors	• data gathering conducted before and during the project on recognising the challenges of creating a decentralised system from scratch, within an existing centralised composting one • use of a strong communication plan, intended for residents living within the municipalities targeted by the project
Photos	 
Contact info	Website: https://revitaliza.depo.gal/

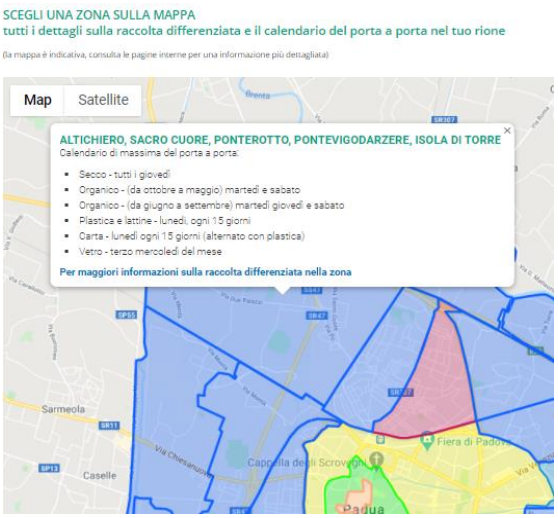
4.6 Parma Municipality (Italy)

Population	194.558 inhabitants (26.000 students, 30% from other cities)
Municipal Waste	4,450 ton/yr (2015)
Separate bio-waste scheme	In November 2012, Parma separately collected 48.2% of its MSW, mostly through roadside containers. Similar to other cities, Parma started its zero waste strategy by improving the separate collection of waste, through door-to-door collection and the separate collection of bio-waste. The city started the shift in the historical centre, with the aim of progressively introducing it to the whole city. Although it is unusual to start with the city centre, the need to introduce bio-waste collection was used as a leverage to rethink the whole system of collection. A year and a half later, all districts were collecting four waste streams (bio-waste, paper and cardboard, light packaging and residual waste) at kerbside. In these first steps, the council managed to get Iren, the waste operator company, engaged in transforming the model of collection of Parma. Although Iren, the waste management company, owns the incinerator and has been dealing with MSW of Parma since before the shift, the political initiative to go towards zero waste managed to engage local employees of Iren and motivated to improve the system. This contrasts with other provincial capitals managed by Iren, where, without political will, results have remained wanting. As of 2014, inhabitants of Parma have had their waste collected door-to-door. The collection system is, however, modulated according to the population density of the neighbourhood, with bio-waste and residual waste being collected more often in the city centre than in residential areas. In the outskirts, buckets tend to be substituted by larger 120l wheeled bins for biowaste, while in the city centre the collection is done in buckets. The second main difference is that, in the city centre, collection takes place during the night, while in residential areas waste is collected in the morning. Garden waste are collected in roadside containers. Of course, any change in collection systems has some challenges and the procedures need some time to be optimised. In Parma the operators of the separate collection and an environmental brigade make sure the collections are performed properly. Soon after the introduction of the new system, the problems that arose with the change –such the type of bag to be used and the time of collection- have been significantly reduced. Yet there is still some control from the company and the operators who, at the same time, provide feedback to citizens. Another fundamental change more recently brought to the system is the introduction of a **pay-as-you- throw (PAYT) scheme,** under which the waste fee of every household depends on the waste they generate. **The fee for every household is composed of two main elements: a fixed part based on the number of household members and the square meters of the household, and a variable part that essentially depends on residual waste generation (accounted in terms of number of set-outs) and home composting.**

	Additional removals are charged (€0.7 per bag, €1.4 per bucket and €4.2 per wheeled bin). In terms of positive incentives, households get a 12% reduction in their fee if they do home composting. Households making use of nappies are not charged for the extra removals.
Results	In only 4 years Parma has overall managed to reduce total waste generation by 15% and increase significantly separate collection, moving from 48.5% in 2011 to 72% in 2015. Residual waste has also decreased significantly in the city, from 313 kg per inhabitant a year in 2011 to 126 kg a year in late 2015, a reduction of 186 kg of waste per inhabitant, meaning a 59% reduction in 4 years. One must note that PAYT was only introduced in the second half of 2015. Aggregated data of the first 5 months of 2016 suggest a further decrease of the residual waste and of the total waste generation, reaching 126 kg and 497 kg per inhabitant, respectively. The new separate collection scheme has proven to be a success, also because it has managed to significantly reduce the contamination in every waste stream, resulting in higher quality materials. The impurity of collected bio-waste is between 3 and 5%. This allows for quality recycling, an essential pre-condition for any economy that aims to be circular. The new waste management system of Parma has brought a reduction in the overall annual costs of €450,000 (2016). Whilst the costs of collection have increased with the introduction of a new fraction and door-to-door collection, bringing higher labour costs, the revenues from selling high purity materials jumped from €0.8 m in 2013 to €1.3 m in 2014, and the annual costs of waste disposal have been reduced by almost €3.5 m.
Success factors	• Political will • Involvement of civil society • Strategy on minimizing residual waste
Photos	 
Contact info	Website: Iren (www.irenambiente.it) https://www.comune.parma.it/ambiente/Rifiuti-zero.aspx

4.7 Padova Municipality (Italy)

Population	210.465 inhabitants
Municipal Waste	N/A
Separate bio-waste scheme	The city of Padova is divided in 6 neighborhoods, the historic center and the suburbs. Moreover the historic center is divided in three zones, the orange, the green and the yellow area regarding waste collection. To be more specific in the orange area, the main core of the historic center, biowaste are collected door-to-door, in the green area the residents use dedicated containers for each household and finally in the yellow area the traditional kerbside collection takes place. The residents/ users are divided in two main categories: (a) households, shops and offices and (b) restaurants and bars. All the materials or bags used for the delivery of bio-waste are supplied by the municipality to all users. However, the service differs in the times at which the waste is exhibited and in the methods of delivery. The Households etc. are using brown semi-transparent bag and the collection takes place morning hours (7:00 – 9:00) three times per week. On the other hand, restaurants and bars are using grey bin with brown lid and the collection takes place Monday to Friday night hours (23:00 – 23:30). For bars and restaurants operators tend to collect waste at a time close to the closure of the restaurant, so the exposure and collection operations are not visible to the tourists. At the “green zone” all the residents are using the grey bin with brown lid and finally at the “yellow zone” all residents are using brown bins on the kerbside. The bins for the bio-waste fractions are 120l, 240l and 360l. The Municipality of Padova allows and favors the domestic composting of the organic fraction through the reduction to 70% of the variable share of Waste tax, equal to a "discount" of 30% of the amount of the variable share alone. In order to obtain the reduction of the tariff, the citizen must sign, at the offices of the Environment Sector, an agreement with the Municipality (the form for the convention can be downloaded from the "Link" section of this page). In addition, it is necessary to present: tax code; purchase or photographic documentation of the composting structure; agreement signed by the neighbor regarding the positioning of the composting structure, in the event that the structure itself is located at a distance of less than five meters from the border of ownership.
Results	The door-to-door collection system, which is gradually replacing the traditional kerbside collection in all the neighbourhoods of Padova resulted in a bio-waste fraction without impurities.
Success factors	• frequency of the collection routes • strategy on supporting domestic composting by providing tax reduction • a user-friendly site providing information regarding bio –waste collection schedule for each area

Photos	 
Contact info	Websites: https://www.comune.padova.it/ambiente-territorio-e-verde/rifiuti www.acegasapsamga.it

5. Recommendations on further incentives for citizens and information measures, up-scaling, financial and environmental benefits, and social business integration

It is highly recommended that once the new scheme of separate bio-waste collection is launched, awareness campaigns shall be initiated and repeated on a regular basis i.e. at least twice per year in all the neighbourhoods of the local authority and adjusted under the individual specificities of each service area. The awareness campaigns should primarily focus on the quality of collected bio-waste as well as other aspects of the scheme during the implementation stages of a separate collection scheme.

Awareness and PR affairs for local authorities require a comprehensive information to or via the following stakeholders:

- council members of the local authority in writing and verbally
- media representatives in writing and verbally, both in traditional and modern media such as web pages, dedicated mobile applications, social media (Facebook, Twitter, Instagram, etc.) – with weekly / monthly updates of certain aspects of bio-waste
- residents/users
    - in writing form – short notes why the separate bio-waste collection is important, leaflets concerning bio-waste collection scheme, waste streams collection calendars and services, etc.
    - via open councils/town hall meetings
    - via specialised members of the municipal waste management department (appearances in schools, cultural organisations, farmers markets etc.) by showing and distributing kitchen bins at households

Local authorities should allocate bio-waste advisors within their existing personnel to deal with these campaigns and PR affairs. Classic “horizontal actions” should aim to create the identity of the project, as well as to develop basic dissemination tools that will be used for the promotion of the project to target and general audience.

Additionally, it is important to note that before the first phase of the awareness activities, a contact line dedicated to the separate bio-waste collection project must be set up by the local authority. The dedicated contact line number should be communicated through all informative materials used i.e. leaflets, brochures, posters, bins stickers, etc.). Through the contact line, the target audience may require information, briefing, technical guidance, or express complaints. Properly trained personnel should be allocated to this task daily based on the frequent asked questions database.

Finally, it is recommended to think of bonus attractions and similarly, positive activities for neighbourhoods participating seriously in source separation of bio-waste, like Citizen Cards, subsidised tickets for cultural events in the local authority, etc..

Recommendations concerning citizens’ engagement and incentives might include bonuses, which might address the neighbourhood or parts of the municipality, which contributed to the success or improvement of the situation. Such incentives should have a clear relation to the improvement of the waste management situation.

6. Concrete recommendations on the improvement of legislation and regulations

The recommendations of the project at a local authority level are indicatively as follows:

- All local WM Plans must be revised in accordance with the updated National WM Plan 2020-2030 and the overall European targets in a feasible and realistic way
- All related costs to waste management should be clearly identified and through proper cost accounting using cost-accounting tools i.e. the developed full cost accounting tool provided by the GIZ project or similar tools
- Containers in civic amenity sites and in other types of recycling points are essential (food waste is not accepted in the civic amenity sites, only green waste and used oils)
- Local authorities in islands with high touristic impact should coordinate with 3-5 stars hotels, restaurants (for cooked products as part of bio- waste) and farmers' markets, for bio-waste separate collection. The option of a tourist tax to cover additional costs for separate collection and treatment facilities for bio-waste should be examined
- It should be considered the potential inter-municipal cooperation, especially in rural and smaller urban areas, in terms of efficiency and feasibility of collection (economies of scale)
- Additional personnel for more efficient collection and monitoring will be necessary. A regular exchange of information among waste management departments in each Region or on a national level, is necessary within the same type of settlement structure, along with the set-up of a bench-marking process concerning the improvement of the collection's efficiency

7. References

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7. **Practical Guide to the implementation of community composting as an alternative for the local management of bio-waste** [Report] / auth. Association Fertile Auro. - 2019.

8. Further reading

- https://ec.europa.eu/environment/waste/compost/index.htm
- https://www.acrplus.org/en/activities/previous-projects
- https://benefit-as-you-save.eu/
- https://waste4think.eu/
- http://www.mou.gr/elibrary/FinalBrochure_bio.pdf
- http://www.mou.gr/el/Pages/eLibraryFS.aspx?item=2522
- https://www.biowaste.gr/site/general/organic-waste/
- http://www.vvv.gov.gr/index.php/environment-and-planning/waste-and-recycling/zerowaste#tab
- https://fisikolipasma.gr/
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- https://www.lovefoodhatewaste.com/
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