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Zusammenarbeit (GIZ) GmbH

Guide on separate collection of municipal waste in Greece

Final Report

I. Frantzis & Associates Ltd.
ENVIRONMENTAL CONSULTANTS

BLACKFOREST
SOLUTIONS

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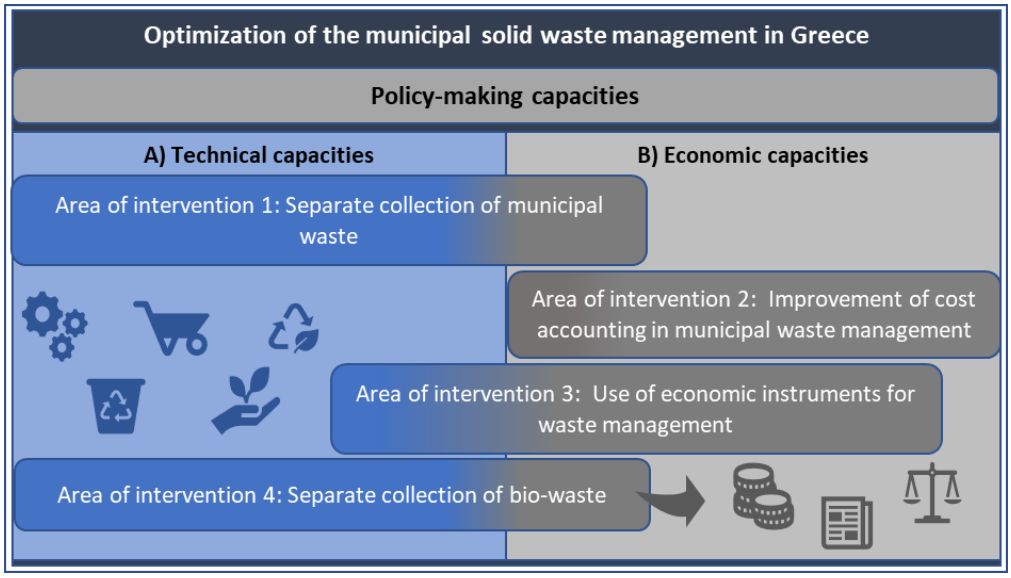
Background

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 afore-mentioned 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 funded 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 collaboration 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 July 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 (including one pilot)
AI 4. Separate collection of bio-waste (including 6 pilots)



Classification of four areas of intervention (BFS, 2019)

The present final report "Guide on separate collection of municipal waste in Greece" was prepared as the final deliverable for AI 1 of the contact '*Optimizing municipal waste management in Greece - introducing effective separate waste collection and cost-accounting, and making use of economic instruments*'. This study focuses on the guideline for AI 1 "Separate collection of Municipal Solid Waste (MSW)" and on an important question:

"Why apply a separate collection of important fractions from MSW?"

The purpose of this study is to collect data and analyse the status of separate collection of municipal waste in Greece in order to develop step-by-step guidelines for separate collection and recovery of municipal solid waste for different municipal contexts. Recommendations will be drawn on decision-making tools, upscaling and replication, citizens engagement and incentives, and informal sector integration, while concrete proposals on the improvement of legislation and regulations will be also provided.

Disclaimer

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

This report was partially funded by 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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LIST OF ABBREVIATIONS

AD	ANAEROBIC DIGESTION
AIs	AREA OF INTERVENTIONS
BAT	BEST AVAILABLE TECHNIQUES
BFS	BLACKFOREST SOLUTIONS GMBH
BMU	GERMAN FEDERAL MINISTRY FOR ENVIRONMENT, NATURE CONSERVATION AND NUCLEAR SAFETY
CAS	CIVIC AMENITY SITES
CHP	COMBINED HEAT AND POWER
DA	DECENTRALISED ADMINISTRATION
DG REFORM	DIRECTORATE-GENERAL FOR STRUCTURAL REFORM SUPPORT
DWR	DIGITAL WASTE REGISTRY
EC	EUROPEAN COMMISSION
EU	EUROPEAN UNION
EWC	EUROPEAN WASTE CATALOGUE
EPR	EXTENDED PRODUCER RESPONSIBILITY
FODSA	SOLID WASTE MANAGEMENT ORGANIZATIONS
GIZ	DEUTSCHE GESELLSCHAFT FÜR INTERNATIONALE ZUSAMMENARBEIT
HERRCO	HELLENIC RECOVERY RECYCLING CORPORATION
HRA	HELLENIC RECYCLING AGENCY
INHAB.	INHABITANT
JMD	JOINT MINISTERIAL DECISIONS
JRC	JOINT RESEARCH CENTRE
LDPE	LOW-DENSITY POLYETHYLENE
LWMP	LOCAL WASTE MANAGEMENT PLAN
MBT	MECHANICAL AND BIOLOGICAL TREATMENT
MOM	MINUTES OF MEETINGS
MRF	MATERIAL RECOVERY FACILITY
MS	MEMBER STATES
MSW	MUNICIPAL SOLID WASTE
NGO	NON-GOVERNMENTAL ORGANISATION
NSRF	NATIONAL STRATEGIC REFERENCE FRAMEWORK
NWMP	NATIONAL WASTE MANAGEMENT PLAN
OECD	ORGANISATION OF ECONOMIC AND OPERATION DEVELOPMENT
PAYT	PAY AS YOU THROW
PR	PUBLIC RELATIONS
PROS	PRODUCER RESPONSIBILITY ORGANIZATIONS
RDF	REFUSED DERIVED FUEL
RG	REGIONAL GOVERNANCE
RWMP	REGIONAL SOLID WASTE MANAGEMENT PLANS
SAS	SELECTION AT SOURCE
SCOW	SEPARATE COLLECTION OF WASTE
SMS	SHORT MESSAGE SERVICE
SRSP	STRUCTURAL REFORM SUPPORT PROGRAMME
WFD	WASTE FRAMEWORK DIRECTIVE
YPEN	MINISTRY OF ENVIRONMENT AND ENERGY
YPES	MINISTRY OF INTERIOR

0. Key data

Assignment	**Optimizing municipal waste management in Greece- introducing effective separate waste collection and cost-accounting, and making use of economic instruments**
Area of Intervention	**1 – Separate collection of municipal waste**
Region	Greece
Contract No.	81241739
Project Name	Technical support for the implementation of the National Waste Management Plan (NWMP) of Greece (68.3045.9)
Client / Project Executing Agency	**Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH** (GIZ) Project Leader: Eva Ringhof (eva.ringhof@giz.de) Senior Adviser: Vasiliki Panaretou (vasiliki.panaretou@giz.de) Senior Adviser: Maria Pisimisi (maria.pisimisi@giz.de)
Financing Institution	**European Commission** via the Structural Reform Support Programme (SRSP) and the **German Federal Ministry for Environment, Nature Conservation and Nuclear Safety** (BMU)
Consultant	**BlackForest Solutions GmbH**: Lead & Contracting Partner **Ressource Abfall GmbH:** Subcontractor International expert: Theo Schneider (mail@ressource-abfall.de) **I.Frantzis & Associates Ltd:** Subcontract National experts: Dr. Constantinos Raptis (raptis@i-frantzis.com) Natalie Cretsi Bacolas (cretsi-bacolas@i-frantzis.com)
Contract Date	08th July 2019
Completion Date	30th April 2020

1. Executive summary

In 2018, the European Union (EU) set highly ambitious and strict targets for the next ten to fifteen years regarding waste management as part of the Circular Economy Package, which will apply in all Member States, including Greece. Greece is facing a significant challenge taking into account the low recycling rates for the latest submitted data of 2017 (19%) compared to the EU's average (46%) and especially compared to the EU recycling targets for 2025, of 50% recycling of municipal waste (the Year 2025 is set for Greece under the five-year prolongation the country secured in getting to achieve this aim) and 2035, of 65% recycling of municipal waste.

Within this framework, the "Guide on separate collection of municipal waste in Greece" is intended to guide the Greek Government and mainly the municipalities on how to improve their performance in waste management, and separate collection of waste (i.e. paper, plastic, metal, glass and biowaste), according to the EU standards. Furthermore, this guideline is intended to facilitate the discussion on the topic, to name decisive key figures, to support the examination of optimisation possibilities and to provide information on the onward procedure.

Which approach the Guideline is following?

Based on the developed methodology, this guideline is describing a recommended step-wise approach for all waste stream and specific examples for each waste stream respectively. Moreover, an evaluation of the settlement structure (urban, rural, island) and performance criteria are provided under which the municipalities will identify themselves in lower, medium or advanced status. The recommendations are suited for the Greek context and were derived from an extensive literature review, as well as from international, European and national good practices.

What is the status of separate collection in Greece and the proposed stepwise approach?

Separate collection of bio-waste is almost non-existent in Greece, with only a few piloting projects running. The average municipal waste composition in Greece is about 44% organic which leads to a potential of about 223 kg/(cap x yr) for bio-waste.

Dry recyclables' separate collection of municipal waste in Greece is mainly applied to packaging through the existing Extended Producer Responsibility (EPR) Systems and the PRO's operating in the country. That includes the collective HERRCO, Rewarding Recycling S.A. and the individual system AB Vassilopoulos.

Separate collection of paper and cardboard packaging is being performed through the existing Producers Responsibility Organisation (PRO) with the printed paper being included in HERRCO's due to the lack of an established EPR. The average waste composition in Greece contains about 22 % paper (sum of non-packaging and packaging paper), which leads to a potential of about 112 kg/(cap * yr) for paper.

Plastic is a challenging waste fraction due to the several types of plastics available in the market, along with the hazardous environmental impact of plastics. The average waste composition in Greece contains about 13.9 % of plastic waste which leads to a potential of about 70 kg/(cap x yr) for plastic waste.

In terms of metals, separate collection is relatively easy as it can be efficiently separated by the existing sorting/recovery technologies, nonetheless, impurities are occurring especially in treatment facilities dealing with mixed waste. The average municipal waste composition in Greece consists of

about 3,9 % of metals (sum of non-packaging and packaging metals) leading to a potential of about 20 kg/(cap x yr) for metals.

Lastly, a separate collection of glass is already established as a single waste stream collection, through the “blue bells” containers and the other PRO’s means of collection in an effort to improve the low recycling rates. The average waste composition of the country contains about 4.3 % packaging glass, leading to a potential of about 22 kg/(cap x yr) for packaging glass.

A step-wise approach is given for each fraction which in general concludes that for the first-year municipalities under the “advanced” categorisation should keep running the awareness campaigns, while for municipalities under “medium” and “lower” status should intensify their bins network or in the case of biowaste consider the initiation of a “pilot” project within the Greek context based on international and Greek experiences. Within the next two to three years, the status of the municipality should be re-evaluated and the measures to be reconsidered based on the new data under the evaluation table, and the new measures to be undertaken accordingly. For bio-waste municipalities not identified as “advanced” should extend their pilot schemes (if implemented) until full coverage is achieved.

Within this guide, a separate reference to the optimisation of collection and awareness campaigns is given. Some of the key recommendations for the optimisation of collection include that for biowaste, brown bins of 120 litres to 240 litres are mostly recommended for urban housing areas, and in rural areas, 80-litre brown bins might be necessary in combination with home composting. For dry recyclables, it is highly recommendable to split the co-mingled collection system of packaging, into four different collection streams, one per each fraction, with the collection bins, to be easily identifiable with specified colouring. Lastly, the importance of the closed lids of the containers is emphasised, to secure the quality of the collected material, especially for paper and cardboard.

The cost of collection depends on the aspects of the applied waste management system. For biowaste, the cost of collection is expected to increase while for dry-recyclables to decrease as it is relevant to the quantity and quality of both the recyclable and residual waste to be collected.

Lastly, awareness campaigns should be increased and intensified by the municipalities in addition and collaboration to the EPRs campaigns and should include actions in public markets, schools and Civic Amenity Sites, while utilizing social media and other modern approaches is strongly recommended.

What are the key recommendations at a national level?

I. The Ministry of Environment and Energy should support and facilitate the adoption of the new EU Circular Economy Package in National Legislation including new calculating methods for recycled quantities.

II. The Ministry of Environment and Energy should consider the re-establishment of the landfill tax or the revision of the circular economy levy to increase it from 10 euros per tonne to above 50 euros per tonne based on international practices.

III. Calculations concerning total produced, reused and recycled waste quantities should be provided on an annual basis for at least the upcoming six (6) years, which will have to be in accordance with the EU target rates.

IV. Incentives should be provided such as the imposition of fines in non-compliance cases including non-economic incentives. Furthermore, the revenues from the circular economy

levy should be utilised into enhancing separate collection schemes (bins, trucks, awareness campaigns).

V. The encouragement and support of piloting projects for bio-waste and dry recyclables separate collection in rural areas as well as, as in urban areas should be promoted through funding.

VI. The simplification if feasible of the funding procedures for separate collection projects should be promoted.

What are the recommendations of the project at a regional level?

I. All 13 Regional Waste management Plans should be regularly revised in accordance with the forthcoming updated National Waste Management Plan and the overall European targets in a feasible way.

II. It should ensure that the submitted data by municipalities to the FoDSA are accurate, for example, through the auditing by an independent third party to check the reliability of the data. Any violation should be severely penalised irrespective to political ideals.

III. Strong and close follow-up during implementation is required in relation to regions and municipalities. Regular semi-annual meetings should be arranged in each region about progress and activities in the area of separate collection and treatment of municipal waste with the participation of municipalities, FODSAs and government, as well as the HRA.

What are the key recommendations of the project at a municipal level?

I. All Local Waste Management Plans must be regularly revised in accordance with the updated National Waste Management Plan and the overall European targets in a feasible way.

II. All related costs to waste management should be identified and through proper cost accounting using cost-accounting tools (e.g. the developedfull cost accounting tool provided by the second study of the overall GIZ project “Improvement of cost accounting in municipal waste management” or similar tools).

III. The most appropriate system of separate collection to be recommended in order to bridge the existing performance gap is to target waste streams as follows:

   a. Bio-waste via door-to-door or kerbside collection
   b. Separate collection of glass should be applied through bring-system
   c. Separate collection of plastic and metals should be collected via kerbside collection.
   d. All types of paper should be collected separately via kerbside collection.

IV. Containers in civic amenity sites and in other types of recycling points are essential.

V. Local authorities in Islands with high touristic impact should coordinate with three to five - stars hotels, restaurants (for cooked products as part of bio-waste) and groceries’ markets, for bio-waste separate collection. It is advisable to consider the option of a **tourist tax** to cover additional costs for separate collection, new transfer stations for dry recyclables, and treatment facilities for bio-waste.

VI. 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).

VII. Additional staff for more efficient collection and monitoring will be necessary. A regular exchange of information amongst 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 benchmarking process concerning the improvement of the collection efficiency.

The recommended actions and steps might need adjustment under the individual specificities of each municipality. **The time until 2025 is short in relation to the challenges Greece is facing, and as such the municipalities should start making changes now!**

1. Περίληψη

Το 2018 η Ευρωπαϊκή Ένωση (ΕΕ) έθεσε φιλόδοξους και αυστηρούς στόχους, για τα επόμενα δέκα (10) με δεκαπέντε (15) χρόνια, στη διαχείριση αποβλήτων, ως μέρος του πακέτου Κυκλικής Οικονομίας, για να εφαρμοστούν από όλα τα Κράτη - Μέλη, συμπεριλαμβανομένου και της Ελλάδας. Η Ελλάδα, είναι αντιμέτωπη με μία σημαντική πρόκληση, λαμβάνοντας υπόψιν τα τελευταία κατατεθειμένα στοιχεία ανακύκλωσης του 2017, που ανέρχονται στο 19% σε σύγκριση με τον αντίστοιχο μέσο όρο της ΕΕ (46%) και ειδικά, ως προς τους στόχους ανακύκλωσης αστικών αποβλήτων (50%), για το 2025 (το έτος 2025 έχει τεθεί με βάση την πενταετή παράταση, που έχει εξασφαλίσει η Ελλάδα, για να πετύχει το στόχο) και για το 2035 (65%).

Μέσα σε αυτό το πλαίσιο ο «Οδηγός χωριστής συλλογής αστικών αποβλήτων στην Ελλάδα» έχει σκοπό να παρέχει οδηγίες στην Ελληνική κυβέρνηση και κυρίως στους Δήμους της χώρας, ως προς την βελτίωση των αποδόσεών τους στη διαχείριση αποβλήτων και στη χωριστή συλλογή αποβλήτων (χαρτιού, πλαστικού, μετάλλου, γυαλιού και βιοαποβλήτων), σύμφωνα με τα πρότυπα της ΕΕ. Επιπλέον, αυτός ο οδηγός αποσκοπεί να διευκολύνει τη συζήτηση στο θέμα της χωριστής συλλογής, να παραθέσει κάποια καθοριστικά στοιχεία, να υποστηρίξει τη διερεύνηση των δυνατοτήτων βελτιστοποίησης και να παρέχει πληροφορίες σχετικά με τα περαιτέρω βήματα.

Ποια προσέγγιση ακολουθεί ο Οδηγός;

Με βάση τη μεθοδολογία που αναπτύχθηκε, αυτός ο οδηγός περιγράφει μια προτεινόμενη, βήμα προς βήμα προσέγγιση, για κάθε ρεύμα αστικών αποβλήτων, σύμφωνα με μια αξιολόγηση, που λαμβάνει υπόψιν τη δομή των οικισμών (αστική, αγροτική, νησιωτική) και κριτήρια απόδοσή τους, βάσει των οποίων οι δήμοι θα κατηγοριοποιηθούν σε χαμηλό, μεσαίο ή προχωρημένο επίπεδο. Οι συστάσεις είναι συμβατές για το ελληνικό πλαίσιο και προέρχονται από μια εκτενή βιβλιογραφική ανασκόπηση, καθώς και από διεθνείς, ευρωπαϊκές και εθνικές ορθές πρακτικές.

Ποια είναι η κατάσταση της χωριστής συλλογής στην Ελλάδα και η προτεινόμενη προσέγγιση;

Στην Ελλάδα η χωριστή συλλογή βιοαποβλήτων είναι σχεδόν ανύπαρκτη, με μόλις μερικά πιλοτικά προγράμματα να είναι σε εφαρμογή. Το 44% της μέσης σύστασης αστικών αποβλήτων στην Ελλάδα αντιστοιχεί στο οργανικό κλάσμα , που μεταφράζεται σε ένα δυναμικό βιοαποβλήτων περί 223 κιλά ανά κάτοικο κατ' έτος.

Η χωριστή συλλογή των ξηρών ανακυκλώσιμων (dry recyclables) αστικών αποβλήτων στην Ελλάδα βασικά εφαρμόζεται, ως προς τις συσκευασίες, μέσω των υφιστάμενων συστημάτων διευρυμένης ευθύνης παραγωγών και των Συστημάτων Εναλλακτικής Διαχείρισης (ΣΕΔ), που λειτουργούν στην χώρα. Αυτά περιλαμβάνουν τα Συλλογικά Συστήματα Εναλλακτικής Διαχείρισης (ΣΣΕΔ) Ελληνικής Εταιρείας Αξιοποίησης Ανακύκλωσης (ΕΕΑΑ) και την Ανταποδοτική Ανακύκλωση, καθώς και το Ατομικό Σύστημα Εναλλακτικής Διαχείρισης ΑΒ Βασιλόπουλος.

Η χωριστή συλλογή συσκευασιών από χαρτί/χαρτόνι συλλέγεται μέσω των υφιστάμενων ΣΕΔ, με το έντυπο χαρτί , να συλλέγεται απότην ΕΕΑΑ λόγω της έλλειψης εγκεκριμένου ΣΕΔ. Το 22% της μέσης σύστασης των αστικών αποβλήτων στην Ελλάδα αντιστοιχεί στο χαρτί/χαρτόνι (σύνολο συσκευασιών και μη), που μεταφράζεται σε ένα δυναμικό χαρτιού/χαρτόνι περί 112 κιλά ανά κάτοικο κατ'έτος.

Το πλαστικό, ως ρεύμα αποβλήτου αποτελεί πρόκληση εξαιτίας των διαφορετικών τύπων πλαστικού, που υπάρχουν διαθέσιμα στην αγορά, καθώς και λόγω του αρνητικού αντικτύπου των πλαστικών στο περιβάλλον. Το 13,9% της μέσης σύστασης των αστικών αποβλήτων στην Ελλάδα αντιστοιχεί στα

πλαστικά απορρίμματα, που μεταφράζεται σε ένα δυναμικόπλαστικού περί 70 κιλά ανά κάτοικο κατ'έτος.

Ως προς τα μέταλλα, η χωριστή συλλογή τους θεωρείται σχετικά εύκολη, λόγω της δυνατότητας αποτελεσματικού διαχωρισμού τους με τις υφιστάμενες τεχνολογίες διαλογής/ανάκτησης. Παρόλα αυτά παρατηρείται παρουσία προσμίξεων, ειδικά σε εγκαταστάσεις, όπου διαχειρίζονται μικτά απόβλητα. Τα μέταλλα αποτελούν το 3,9% της μέσης σύστασης των αστικών αποβλήτωνστην Ελλάδα (σύνολο συσκευασιών και μη), που μεταφράζεται σε δυναμικό 20 κιλά μετάλλων ανά κάτοικο κατ'έτος στην χώρα.

Τέλος, η χωριστή συλλογή γυαλιού θεωρείται ήδη καθιερωμένη ως ξεχωριστό ρεύμα αποβλήτου συλλογής, , μέσω των μπλε κώδωνων και τα μέσα συλλογής των άλλων συστημάτων, σε μια προσπάθεια να βελτιωθεί το χαμηλό ποσοστό ανακύκλωσης . Τα μέταλλα αποτελούν το 4,3% της μέσης σύστασης των αστικών αποβλήτων στην Ελλάδα, που αντιστοιχούν σε ένα δυναμικό 22 κιλών ανά κάτοικο κατ'έτος.

Για κάθε ρεύμα αποβλήτου δίνεται μία σταδιακή προσέγγιση βελτίωσης, που σε γενικές γραμμές καταλήγει, ότι κατά το πρώτο έτος εφαρμογής οι Δήμοι που ανήκουν στο «προχωρημένο» επίπεδο, θα πρέπει να συνεχίσουν τις εκστρατείες ευαισθητοποίησης. Οι Δήμοι, που κατηγοριοποιούνται, στα επίπεδα «μέτριο» και «χαμηλό» θα πρέπει να αυξήσουν το δίκτυο κάδων ή στην περίπτωση των βιοαποβλήτων να εξετάσουν την έναρξη ενός πιλοτικού προγράμματος, με βάση τις διεθνείς και εθνικές εμπειρίες. Στα επόμενα 2 με 3 έτη, το επίπεδο στο οποίο βρίσκονται οι Δήμοι και τα μέτρα που έχουν πάρει θα πρέπει να επανεξετάζονται με βάσει τα νέα δεδομένα και εφόσον δεν υπάρχουν αλλαγές στο επίπεδο στο οποίο κατηγοριοποιούνται, να επανεξετάζονται τα μέτρα. Για τα βιοαπόβλητα, οι Δήμοι, που δεν κατηγοριοποιούνται στο «προχωρημένο» επίπεδο, θα πρέπει να επεκτείνουν το πιλοτικό τους πρόγραμμα (αν εφαρμόζεται) μέχρι την πλήρη κάλυψη του Δήμου.

Στο συγκεκριμένο οδηγό, γίνεται χωριστή αναφορά στην βελτίωση της συλλογής και των δράσεων ευαισθητοποίησης. Οι βασικές προτάσεις βελτίωσης της συλλογής, για τα βιοαπόβλητα περιλαμβάνουν τη χρήση κάδων 120 λίτρων και 240 λίτρων, για αστικές περιοχές και των 80 λίτρων, για τις επαρχιακές σε συνδυασμό με εφαρμογή οικιακής κομποστοποίησης. Για τα ξηρά ανακυκλώσιμα, συνιστάται ιδιαίτερα ο διαχωρισμός του μικτού συστήματος συλλογής ανακυκλώσιμων συσκευασιών σε τέσσερα χωριστά ρεύματα, ένα για κάθε ρεύμα, χρησιμοποιώντας εύκολα αναγνωρίσιμους κάδους καθορισμένου χρώματος, ανά ρεύμα. Τέλος, τονίζεται η σημασία των κλειστών καπακιών των περιεκτών, για τη διασφάλισητης ποιότητας του συλλεχθέντος υλικού ειδικά, για το χαρτί/χαρτόνι.

Το κόστος της συλλογής εξαρτάται από τις παραμέτρους του εφαρμοζόμενου συστήματος διαχείρισης αποβλήτων. Για τα βιοαπόβλητα, το κόστος συλλογής ενδέχεται να αυξηθεί, ενώ για τα λοιπά ανακυκλώσιμα να μειωθεί, καθώς εξαρτάται από την ποσότητα και ποιότητα τόσο των συλλεχθέντων ανακυκλώσιμων, όσο και των υπολειμματικών σύμμεικτων αστικών αποβλήτων.

Τέλος, οι Δήμοι θα πρέπει να αυξήσουν και να εντατικοποιήσουν τις δράσεις ευαισθητοποίησης, επιπρόσθετα με τις δράσεις των ΣΕΔ, που θα πρέπει να συμπεριλαμβάνουν και δράσεις σε λαϊκές αγορές, σχολεία και δημοτικές εγκαταστάσεις, ενώ συνιστάται ιδιαίτερα να χρησιμοποιούν τα μέσα κοινωνικής δικτύωσης και άλλες σύγχρονες προσεγγίσεις.

Ποιες είναι οι κύριες προτάσεις σε εθνικό επίπεδο;

I. Το Υπουργείο Περιβάλλοντος και Ενέργειας θα πρέπει να υποστηρίξει και να διευκολύνει την υιοθέτηση του Νέου Πακέτου Κυκλικής Οικονομίας στην εθνική νομοθεσία, συμπεριλαμβανομένων και των νέων μεθόδων υπολογισμού των ποσοτήτων ανακύκλωσης.

II. Το Υπουργείο θα πρέπει σκεφτεί την επαναφορά του τέλους ταφής ή την αύξηση του τέλους κυκλικής οικονομίας από 10€/τόνο, που είναι τώρα σε υψηλότερη χρέωση ακολουθώντας τις διεθνείς πρακτικές (πάνω από 50€/τόνο).

III. Θα πρέπει να δίνονται σε ετήσια βάση, οι υπολογισμοί των συνολικών παραγόμενων, επαναχρησιμοποιούμενων και ανακυκλούμενων ποσοτήτων για τα επόμενα έξι (6) χρόνια τουλάχιστον, που θα πρέπει να συνάδουν με τους στόχους της ΕΕ.

IV. Θα πρέπει να δοθούν κίνητρα, όπως η επιβολή προστίμων σε περιπτώσεις μη συμμόρφωσης συμπεριλαμβανομένων και μη οικονομικών κινήτρων. Επιπλέον, τα έσοδα από το τέλος κυκλικής οικονομίας θα πρέπει να χρησιμοποιούνται, για την ενίσχυση της χωριστής συλλογής (κάδοι, απορριμματοφόρα, δράσεις ευαισθητοποίησης).

V. Θα πρέπει να προωθηθούν η ενίσχυση και η υποστήριξη πιλοτικών προγραμμάτων, για χωριστή συλλογή βιοαποβλήτων και ξηρών ανακυκλώσιμων (dry recyclables) τόσο σε αστικές όσο και σε υπαίθριες περιοχές, μέσω χρηματοδότησης.

VI. Θα πρέπει να απλουστευτούν, όπου είναι δυνατόν, οι διαδικασίες χρηματοδότησης, για προγράμματα χωριστής συλλογής.

Ποιες είναι οι κύριες προτάσεις σε περιφερειακό επίπεδο;

I. Συστηματική αναθεώρηση και των δεκατριών (13) Περιφερειακών Σχεδίων Διαχείρισης Αποβλήτων σύμφωνα με τον προσεχή αναθεωρημένο Εθνικό Σχεδιασμό Διαχείρισης Αποβλήτων και των Ευρωπαϊκών στόχων με εφικτό τρόπο.

II. Θα πρέπει να εξασφαλιστεί η ακεραιότητα των δηλωθέντων δεδομένων των δήμων στους ΦοΔΣΑ, μέσω για παράδειγμα, ανεξάρτητου τρίτου μέρους, που θα ελέγχει την αξιοπιστία των δεδομένων. Οποιαδήποτε παραβίαση πρέπει να τιμωρείται αυστηρά, ανεξάρτητα από τις πολιτικές προσεγγίσεις.

III. Απαιτείται ισχυρή και στενή παρακολούθηση κατά την εφαρμογή, σε σχέση με τις περιφέρειες και τους δήμους. Σε κάθε περιοχή θα πρέπει να διοργανώνονται τακτικές εξαμηνιαίες συναντήσεις σχετικά με την πρόοδο και τις δραστηριότητες στον τομέα της χωριστής συλλογής και επεξεργασίας αστικών αποβλήτων με τη συμμετοχή δήμων, ΦοΔΣΑ και της κυβέρνησης, καθώς και του ΕΟΑΝ.

Ποιες είναι οι κύριες προτάσεις σε τοπικό επίπεδο;

I. Συστηματική αναθεώρηση των Τοπικών Σχεδίων Διαχείρισης Αποβλήτων τον προσεχή αναθεωρημένο Εθνικό Σχεδιασμό Διαχείρισης Αποβλήτων και των Ευρωπαϊκών στόχων με εφικτό τρόπο.

II. Όλες οι σχετικές δαπάνες, για τη διαχείριση των αποβλήτων θα πρέπει να προσδιορίζονται και μέσω κατάλληλης λογιστικής κοστολόγησης χρησιμοποιώντας εργαλεία κοστολόγησης (για παράδειγμα το ανεπτυγμένο εργαλείο πλήρους κοστολόγησης που παρέχεται από τη δεύτερη μελέτη του συνολικού έργου GIZ «Βελτίωση της κοστολόγησης στη διαχείριση αστικών αποβλήτων» ή παρόμοιο εργαλεία).

III. Το καταλληλότερο σύστημα χωριστής συλλογής, που συνιστάται, για να γεφυρωθεί το υπάρχον κενό απόδοσης είναι να στοχευθούν τα ρεύματα αποβλήτων, ως εξής:

α) Βιο-απόβλητα μέσω συλλογής από πόρτα σε πόρτα ή σύστημα συλλογής στα πεζοδρόμια.

β) Η χωριστή συλλογή του γυαλιού πρέπει να εφαρμόζεται μέσω του συστήματος συλλογής σε κεντρικούς κάδους.

γ) Η χωριστή συλλογή πλαστικών και μετάλλων θα πρέπει να συλλέγεται μέσω συστήματος συλλογής στα πεζοδρόμια.

δ) Όλα τα είδη χαρτιού / χαρτονιού θα πρέπει να συλλέγεται χωριστά μέσω συστήματος συλλογής στα πεζοδρόμια.

IV. Κάδοι σε δημοτικά πράσινα σημεία και άλλα σημεία ανακύκλωσης είναι απαραίτητα.

V. Οι τοπικές αρχές στα νησιά με υψηλό τουριστικό αντίκτυπο θα πρέπει να συνεργάζονται με ξενοδοχεία τριών έως πέντε αστέρων, εστιατόρια (για μαγειρεμένα προϊόντα ως μέρος των βιοαποβλήτων) και αγορές ειδών οπωροπωλείου, για τη χωριστή συλλογή βιοαποβλήτων. Θα μπορούσε να τεθεί η επιβολή ενός **τουριστικού φόρου**, για την κάλυψη πρόσθετων δαπανών της χωριστής συλλογής, νέους σταθμούς μεταφοράς για ξηρά ανακυκλώσιμα και εγκαταστάσεις επεξεργασίας βιοαποβλήτων.

VI. Θα μπορούσε να εξεταστεί η δυνατότητα διαδημοτικής συνεργασίας, ειδικά σε περιοχές της επαρχίας και μικρότερες αστικές περιοχές, ως προς την αποτελεσματικότητα και τη σκοπιμότητα της συλλογής (οικονομία κλίμακας).

VII. Θα χρειαστεί πρόσθετο προσωπικό για πιο αποτελεσματική συλλογή καιπαρακολούθηση. Μια τακτική ανταλλαγή πληροφοριών μεταξύ των τμημάτων διαχείρισης αποβλήτων σε κάθε περιφέρεια ή σε εθνικό επίπεδο, είναι απαραίτητη, μαζί με τη δημιουργία μιας διαδικασίας συγκριτικής αξιολόγησης σχετικά με τη βελτίωση της αποτελεσματικότητας της συλλογής.

Οι προτεινόμενες ενέργειες και βήματα ενδέχεται να χρειάζονται προσαρμογή, με βάση τις ιδιαίτερα χαρακτηριστικά κάθε δήμου. **Ο χρόνος έως το 2025 είναι σύντομος σε σχέση με την πρόκληση, που αντιμετωπίζει η Ελλάδα και ως εκ τούτου οι δήμοι χρειάζεται να ξεκινήσουν τις αλλαγές τώρα!**

2. Introduction

In Greece, waste management is mainly limited to collection and landfilling, despite the country's efforts in the past years for more capital-intensive options of treatment. The predominant way of collection of recyclables in a municipal level is based on a co-mingled system for paper, plastic and metals with only a limited number of municipalities implementing separate collection of waste (e.g. Halandri, Kozani, Vari-Voula-Vouliagmeni, Vrilissia).

Separate collection of individual waste fractions is seen as a pre-condition for fostering high-quality recycling and high recycling rates. Thus, the European Waste Framework Directive (WFD) sets the general requirement of separate collection and obliges the Member States (MS) to take measures to promote high-quality recycling, and set up separate collection systems for the dry recyclables (paper, metal, plastic, and glass), and bio-waste by 2023.

Despite the transposition of all EU Directives in the Greek legislation including setting-up targets for separate collection since 2012, it non-the-less lacks in implementation.

2.1 Objectives of the study

This guideline is intended to facilitate the discussion of the topic, to name decisive key figures, to support the examination of optimisation possibilities and to provide information on the onward procedure. Recommendations for action and procedures are included for the main dry recyclables and biowaste.

This study aims to develop a step-by-step guideline for Greek municipalities, based on the current recycling system, on how to set up and enhance separate collection of the main five (5) fractions (bio-waste, paper, plastics, metals, and glass).

It should be noted that the recommendations of this guide are to be used as guidelines to be adjusted to the specificities of each municipality, on which the municipalities can base their separate collection schemes.

Lastly, the guide is based on international experience from several countries and strong knowledge of the Greek circumstances including other reports and previous guidelines in these areas of waste management.

2.2 Recycling aims EU & Greece

With the adoption of the WFD of the European Commissions (EC) Directive 2008/98[1], recycling targets have been set for all MS for 2020. This Directive was recently revised in 2018 under the new Circular Economy package by the 2018/851/EU Directive introducing more ambitious recycling and re-use targets up to 2035 as portrayed in *Figure 1*1 (European Commission, 2019).

[1] Article 11

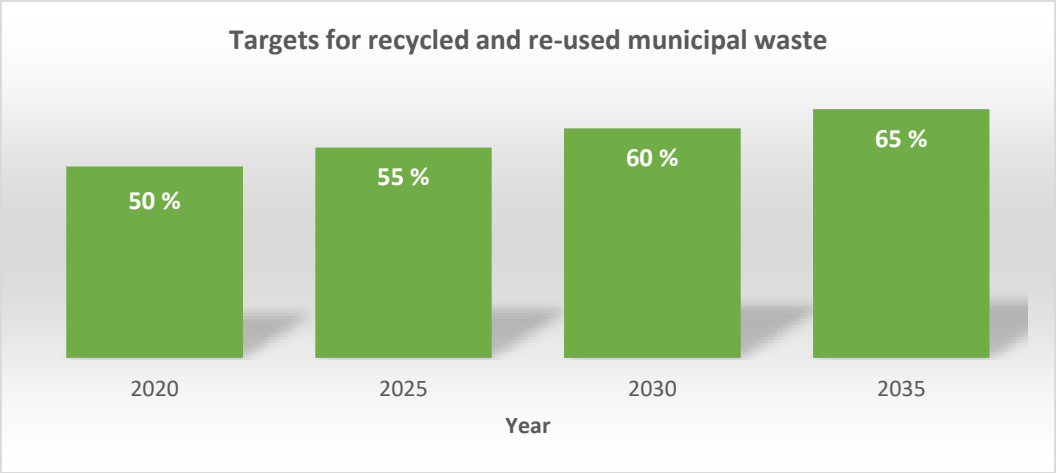
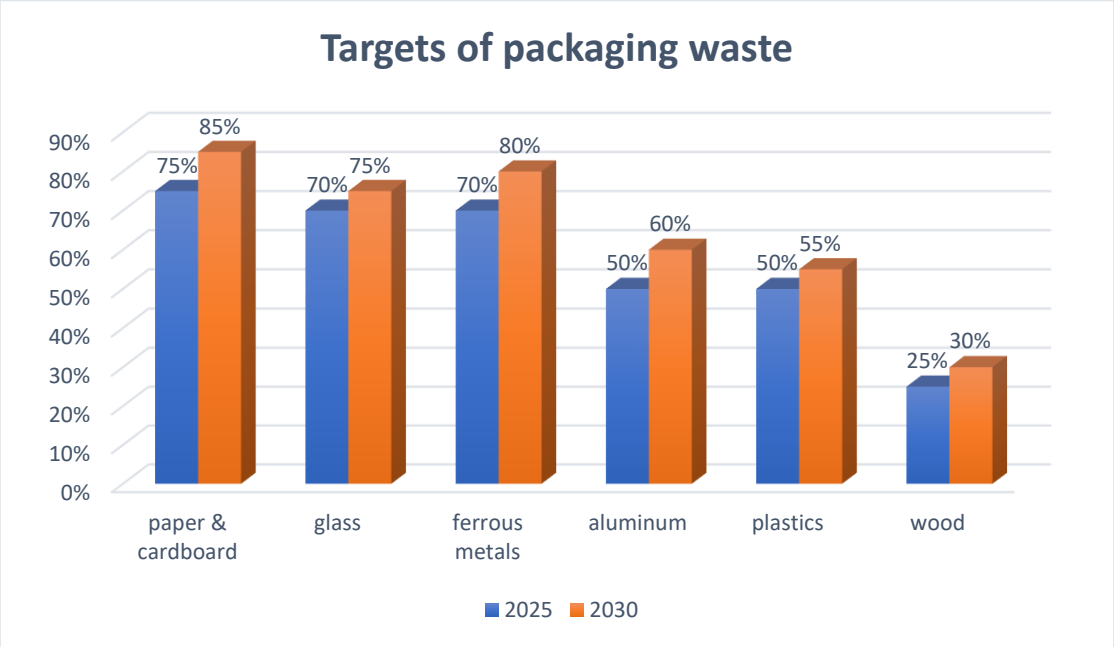


Figure 1: EU Targets for recycled and re-used municipal waste (European Commission, 2019)

The Landfill Directive 1999/31 set a target of 35% of biodegradable waste, (based to 1995 produced quantities), being landfilled by 2016. The Directive has recently been revised under the 2018/850/EU Directive, setting stricter landfill restrictions obliging MS to landfill up to 10% of the total generated municipal waste, in 2035, while banning from landfill separately collected waste suitable for recycling and recovery, including biowaste.[2]

The packaging waste Directive was also recently amended in 2018 by Directive 2018/852/EU, included in the Circular Economy Package, setting re-use and recycling targets for 2025 and 2030 of 65% and 70% by weight respectively. Additional targets are set for 2025 and 2030 per packaging material, as presented by *Figure 2*3[3].

***Figure 2: EU Recycling targets by 2025 and 2030 for packaging waste* (European Commission, 2019)**



[2] Article 1 (4d) and (4b)
[3] 2018/852/EU – Article 1 (5)

Additionally, the amended WFD Directive offers, to MS with more than 60% rate of landfilled municipal waste (in regards to 2013 waste quantities), a deferment of application for five (5) years. The interested MS need to notify the Commission of the postponement at least twenty-four months before the set deadlines (2025, 2030, 2035) by submitting an implementation plan.[4] The extension was granted in 2019 to ten (10) MS including Greece (European Commission, 2019).

By 31st December of 2021, member states shall submit a report to the commission on the implementation of this article as it relates to municipal waste and bio-waste, including the material and the territorial coverage of separate collection and any derogations under paragraph 3.The Greek Government complying with the European Unions (EU) obligations has transposed all the required Directives to its' legislation. The Greek government, through the new NWMP (2020), set more conservative targets, compared to the previous ones, in an attempt to improve the country's waste management efficiency. The revised NWMP and its targets aim to reflect more accurately the country's existing situation. In accordance to which the Regional Waste Management Plans (RWMP) and the Local Waste Management Plans (LWMP) are being revised.

In Greece, various authorities and entities are involved in waste management. The main stakeholders and their main responsibilities are:

- **Ministry of Environment and Energy (YPEN)** - the main governmental authority responsible for the development of environmental and waste management policy in Greece (NWMP, 2015; Presidential Decree (PD) 132/2017 – Government Gazette 160/A/30-10-2017). As of the 7th of August 2019, the staff, functions, and responsibilities of the General Secretariat of Waste Management Coordination, previously encompassed in the Ministry of Interior (YPES), has transferred to YPEN (Law of 4622/2019 – Article 111). As such the main competencies of the YPEN will extend to (NWMP, 2020; P.D. 4/2014 (A'9); P.D. 141/2017[5]):
    - Coordinate the municipalities regarding waste management.
    - Develop and approve of waste management initiatives for the municipalities.
    - Coordinate and supervise along with the involved Ministries (YPES, Ministry of Development and Investments) the pertinent governmental and private entities of the undertaken activities of waste management.
    - Implement the principles and regulations of the EU and National legislation in public procurement.
    - Coordinate and promote the RWMPs.
    - Monitor and assess the governmental, private, and control entities and authorities in regard to the efficiency and the progress of the partaken waste management activities and projects (Law 4622/2019 – Article 111).

- **Ministry of Interior (YPES) -** The YPES is considered the most significant governmental authority of the country, as it is responsible for the supervision of Decentralised Administrations (DA) and local authorities (Municipalities and Regions), amongst others (YPES, 2019). Due to the afore-mentioned transfer of the General Secretariat of Waste Management Coordination, to the YPEN, the Ministry's responsibilities on waste management in terms of

[4] Directive 2018/851/EU – Article 1 (12), (d)
[5] P.D. 141/2017 – Article 27

the municipalities and Solid Waste Management Organisations (FODSA) are to be reframed (Pothou, 2019).

- **Decentralised Administration (DA) -** DAs were established under the Law 3852/2010 "New Architecture of Self-Government and Decentralized Administration - Kallikrates Program", with the most recent amendment by law 4555/2018. The DA is a separate administrative unit responsible for the State's operational and audit activities within its jurisdictive area. Amongst other responsibilities, they provide general guidelines and ensure the implementation of environmental legislation (Law 3852/2010; Law 4555/2018).

- **Regional Governance (RG) -** are local governmental bodies consisting of municipalities (13 nationwide). Each constituency is set up in a wider area of the country (with the exception of Mount Athos) and has its own independent services and budget as defined by Law 3852/2010.
- **Hellenic Recycling Agency (HRA)** – a public interest, non-profit private entity supervised by the Ministry of Environment and Energy. Its main objective is the development, planning and implementation of policy for the recycling and recovery of waste ("Alternative Waste Management" in Greek) such as packaging, packaging waste and other products, as well as the planning and implementation of preventative measures. It is the authority under which all the Extended Producer Responsibility (EPR) schemes are being authorised and monitored (NWMP, 2020; HRA, 2019).
- **Solid Waste Management Association (FoDSA)**[6] - the regional non-profit waste management entities responsible for the development, implementation and monitoring of the RWMP. They are constituted by municipalities within each Region and can be either state-owned or anonymous enterprises under Public-Private Partnerships. They are also responsible for implementing the waste management pricing policy to the municipalities depending on the collected waste and the implemented treatment (Laws 4042/2012, 4071/2012, as amended by Law 4555/2018 – Article 225 – 231).

- **Municipalities**[7] - the local authorities responsible for the implementation of waste management through the development and implementation of LWMPs following the guidelines and targets of RWMP and therefore of the NWMP. Amongst their responsibilities is the development, planning and organisation of waste management within their jurisdictional limits, collection of waste, forming contracts with EPR schemes, or developing their own separate collection system, based on the RWMP requirements, and obligations (NWMP, 2020; Law 4071/2012 – Article 6 and 4555/2018 – Article 228).

- **EPR schemes and Producers Responsibility Organisations (PRO)** – sector-wise mainly private organisations constituting of producers liable under the Extended Producers Responsibility policy regarding their financial and/or operational responsibility for the management of the generated by the consumers waste from their products. The "producer" term refers to manufacturers, sellers and/or importers of any product entering the market (OECD, 2019); (HRA, 2020). In Greece regarding MSW operate four (4) PROs – HERRCO, Antapodotiki (Rewarding Packaging Recycling) and AB Vassilopoulos – managing dry recyclables and especially packaging material and KEPED - managing used oil.

[6] As described in the laws of 4071/2012 – Articles 13-17, and 4555/2018 - Articles 225 - 235
[7] As described in the 4071/2012 – Article 6 and 4555/2018 laws – Article 228

2.3 Current situation in Greece

2.3.1 General

The current state of waste management in Greece constitutes a significant challenge for the Greek government in its attempt to attain the targets set by the EU and the NWMP as adopted in 2020.

According to Eurostat, the annual generated waste amounts to 514kg per inhabitant (inhab.). which compared with the EU average (482kg/inhab.) is much higher despite the financial recession the country has gone through recently (Eurostat, 2017). Moreover, based on NWMP's data, 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. (NWMP, 2020)

Concerning Greece's packaging waste, the available data are shown in Tables 1a and *1b*. The data presented in those tables are the country's official data reported to Eurostat by the HRA and YPEN, complying to the country's obligations. Regarding packaging waste, the data are derived from the annual reports of the certified EPR systems, in terms of recycling and recovery rates.

Table 1a: Total Quantities of Greece's waste (per specific stream) recycling and recovery for 2017 (YPEN, 2019)

Material	Material recycling* (tonnes)	Other forms of recycling (tonnes)	Total recycling (tonnes)	Energy recovery (tonnes)	Total recovery (tonnes)
Glass	34,531	0	34,531	0	34,531
Plastic	81,701	0	81,701	12,600	94,301
Paper/cardboard	551,132	0	551,132	8,400	559,532
Metal	64,628	0	64,628	0	64,628
Wood	3,200	7,600	10,800	2,200	13,000
Organics	224,603	0	224,603	36,000	260,603
Total	**950,824**	**7,600**	**967,395**	**59,200**	**1,026,595**

**Including composting*

Table 1b: Quantities of Greece's packaging waste generation and recovery for 2017 (according to the report for Packaging Waste Directive (YPEN, 2019))

Material		Packaging waste generation (tonnes)	Material recycling* (tonnes)	Other forms of recycling (tonnes)	Total recycling (tonnes)	Energy recovery (tonnes)	Total recovery (tonnes)
Glass		95,800	34,500	0	34,500	0	34,500
Plastic		188,200	77,860 (81701)	0	77,860	12,600	90,460
Paper/cardboard		357,400	355,790	0	355,790	8,400	364,190
Metal	Aluminium	21,700	7,250	0	7,250	0	7,250

Material		Packaging waste generation (tonnes)	Material recycling* (tonnes)	Other forms of recycling (tonnes)	Total recycling (tonnes)	Energy recovery (tonnes)	Total recovery (tonnes)
	Steel	64,800	53,700	0	53,700	0	53,700
Wood		53,000	3,200	7,600	10,800	2,200	13,000
Total		**786,500***	**532,300**	**7,600**	**539,900**	**23,200**	**563,100**

**Including "other" according to the report submitted for Packaging Waste Directive (94/62/EC)*

Lastly, in terms of the existing infrastructure regarding waste management, the country has progressed significantly the past decade, currently counting 84 operating sanitary landfills, 10 operating and 6 under construction MBTs, 35 material recovery facilities (MRF), and approximately 93 waste transfer stations (Wasteatlas, 2019).

2.3.2 Prevailing bio-waste's situation and challenges

In Greece separate collection of bio-waste has been restricted in the implementation of limited pilot programs, in regards to home composting, on-site composting, selection at source (SaS) and composting of material recovered from MBTs (NWMP, 2020).

According to Greek legislation, all responsibilities concerning bio-waste fall under the municipalities, however only a limited number of municipalities which have implemented a pilot project have upscaled their system (e.g. Halandri, Voula – Vari - Vouliagmeni, the case studies of which are provided in **Annex 4**).These pilot-driven programs have been funded by either European programs such as the Life+ or Horizon 2020 program either by the National Strategic Reference Framework (NSRF) 2014 – 2020, with only a few rare cases where separate collection schemes have been funded by the municipality's own means. The private sector is only involved in terms of contracts with municipalities under the form of Public-Private Partnerships or tendering.

In regards to the development of a pilot project, detailed information can be found in the "Separate collection of bio-waste" study, part of the overall project of GIZ, which can be used as a baseline to the municipalities for the development of their own pilot projects. (**Annex 9**)

The legislation framework concerning bio-waste and compost:

- JMD No. 171914/2013 (Government Gazette B 3072/03.12.2013) is the transposition of the EU Decision 2006/799/EC "on the definition of revised ecological criteria and the related assessment and verification requirements for the award of the Community eco-label to soil improvers"
- Law 4496/2017 – Article 2 provides the option of the creation of an EPR scheme for bio-waste
- GIZ is conducting a study on proposed compost and digestate standards, concurrently to this report, under the YPEN's supervision.

Greece has significant potentials in regards to bio-waste, but significant and immediate actions are to be taken to comply with the targets, such as the application of the EPR scheme.

The challenges for the municipalities on separate collection of, especially but not exclusively, household bio-waste, are mainly in regards to:

- The biodegradability of the specific type of waste.
- The easily occurring contamination in households, and the difficulty of removing impurities.
- The unstable sources of nuisances, e.g., odour, percolation.
- The variable moisture levels, affecting the logistical and technical requirements for its collection and further processing.

2.3.3 Prevailing Dry recyclables' (paper & cardbpard, plastic, metal, glass) situation and challenges

Separate collection dry recyclables (paper & cardbpard, plastic, metal, glass) derived from municipal waste are mainly collected through EPR schemes for packaging waste. The most widely developed EPR scheme in Greece, as mentioned previously, is HERCCO and it's developed "blue bin" network in a co-mingled packaging waste system.

Collection liability, according to the existing Greek legislation, belongs partially to the municipalities (collection and transfer) and to the private sector — EPR schemes for treatment and valorisation of packaging paper.

The PRO's managing packaging waste, other than HERRCO, are Rewarding Recycling S.A. and AB Vassilopoulos through the use of Reverse Vending Machines (RVM) distributed mainly in urban open space areas ("Recycling Houses" and within the premises of the supermarket respectively), offering monetary incentives to participants.

Only for packaging glass the "Athenian Brewery" for beer and beverage bottles runs a voluntary deposit refund scheme. (HRA, 2019); (Athenian Brewery, 2020). According the DRS, the consumers pay a fee of 0.14€ per beer bottle and get refunded when they return the empty bottle to the retailer. This system is mainly facilitated by large supermarket chains and on voluntary bases through the wholesalers. More information on DRS's can be found in the report of "Economic Instruments" of the overall GIZ project.

HERRCO, as afore-mentioned, besides the "blue bins" network, has developed a network of "blue bells" specifically tackling packaging glass waste. The "bells" have either a 1.3m^3 or 2.5m^3 capacity, accommodating mainly major producers and business venues (entertainment halls, hospitality sector, etc.), along with the development of the system to municipalities for the general public. Currently, in Greece, there are situated about 13.500 "blue bells" nationwide.

Collection is tendered by HERRCO Glass on an annual basis for each regional area with the collected material being transferred to either interim storage facilities or in the cases of Attica, Thessaloniki and Larissa directly to the end-users (HERRCO Glass, 2019).

The applied collection system of mixed colour glass (brown, green, white) is managed by the companies active in glass separation in Greece, which they have installed their own separation technology to split up the delivered quantities into different colours.

Moreover, printed paper is collected unofficially by HERRCOs "blue bins" network, attempting to close the gap that exists due to the absence of an EPR scheme for non-packaging paper (HERRCO, 2019, [12]).

One of the main challenges the PRO's are up against is the impurities and the contamination of the collected material due to the citizens' unawareness of the acceptable materials and the conditions to which they should dispose of their recyclables (empty, clean, etc.). (HERRCO, 2019)

Furthermore, a significant contribution to the collection of paper and cardboard (packaging and non-packaging), is occurring by the informal sector, especially during the recent financial crisis. The sector's activities are occurring mostly in urban dense populated areas namely Athens and Thessaloniki, resulting in reducing the amounts of separately collected material from the existing PROs and in preventing the assessment of the actual state of paper and cardboard recycling in Greece (HRA, 2019).

The main challenges the municipalities in Greece face, regarding the recycling of packaging materials are:

- Intensification of awareness campaigns and public relations, in addition to campaigns from PROs dealing with packaging materials;
- Improvement of efficiency in collection areas;
- Organisation of treatment capacities like MRFs in cooperation with PROs;
- Formation of cooperation agreements with the existing secondary market (recycler/potential end-users) either through FoDSA or directly;

For Greece to achieve the targets, separate collection of good quality is a pre-condition with no impurities, which can only be accomplished by implementing separate collection. To validate the potential expectations, it is highly advisable to perform a waste composition analysis regularly — maybe every 5 years.

3. Methodology

3.1 How to read this guide

This guide has been developed to facilitate the municipalities in identifying their current situation and to follow the step-wise approach accordingly, to improve separate collection of the main five (5) waste fractions (bio-waste, paper, plastic, metal, and glass) commonly present in MSW.

Each waste fraction is being analysed separately by providing general information of the material, followed by good practices as case studies from different countries/municipalities within the EU, already implementing separate collection.

The main issues that will be addressed within the report are in regards to:

- Applied system per waste stream;
- Organisation of separate collection of biowaste and dry recyclables;
- Optimisation of the efficiency of the collection systems;
- Awareness campaigns and public relations;

Information and recommendations on optimisation of collection of the recyclables including biowaste (frequency, quality, etc.) along with optimisation on awareness and engagement campaigns are being provided separately of the waste fractions chapters. The recommendations within each chapter are addressed to municipalities. A separate chapter or recommendations is being provided, with recommendations on a national level (YPEN), regional (FoDSA's) as well as on a local/municipal level.

It is advisable from the authors of this guide for each municipality to perform a waste composition analysis before implementing a separate collection system. Especially urban-type municipalities should consider the quantity and composition of the produced waste within their community additionally to the recommendations within this guideline. Such an analysis would become a baseline for all future comparison of improved waste management evaluations.

However, as previously mentioned, each case (municipality, waste fraction) needs further consideration based on the specificities and the existing conditions of each municipality. As such this the guidelines provided by this guide are to be used as a general basis on which each municipality will adjust based on their existing conditions.

3.2 Development of scenarios

This report is attempting to set the main boundaries of the system, as illustrated in Figure 6, starting from the core components of the waste management system, collection, treatment, marketing of compost and dry recyclables. The financial optimisation derives from the attempt to enhance the three core components having a reciprocal relation. Finally, the public relations , awareness campaigns and follow up of the services' quality reinforce the efforts towards the achieventment of the set-up goals and thus waste sustainability.

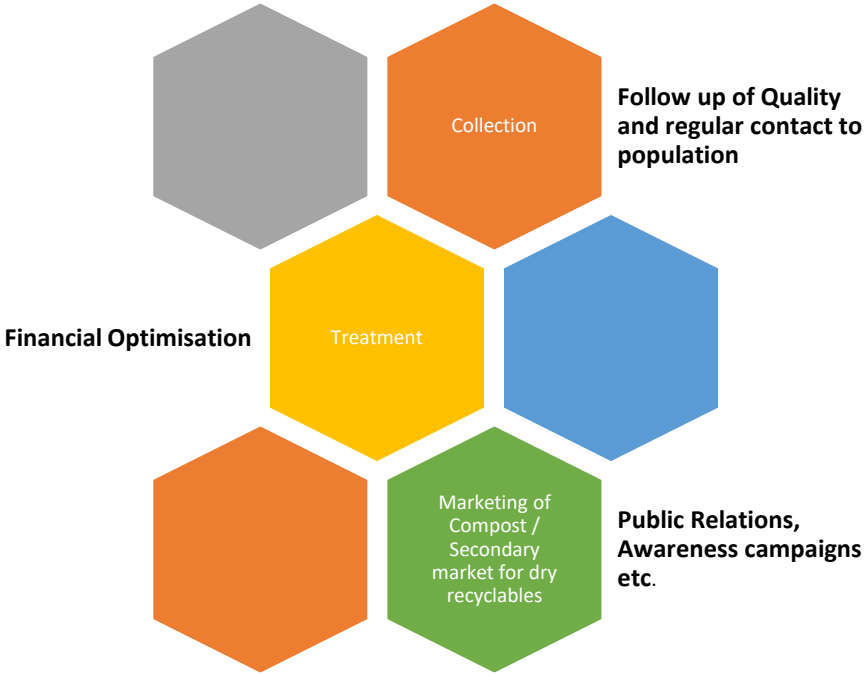


Figure 3: ***Core areas to deal with during preparation and implementation of separate collection of dry recyclables and biowaste (Ressource Abfall, 2019)***

Hereinafter, the municipalities are invited to evaluate themselves through the provided evaluation table for each stream , and to identify their status, based on their performances in separate collection. The evaluation is taking into consideration the aspects of the settlement structure (urban, rural, island) along with several parameters including the quantity and quality of the collected material (purity), coverage of collection network, under which they will be categorised under "advanced", "medium" or "low" status.

As to facilitate and include all types of municipalities in regards to their settlement structure, regarding the evaluation, three (3) groups of municipalities have been adopted (urban-rural – islands with high touristic impact).

The municipalities in remote or mountainous areas are being classified under the settlement structure type "rural" within this guideline due to the similarity of the existing conditions in regards to waste management defined by a rather low number of inhabitants per square kilometre and complicated transport issues.

The approach with three settlement categories is based on international experience and to the authors perspective regarding the easy use of the guide by the municipalities. As a basis, the adopted categories of municipalities according to Greek legislation are adopted as presented in **Error! Reference source not found.**2. *The* Categorisation for the thirty largest Greek islands is shown in Annex 1.

Table 2: Categorisation for scenarios (Ressource Abfall, 2019)

<table>
<tr><th>Categories of municipalities (Klisthenis)</th><th>Description of municipalities belonging to category (Klisthenis)</th><th colspan="2">Within this guideline in scenarios</th></tr>
<tr><td>1. Municipalities of Metropolitan Centres</td><td>All the municipalities of the Central, North, South and West Districts of Athens and the Regional Unit of Piraeus of the Attica Region. The municipalities of Thessaloniki, Ampelokipon - Menemeni, Kalamaria, Kordelio - Evosmos, Neapolis - Sykeon, Pavlou Mela and Pilea - Chortiati of the Regional Unit of Thessaloniki</td><td colspan="2" rowspan="3">Urban</td></tr>
<tr><td>2. Large Continental Municipalities & Capitals of Prefectures</td><td>All continental municipalities, as well as the municipalities of the Region of Crete and the Regional Unit of Evia, with a population of more than 25,000 inh.</td></tr>
<tr><td>3. Middle Continental Municipalities</td><td>All continental municipalities, as well as the municipalities of the Region of Crete and the Regional Unity of Evia, with a population of more than 10,000 and up to 25,000 inh.</td></tr>
<tr><td>4. Small Continental and Small Mountain Municipalities</td><td>All continental municipalities, as well as the municipalities of the Region of Crete with a population of less than 10,000 inh.</td><td colspan="2">Rural</td></tr>
<tr><td>5. Large and Medium Island Municipalities</td><td>All island municipalities with a population of over 3,500 inh.</td><td>Islands with high touristic impact*</td><td>Rural**</td></tr>
<tr><td>6. Small Island Municipalities</td><td>All island municipalities, with a population of up to 3,500 inhab.</td><td>Islands with high touristic impact*</td><td>Rural**</td></tr>
</table>

* Ratio of touristic beds / number of residents is > 0.25 and more than 1,000 beds or > 0.50

* *Ratio of touristic beds / number of residents is < 0.25 and less than 1,000 beds

The evaluation is followed by a step-wise approach based on the municipalities classification and evaluation, on how the municipalities should proceed in improving their separate collection.

3.3 The step-by-step process

A general stepwise approach is presented for the municipalities to follow based on their previous classification. Detailed recommendations on the collection schemes, the entailed cost as well as the awareness campaigns are presented in chapters nine (9) and ten (10) respectively.

The following systematic description of steps allows self-control and future identification of improvement areas:

STEP 1: **Take inventory of your actual situation of separate collection stream** Take inventory via evaluation according to table which indicates the evaluation scale for each separate collection stream respectively.
STEP 2: Identify your areas of improvement In case the quantity parameters based on the criteria are all evaluated as "advanced status" keep your awareness campaigns on-going. In case the inventory has shown that quantity parameter concerning the criteria don't match with an advanced status, check how your collection schemes and publicity campaigns perform.
STEP 3: First year's measures 1) In case you have identified that the collection scheme isn't advanced => intensify your grid of bins and/or collection frequency (see chapter 9). 2) In case you have identified that your publicity is lacking => start additional awareness campaigns, go to public markets, schools etc. Send your waste advisors to the households, etc.
STEP 4: Measures during 2nd and 3rd year 1) Continue with measures from the first year if not completely implemented. 2) Duplicate and scale up the implemented measures.
STEP 5: Re-Check your actual situation of separate collection streams and go back to STEP 2 Conduct an evaluation of your municipality based on the tables indicating the evaluation scale for each separate collection stream on an annual basis along with the annual waste management data report. Wherever results are not falling under the "Advanced Status" rated column, the municipality should establish stronger efforts for improvement.

The following issues should be further considered:

- On islands with high touristic impact with no waste collection via trucks, different bins and collection schemes should be selected. The placement and selection of collection bins (type and size), should be decided by taking into consideration the users' proximity and the existing commercial activity of the area. The bins should be of high aesthetics to be harmonized with the adjacent activities (commercial, tourist, etc.) and the surrounding environment. Furthermore, besides the separate collection, the efficient transport of recyclables to MRFs or other treatment facilities has to be established also for such islands.
- An annual exchange should be initiated and supported among all waste management branches of municipalities in one region concerning "lessons learned" and the approaches to overcome difficulties with the separate collection, especially of bio-waste.
- The concerns of additional bins and collection trucks might require collaboration through the exchange of information with HERRCO and/or other PROs.

- After the intensification of the collection scheme, data should be evaluated within the municipalities monthly.
- Evaluation results should be reported to YPEN at least semi-annually.
- Recommendations from this guideline might be modified in relation with own experiences of improvement of separate collection schemes.

Pay As You Throw (PAYT) systems are the most effective drivers behind the implementation of source separation of bio-waste in many of the EU-MS.

4. Guidelines for separate collection of bio-waste

4.1 About separate collection of bio-waste

The Greek 4042/2012 law transposing the 2008/98/EC European Framework Directive defines bio-waste as: *"the biodegradable garden and park waste, food and waste from households, restaurants, caterers and retail premises and related wastes from food processing plants".*

Bio-wastes, depending on their nature or origin and the deriving waste streams, can be categorised in (ΕΠΠΕΡΑΑ, 2012)[8]:

1. **Household bio-waste:** the organic fraction of biodegradable waste that is produced by the households or municipalities and concerning garden waste, with further classification in:
   - Food waste: Unused food or food residues from meal preparations in households.
   - Garden – green waste: garden or green waste from private yards or public parks and green spaces, consisting of grass clippings, shrub or yard clippings, branches, woodchips, bark, wood (not containing hazardous substances), old flowers, etc.
2. **Commercial bio-waste**: the organic fraction of biodegradable waste produced by businesses for trade or commerce purposes, such as areas for food and drink consumption, sport and recreational activities, government agencies, private business, educational institutions, etc.
3. **Industrial bio-waste**: the organic fraction produced from the food and drink processing sector. Forestry or agricultural waste, manure, sludge, natural textiles, paper or paperboard, along with food and animal by-products are not included in the definition.

Bio-wastes are classified under the "municipal waste" of the European Waste Catalogue (EWC) (Chapter 20) and can be identified in the following *Table 3*.

Table 3: Classification of Bio-waste according to LoW (Eurostat, 2010)

Types of Bio-waste	EWC Code	Origins
Food waste (household and commercial)	20 01 08	Households, restaurants, canteens, bars, caterers, etc.
Markets waste	20 03 02	Biodegradable waste from markets
Garden and park biodegradable waste	20 02 01	Private & public parks and green spaces
Wood waste	20 01 38	Not containing hazardous substances, no furniture or bulky household waste

Waste deriving from meat and fish processing establishments, in general, are excluded as they are falling under the animal by-products regulations (1774/2002/EC and its amendments).

The collection of food waste from restaurants, caterers and retail premises depends on the MS regulations. In some countries, similar bio-waste from small enterprises is collected together with bio-

[8] ΕΠΠΕΡΑΑ, (2012). Guide in implememnting bio-waste separate collection and Bio-waste management systems

waste from households by the municipality (e.g., France and Ireland), while in others the enterprises themselves are responsible for taking care of the collection (e.g., in Germany and Finland).

In contrast with dry recyclables, bio-waste cannot be stored or conveniently transported by households due to the smell, foulness and deterioration in time. Moreover, although research is ongoing for high-value niche applications, bio-waste currently has a relatively low value in many EU-MS. Therefore, the main economic driver to collect bio-waste separately in many EU-MS is the extraction of bio-waste from the expensive mixed waste stream, valid for such countries with lower or nearly no landfilling of MSW and the calculation of costs including capital costs. (Oeko-Institut+EY, 2019).

In 2017, the recycling of municipal bio-waste[9] in the EU MS was at 81 kg/(cap x yr) on average. A big variation was observed in some countries presenting a recycling rate above 100 kg/(cap x yr) in total, along with differentiations regarding the capture rate of garden waste and food waste.

The preferred material for composting varies between municipalities/countries depending on the existing conditions, in their attempts to achieve the collection of high quantities at the best possible quality level for the treatment stage that follows. The applied treatment technology also has some implications concerning acceptable or wanted input composition.

A few of the main issues that cause deviations concerning input to the brown bin are briefly highlighted:

- Salt content of input – this should be limited to achieve a good compost product applicable to soil; therefore, municipalities sometimes exclude seafood
- Cooked meat residues from dishes – sometimes these are excluded too, either from a salt content point of view or from a view of risks related to attracting cats or rats, for example
- Use of biodegradable – compostable – plastic bags for kitchen waste, etc.

Within this guideline, we suggest that the above deviations should be ignored at least at an early stage. It is strongly recommended to further examine this approach with the results from composting facilities treating separately collected bio-waste in Greece and link to the results from parallel compost quality projects initiated by GIZ.

An indicative list of suitable input for the separate collection of bio-waste is shown in **Annex 5** along with a table of the symbols used in packaging products to indicate the recyclability of the product, in **Annex 8**.

4.2 Good practice case studies from Europe

Depending on the type of settlement structure the applied systems for bio-waste collection differ across the EU (Oeko-Institut+EY, 2019):

- **Urban areas:** Most of the EU capital cities rely on door-to-door separate collection of bio-waste supported by Civic Amenity Sites (CAS) (Bipro 2015). In general, door-to-door schemes seem to be the most common schemes for separate collection of bio-waste especially food waste from households.

[9] Including both garden and park waste, food and kitchen waste from households, etc.

- **Rural areas**: Separate collection of bio-waste in rural areas has been a practice in Austria for many years. The results demonstrate that high capture rates and good quality can be obtained in regions with many rural areas e.g. Styria.
- For **touristic zones in rural areas,** a number of good practices have been identified in the Selective Collection of Organic Waste (SCOW) Project – *"Selective collection of the organic waste in touristic areas and valorisation in farm composting plants*" (SCOW, 2019).

Box 1: Case study – Milan (Italy) (Oeko-Institut+EY, 2019):

Door-to-door household organic waste collection was first introduced in November 2012 and was then progressively extended to the whole city by June 2014**. An example with "high-speed implementation period" of less than two years to full scale. The key to success was strong commitment to a user-friendly collection of bio-waste via an obligatory scheme.**

Brown bins and compostable bags are used for collection, while small kitchen bins with a special airy structure to minimize the inconvenience related to the formation of odours and liquids are used in apartments.

Preliminary measures like the obligatory transparent, compostable bag to allow inspection of the content were another key factor. Accompanying measures include also quality controls of the organic waste bins by 24 trained personnel and sanctions in case of irregularities.

Thorough resource planning, maintenance of vehicles and proper communication (before and after) to citizens have been key success factors. An information campaign was launched with a distribution of 180,000 separate collection guides in 10 languages and a specific campaign for raising the quality It is underlined that, according to international experience, the time demand for implementation of separate collection of bio-waste in other municipalities or countries exceeded the aforementioned timeline of fewer than two years for the Milan case.

Form concept to implementation it required three to five years. That included the first concept for pilot projects, preparation of awareness campaigns and public relation activities, starting pilot project in three areas, evaluation of first results and finally to the stepwise implementation into full scale (in general two-four steps in urban areas, depending on size). Before the full-scale application, it was included a modification of awareness campaigns, buying of bins and new trucks, and the finalisation of large scale implementation in many cases.

Figure 4: Collection point at high-rise building in Milan & Bio-waste collection in Milan (Favoino, 2015; Giavini, 2016)

Box 2: Case study – Ljubljana (Slovenia) (Oeko-Institut+EY, 2019)

Ljubljana has implemented a door-to-door collection system between 2006 and 2013, with the development of a network of about 20,000 brown containers. **Reached a reasonable collection rate of more than 70% of bio-waste. The key to success was the dense collection system, which allows better quality of collected material, optimisation of collection frequency, better possibilities for increased peoples engagement/participation.**

Communication and dissemination actions included the use of social media and Short Message Service (SMS) to inform and engage the citizens. Users may set up a free SMS reminder of the waste collection schedule, along with monitoring collection costs and update their services. JP Voka Snaga – the Ljubljana waste management company - also organized a field trip for the media to foster exposure of the program and communicate on issues with impurities.

The system presented a high capture rate (up to 73%), the collected material has reached-up to about 23,600 tons of bio-waste, which amount to 32,600 tons per year.

Figure 5: Underground collection points in central city and neighbouring areas,in Ljubljana (JP VOKA SNAGA)

Figure 6: Regular bio-waste collection bins, in Ljubljana, (JP VOKA SNAGA)

Box 3: Case study - Würzburg, Germany (Dr. Tuminski GmbH, 1994)

Composting plant Würzburg is a very good example as they have developed since 1995 over years a very multifaceted system of marketing of compost products from separately collected bio-waste (see **Error! Reference source not found.**). In the last years, the marketing of soil products with compost generated about 1.2 million € annual turnovers (ANS, 2016). Two full-time and two part-time employees are working only in the marketing area.

The key to success was a long term approach and steady communication with marketing target groups, which resulted in the marketing of compost products to citizens and agriculture.

By 2019, approximately 135 digestion plants in Germany used a total of about two million tonnes of source-separated organic waste from households (Fachverband Biogas e.V., 2019). Globally, biogas production from waste is on the rise and it may become one of the most important waste management and energy production systems in developing countries and emerging economies.

Marketing area for bagged compost and products from compost at Würzburg composting facility

Storage area for compost and soil products *Citizens filling in compost from bulk*

Figure 7: ***Photos from best Practice example of compost marketing (Ressource Abfall GmbH, 2016 ; ANS, 2016)***

Detailed good practice examples from Greece are described in **Annex 4**.

4.3 Recommendations – Step-wise approach for bio-waste

Each municipality is responsible for a good collection quality with a low content of impurities within the separately collected bio-waste. Table 4 provides an evaluation scale-up, to which municipalities will need to identify themselves based on their performances according the criteria regarding bio-waste. The general step-wise approach is implemeneted for bio-waste stream to follow based on their current classification.

Table 4: Evaluation scale for separate collection of bio-waste (Ressource Abfall, 2019)

Parameters	Advanced Status	Medium Status	Low Status
Quantity of separately collected bio-waste	> 120 kg/(cap x yr)	> 60 kg/(cap x yr)	< 60 kg/(cap x yr)
Percentage of separately collected bio-waste	> 65 % of potential	> 45 % of potential	< 45 % of potential
Coverage of separate collection system	> 95 % of area (> 90 % of area in Rural, Remote & Mountainous)	> 80 % of area (> 75 % of area in Rural, Remote & Mountainous)	< 80 % of area (< 75 % of area in Rural, Remote & Mountainous)
Quality of collected bio-waste, content of impurities	< 1 % in weight	> 1 % to 2 % of weight	> 2 % of weight

In **Annex 2** are illustrated some extra key elements which indicate the status of the municipalities regarding the bio-waste fraction of the separated collection.

Following systematic description of steps allows self-control and future identification of improvement areas. Generally, separate collection of bio-waste is just starting in Greece and the majority of the municipalities cab identify themselves in the "low status" category. Therefore, it is highly recommended to gain first experiences with awareness-raising and collection efficiency and success from pilot projects for bio-waste within Greek framework conditions.

The pilot projects are recommended to start **(STEP 3: *Measures during 1st year*)** with close kerbside collection or door-to-door collection in an area with about 3,000 – 5,000 inhab. Pilot project areas should be representative of the type of population density and may take place in areas where higher support from population might be expected.

Experiences and data from pilot projects in similar municipalities in the region or near distance can be used for the implementation of the "new" pilot. A first larger-scale part might be prepared for about 15,000 – 30,000 inhab., in case pilot projects have been executed at least in two other municipalities of similar structure type in the same region. Inter-municipal exchange of experiences is of the utmost importance.

The municipalities that have executed a pilot project during the first year, the 2nd and 3rd year can proceed **(STEP 4: Measures during 2nd and 3rd year)** by extending pilot project experience. In an urban structure of more than 100,000 inhab., full coverage can be achieved at latest in four years. About 1/3 of the municipality can enter the implementation phase each year, after the the results from the pilot project (= altogether four years).

In smaller urban structures (less than 100,000 inhab) full coverage should be achieved in a maximum two years after the implementation and the results of the pilot project (= altogether three years). Extend experience to about 1/2 of the municipality each year.

The municilalities that are looking to upscale the pilot area for separate bio-waste collection during the first year then in urban structures of more than 100,000 inhab., full coverage can be achieved in three years. In smaller urban structures full coverage should be achieved at maximum one year after results from the first larger part would be available (= altogether two years).

In case you have identified that your publicity is lacking continue additional awareness campaigns, go to public markets, schools etc. Send your waste advisors to the households. Show benefits and incentives to your citizens, etc.(see chapter 10)

5. Guideline on separate collection of MSW fraction paper

5.1 About separate collection of paper

Separate collection of paper is regarded as a straightforward requirement of EU-legislation (bipro, 2015). Separate collection of paper, both packaging paper and non-packaging paper is a common practice in countries such as Germany, UK, France, and Spain, exceeding a recycling rate of 70% in 2015. (ImpactPapeREC, 2018)

The most relevant to MSW household waste in which this study is focusing on, in regards to paper and cardboard, can be identified under the EWC codes as indicated to Table 5 (EUR-Lex, 2018):

Table 5: Key EWC codes for municipal paper and cardboard waste

EWC	Description
20 01 01	MSW including separately collected paper and cardboard
15 01 01	Packaging paper and cardboard

The paper fraction from MSW consists of packaging and non-packaging paper products. Regarding enhancing recycling mainly the following materials should be collected:

- packaging made of paper
- paper and cardboard
- newspapers, books and brochures (aha, 2019)

An indicative list with the acceptable materials regarding separate collection of paper and cardboard, additional information on the materials “new products“ which can be recycled into, along with some environmental facts on their recycling, are available in **Annex 6** and **Annex 7** respectively. Moreover, it is provided a table of the symbols used in packaging products to indicate the recyclability of the product, in **Annex 8**.

5.2 Good practice case studies from Europe

In this chapter case studies across the EU are being presented as good practices for municipalities, in the following boxes.

<u>Box 4: Case Study – Barcelona (Spain)</u> (Barcelona, 2019)

Barcelona is implementing a separate collection system of municipal household waste based on the characteristics of each urban district. The region is using different collection systems according to the specificities of each district including door-to-door system, bring-point or recycling yards/Green Dots (similar to Greek Green Points), or pneumatic collection system.

Regarding the bring-point system, separate collection of paper and cardboard is taking place with the placement of blue containers/bins, within a distance of 100 meters of each household, to ensure the accessibility to all the citizens.

Door-to-door waste collection including paper and cardboard is being applied in specific zones and areas, such as the old part of the city, shopping areas and areas where the accessibility of vehicles and the placement of the containers is difficult. There are specified hours that the collection is taking place in order to avoid the accumulation of waste bags on the streets.

Green Dots, are used for the collection of waste that cannot be collected by street bins/containers which are situated in 21 neighbourhoods throughout Barcelona, two mobile green dots at schools and other places.

Lastly, Recycling yards, (similar to Green Points), are for the disposal of material that cannot be collected by the street containers.

Figure 8: Recycling bins in Barcelona (Source: Ajuntament de Barcelona, 2020)

Figure 9: Recycling street bin for paper & cardboard in Barcelona (Ajuntament de Barcelona, 2020)

<u>Box 5: Case study – Jena (Germany)</u> (kommunal service jena, 2016)

Jena implements a separate collection system, since 1990, which has recently revised by introducing the new system in a step-wise approach, addressing most waste streams including paper and cardboard. Paper, cardboard and cartons are collected in blue containers/bins of 120lt, 240lt, as well as with 1,100lt with a chip-lock.

Figure 10: Recycling bins for paper and cardboard (blue bin) and light packaging (yellow bin) in Jena (Source: Hicke Matina, 2016)

Initially, the municipality started with the organization of the system contacting the suburbs and housing administrations, introduce the process/plan to selected committees and to be approved by the city council.

Figure 11: Information on Jena's Recycling system in other languages (Source: Hicke Matina, 2016)

The second step was the initiation of awareness campaigns through the local mass media (i.e. magazines, newspapers), information on the company's website, leaflets in several languages other than German (to include refugees and students), along with an annual waste calendar with current news on waste management.

Furthermore, the system incentivized citizens by introducing fees - reduction for waste collection as recycling increased, through waste compensation for citizens implementing home composting, as well as for citizens owing small private properties with reduced waste generation.

As a result, recycling and recovery rates increased significantly, which in case of paper and cardboard reached up to 7,438 tn/yr, with the recycling rate of waste, in general, reaching up to more than 62%. Moreover, this resulted in lower costs for participating citizens, minimization of residual waste to 99.3 kg/inhab./yr, and reduction of generated waste (paper, textiles and plastics – other than packaging) to 260 tn/yr.

Good practice examples from Greece are described in **Annex 4.**

5.3 Recommendations - Stepwise approach for paper including printed paper

Table 6 provides an evaluation scale up to which municipalities will need to identify themselves based on their performances on paper separate collection:

Table 6*: Evaluation scale for separate collection of paper including printed paper* (Ressource Abfall, 2019)

Parameters	Advanced Status	Medium Status	Low Status
Quantity of separately collected paper	> 90 kg/(cap x yr)	> 60 kg/(cap x yr)	< 60 kg/(cap x yr)
Percentage of separately collected paper	> 85 % of potential	> 60 % of potential	<60 % of potential
Coverage of separate collection system	> 95 % of area (> 90 % of area in Rural, Remote & Mountainous)	> 80 % of area (> 75 % of area in Rural, Remote & Mountainous)	< 80 % of area (< 75 % of area in Rural, Remote & Mountainous)

According the classification, the municipalities should follow the step-by-step process, described in paragraph 3.3. In **Annex 2** are illustrated some extra key elements which indicate the status of the municipalities regarding the paper fraction of the separate collection.

Following issues should be further considered:

- The concerns of additional bins and collection trucks might require collaboration through the exchange of information with HERRCO and/or other PROs.
- For the islands with high touristic impact applying waste collection without trucks, different bins and collection schemes should be considered. The placement and selection of collection bins (type and size), should be decided by taking into consideration the users' proximity and the existing commercial activity of the area. The bins should be of high aesthetics, to achieve harmonization with the adjacent activities (commercial, tourist, etc.) and the surrounding environment. Furthermore, besides the separate collection, the efficient transport of recyclables to MRFs or other treatment facilities has to be established also for such islands.
- After the intensification of the collection scheme, data should be evaluated within the municipalities monthly.
- Evaluation results should be reported to YPEN at least semi-annually.

6. Guidelines on separate collection of MSW fraction plastic waste

6.1 About separate collection of plastic waste

Plastic has vast applications in our everyday life, with a consequential negative environmental impact due to the plastic fragments or microplastics. To tackle the plastic pollution derived from the generated plastic waste the EU has adopted targeted actions and Directives (2019/904 EU "Single-use plastics" Directive, Circular Economy Package, etc) in an attempt to minimise the effects (see chapter 2.2).

Compared to the other dry recyclables, household plastic waste is difficult to be considered as a single and homogeneous waste stream since it is composed of different types of products, representing a high variety of polymers, and very often impurities. There are more than 50 different types of plastics, presenting a significant challenge in sorting and reprocessing them compared to other recyclable materials (Oeko-Institut+EY, 2019).

Moreover, the reprocessing of different types of mixed or in some cases separately collected plastics (PET, PP, LDPE, etc) cannot be technically facilitated due to the heterogeneity of the plastic products and their composition in many cases of multiple types of materials (M.K. Eriksen et al., 2019). These challenges of plastic recycling, along with the EU set targets, and the Circular Economy Package, are the key drivers to promote and implement separate collection of plastic.

EPR systems for packaging are the main approach in the organization of the collection and recycling of plastic packaging waste in the EU. Twenty-six of the 28 EU Members have EPR schemes in place for packaging waste (Watkins et al. 2017) with varying approaches and types of schemes, (collective vs individual producer responsibility, competing schemes vs only one scheme and schemes covering only certain types of packaging, i.e. household/equivalent packaging vs commercial and/or industrial packaging, or both) (Oeko-Institut+EY, 2019).

A relatively new approach for separate collection of plastic is the deposit refund system (DRS), which according to EU MS experience, enhances collection rates for beverage containers and reduces public littering significantly (Oeko-Institut+EY, 2019). The possibility of a DRS within the Greek context is further discussed within the report on "Economic Instruments" of the overall GIZ project.

The most relevant to municipal household plastic waste, of which this study is focusing on, is plastic packaging waste, which can be identified under the EWC codes in *Table 7*. (EUR-Lex, 2018)

Table 7: Key EWC codes for municipal plastic waste

EWC	Description
20 01 39	MSW including separately collected plastic waste
15 01 02	Plastic packaging
15 01 05	Composite packaging
15 01 06	Mixed packaging

An indicative list of separate collection of plastic along with additional information on the variations of plastic (PET, PVC, etc.), the "new products " which can be recycled into and some environmental facts of the recycling process, are presented in **Annex 6** and **Annex 7** respectively. Moreover, is

provided along with a table of the symbols used in packaging products to indicate the recyclability of the product, in **Annex 8**.

According to Plastics Europe West Region (2019) separate collection of non-packaging household plastic waste is very little applied in Europe. Separate collection of non-packaging plastic waste from households is mainly organized by municipalities via containers in civic amenity sites (Oeko-Institut+EY, 2019). Some non-packaging small plastic items unintentionally follow the plastic packaging waste stream. The fraction is then subject to recycling if the polymer types correspond with the polymers sorted out in the plastic packaging sorting process (Fråne et al 2014).

6.2 Good practice case studies from Europe

In this chapter case studies across the EU are being presented as good practices for municipalities, in the following box, along with some general facts about the separate collection of plastic waste within the EU.

A range of co-mingling systems exist around Europe, which to a large extent are based on mechanical and advanced sorting of different waste fractions. Fourteen (14) MS collected plastic waste in co-mingled systems (nine MS collected plastic and metal together, three MS collected three fractions together and two countries collected four fractions together (Bipro, 2015).

The experience for EU MS shows that well designed and advanced mechanical sorting can achieve higher and/or more efficient sorting than what can be expected from source separation in the households (DEPA 2019).

Regarding collection efficiency, in the EU only in rare occasions is combined the collection packaging and non-packaging plastic. In some Municipalities in Germany collection efficiency regarding non-packaging plastic might count for 5 to 7 kg/(cap*yr), establishing the necessity of long term awareness campaigns to limit impurities in bins.

Good practice examples from Greece are described in **Annex 4**.

<u>Box 6: Case study - FostPlus – Belgium</u> (FostPlus, 2019)

Fost Plus is the Belgian producer responsibility organization accredited for the collection and recycling of household packaging waste. It has financial and partial organizational responsibility. FostPlus is an EPR system with co-mingled collection for plastic bottles, metal cans and drink drink cartons (PMD), while it colelctes separately paper & cardboard and glass, with high capture rate.

The result was a reasonable recycling rate of more than 40% of packaging plastic and the key factor of success were the implementation of an EPR scheme and continuous awareness campaigns. Moreover, high PAYT contributions (up to 3 € for a 60 liter bag) for residual waste were implemented.

Each waste stream has a colour separating bag. Each municipality sets independently the collection date and time, but the system is the same, with the citizens disposing PMD in a blue labelled bag to be collected. The municipalities are sending a waste collection calendar annually to the citizens to inform them on the collection schedule.

Figure 12: PMD separate collection Belgium (Source: FostPlus, 2020)

Fost Plus is seen as a model example due to its exceptional collection and recycling results. Belgium's recycling rate in 2015 for all packaging waste (81.5%) and for plastic packaging waste (42.6%) individually was above the EU average (65.5% and 39.8% respectively). (Oeko-Institut+EY, 2019). EUROSTAT-Data for 2016 show a slight increase (e.g. all packaging waste recycling rate, 81,9% in Belgium) (EEA, 2019).

As a condition for the success of this EPR scheme, continuous awareness campaigns are required to remind citizens of the correct sorting rules, particularly for plastic bottles and flasks. Moreover, Belgium has some of the highest PAYT contributions in Europe (up to 3 € for a 60 litres bag) for residual waste.

6.3 Recommendations - Stepwise approach of plastic waste separate collection

The proposed evaluation scale for plastic waste contains the same elements as for paper but with different numbers for the evaluation of collected quantities (Table 8).

Table 8: Evaluation scale for packaging plastic waste **(Ressource Abfall, 2019)**

Parameters	Advanced Status	Medium Status	Low Status
Quantity of separately collected plastic	> 40 kg/(cap x yr)	> 25 kg/(cap x yr)	< 25 kg/(cap x yr)
Percentage of separately collected plastic	> 55 % of potential	> 35 % of potential	<35 % of potential
Coverage of separate collection system	> 95 % of area (> 90 % of area in Rural, Remote & Mountainous)	> 80 % of area (> 75 % of area in Rural, Remote & Mountainous)	< 80 % of area (< 75 % of area in Rural, Remote & Mountainous)

According the classification, the municipalities should follow the step-by-step process, described in paragraph 3.3. In **Annex 2** are illustrated some extra key elements which indicate the status of the municipalities regarding the plastic fraction of the separate collection.

7. Guidelines on separate collection of MSW metal fraction

7.1 About separate collection of metals from MSW

Metal waste are originating from several products and in different forms, from both industrial and household applications. Metals are in general rather easily separated which is why the majority of the EU MS is collecting this specific fraction along with plastic and/or other waste streams.

However, even within MRF-facilities different qualities and impurities might occur due to the attachment of other fractions on the collected material which results in decreased revenues from markets.

Due to metals high value, metals are the most desirable materials for recycling companies. Even though the value changes depending on the markets' demand, an indicative value can be presented, of 700 €/Mg of high quality of aluminium cans in Central Europe (LetsRecycle, 2019) and of about 500€/ton in Greece for aluminium[10].

The most relevant to household waste of which this study is focusing on is packaging, which can be identified under the EWC as presented in Table 9. (EUR-Lex, 2018)

Table 9: Key EWC codes for municipal metal waste

EWC	Description
20 01 40	MSW including separately collected metals
15 01 04	Metallic packaging
15 01 05	Composite packaging
15 01 06	Mixed packaging

As metals and especially non-ferrous metals are rather valuable any system is more than willing to collect them. Packaging materials from metal and similar products from ferrous and non-ferrous are regarded as suitable input for separate collection of metals from MSW, like (aha, 2019):

- tins and cans
- packaging and foils made of aluminium

Large metal products and household machinery like refrigerators etc. belong to WEEE and should be collected separately.

An indicative list of acceptable input of separate collection of metals along with additional information on the materials "new products " which can be recycled into and some environmental facts on their recycling, are presented in **Annex 6** and **Annex 7** respectively. Moreover, along with a table of the symbols used in packaging products to indicate the recyclability of the product, in **Annex 8**.

7.2 Good practice case studies from Europe

In this chapter, a case study is being presented as good practice of separate collection of metals for municipalities, in the following box.

[10] Values from tenders for resale of recyclable from Municipalities of Volvis (2017) and Virona (2019)

Box 7: Case study – FostPlus (Belgium) (APEAL, 2018) (FostPlus, 2019)

As mentioned before, FostPlus is an EPR for packaging waste, operating in Belgium (Belgium Green Dot). Separate collection in Belgium is applied via door-to-door systems, with metals along with other dry recyclable.

Metals are collected separately in special blue bags, defined as PMD bags. The system was deemed appropriate taking into consideration the population density of Brussels (370.3 inhab./km^2) while for non-dense areas a bring point system is applied, by placing containers/bins close to citizens for them to bring their waste to.

Regarding the metals blue bags, FostPlus, informs the citizens on the acceptable material to improve household sorting which is led to MRFs. For this purpose, it is available a mobile application which informs the citizens on the accepted material, along with information on the collection dates, providing a monthly overview of all waste collections in the municipality, and even information of street-by-street collection. Though the application the citizens can have reminders as to the day and time the collection is taking place in their street along with the quickest route and operational hours of the nearest recycling centre or container park (similar to Greek Green Points).

Good practice examples from Greece are described in **Annex 4**.

7.3 Recommendations - Stepwise approach of metal waste separate collection

The proposed evaluation scale for metal waste from MSW contains the same elements as for metal waste but with different numbers for evaluation of the collected quantities (see *Table 10*).

Table 10: Evaluation scale for separate collection of metal waste **(Ressource Abfall, 2019)**

Parameters	Advanced Status	Medium Status	Low Status
Quantity of separately collected metals	> 16 kg/(cap x yr)	> 10 kg/(cap x yr)	< 10 kg/(cap x yr)
Percentage of separately collected metals	> 85 % of potential	> 60 % of potential	<60 % of potential
Coverage of separate collection system	> 95 % of area (> 90 % of area in Rural, Remote & Mountainous)	> 80 % of area (> 75 % of area in Rural, Remote & Mountainous)	< 80 % of area (< 75 % of area in Rural, Remote & Mountainous)

According the classification, the municipalities should follow the step-by-step process, described in paragraph 3.3. In **Annex 2** are illustrated some extra key elements which indicate the status of the municipalities regarding the metal fraction of the separate collection.

8. Guideline for separate collection of MSW fraction glass

8.1 About separate collection of glass

Glass is considered the material with the highest recycling rates in the EU. As a 100% infinitely re-recyclable, reusable and refillable material, glass within the EU has a collection rate of more than 70%, in terms of beverage and food packaging. (FERVER, 2019)

The most relevant to household waste of which this study is focusing on is packaging waste, which can be identified under the EWC as presented in Table 11.

Table 11: Key EWC codes for municipal glass waste

EWC	Description
20 01 02	MSW including separately collected glass
15 01 07	Glass packaging

Glass, and packaging glass waste recycling is taking into consideration amongst others, the colouring of the material. Mainly, three colours of glass are being recycled:

- clear (white) glass;
- green glass;
- brown glass or other coloured glass bottles like blue ones;

Windowpanes, porcelain or mirrors should stay out of glass collection schemes. (aha, 2019)

An indicative list of separate collection of glass along with additional information on the materials "new products" which can be recycled into and some environmental facts on their recycling, are presented in **Annex 6** and **Annex 7** respectively. Moreover, is provided, a table of the symbols used in packaging products to indicate the recyclability of the product, in **Annex 8**.

8.2 Good practice case studies from Europe

In this chapter, a case study is being presented as good practice of separate collection of metals for municipalities, in the following box.

Box 8: Case study – Madrid (Spain) (Madrid, 2019)

Madrid has 3.273.000 inhab. With urban waste management being a municipal competence carrying out by the City Council. Madrid is implementing a combination of two collection systems, the collective and door-to-door collection system. The collective system is being implemented with the placement of kerbside containers for separate collection of glass and paper & cardboard, while door-to-door is being implemented for packaging.

Separate collection of glass is taking in place in Madrid through the development of collective containers (green coloured specified label) distributed throughout the city, along with door-to-door collection for big producer centres and specific containers for the hotel sector. There are 8.000 recycling points through the city in "igloo" containers for glass and paper/cardboard. Special separate containers for glass are being provided in restaurants and bars throughout the city.

"Door-to-door" packaging and mixed waste is performed daily through the year, including Sundays and Holidays. Standardised containers for packaging waste (yellow) and mixed waste (grey) are being provided, cleaned and maintained by the Madrid's City Council for free.

Figure 13: Collective containers of separate collection of glass (green label), paper & cardboard (blue label), organics (brown), plastic, metal & wood packaging (yellow), residual (orange). (Source: Madrid, 2020)

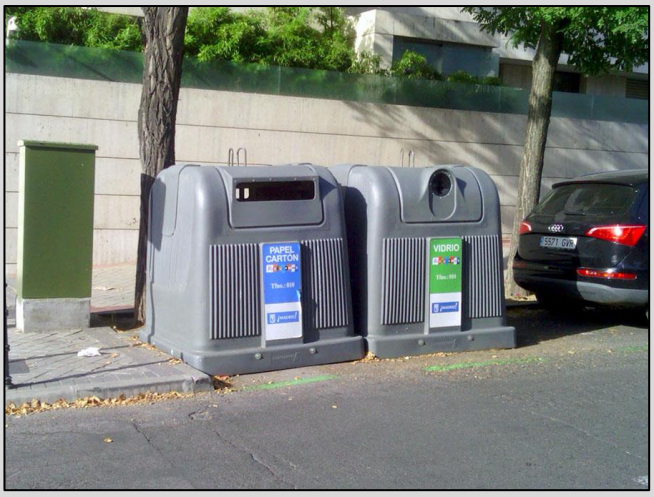


Figure 14: Collective containers for separate collection of paper & cardboard (blue label) and glass (green label). (Source: Residuow Professional, 2017)

Awareness of the citizens is provided through the municipality's website where a guide for separate collection of all materials is being provided and a phone line, to which the citizens can address for additional information and service requests, along with environmental educational programs through visits and activities in Madrid's waste treatment plant, Valdemingomez Technological Park (recycling & recovery of collected recyclable materials, biomethanization and composting, energy recovery and controlled landfill)

Madrid's system results in an annual recovery of 38.000 tn/yr of glass

In EU one can see many practices of separate collection of packaging and non-packaging glass. In Austria are separately collected 25 kg/(cap*yr).of glass, and in Germany more than 20 kg/(cap*yr) are widespread. In both cases Long term awareness campaigns and a dense grid of collection bins are the key for success.

8.3 Recommendations - Stepwise approach of glass separate collection

The proposed evaluation scale for packaging glass contains the elements as given in *Table 12*. Each Municipality should do its own evaluation for the actual situation regarding glass for each of the three given parameters.

Table 12*: Evaluation scale for separate collection of glass* (Ressource Abfall, 2019)

Parameters - Bio-waste	Advanced Status	Medium Status	Low Status
Quantity of separately collected paper	> 16 kg/(cap x yr)	> 10 kg/(cap x yr)	< 10 kg/(cap x yr)
Percentage of separately collected paper	> 75 % of potential	> 50 % of potential	<50 % of potential
Coverage of separate collection system	> 95 % of area (> 90 % of area in Rural, Remote & Mountainous)	> 80 % of area (> 75 % of area in Rural, Remote & Mountainous)	< 80 % of area (< 75 % of area in Rural, Remote & Mountainous)

According the classification, the municipalities should follow the step-by-step process, described in paragraph 3.3. In **Annex 2** are illustrated some extra key elements which indicate the status of the municipalities regarding the glass fraction of the separate collection.

9. Optimisation of collection schemes

9.1 General

Many organisational and operational parameters have to be considered before the implementation of any new waste collection scheme.

Possible collection schemes

Following **options** are regarded as reasonable for each municipality to choose alongside the implementation **of separate collection scheme for recyclables**:

a) **Individual bins (door to door option)**: Using the introduction of separate bins to change to individual bins for each house

b) **Keep System of kerbside collection – Modify frequency of residual MSW collection**: Stick to the existing principle of residual waste collection – add new for each separately collected waste stream at the same collection points – adjust frequencies due to cost reasons

c) **Option b) plus the use of obligatory compostable liners /bags, for biowaste:** To avoid odours, leachates in the bio-waste bins and to improve acceptance of separate collection of bio-waste such bags/liners will be declared as obligatory and promoted by the municipalities as long as they are not the only bags to be used in supermarkets etc. (as it is the situation in Italy for years)

Collection trucks

- How much additional truck transport capacity do we need?
- Where do we get skilled drivers and workers?

Are the available or future vehicles/trucks matched to the relative density of the different materials?

Collection frequency

In correlation with the introduction of the separate collection of bio-waste and dry recyclables, the frequency of collection of residual MSW should be reduced. This optimisation of collection frequency is necessary both in regards to cost optimisation as well as terms of incentives to onward decisions on separate collection and waste management.

Observations for the municipalities to consider regarding the collection frequency:

- For each municipality, detailed calculations of the number of trips and advanced route planning might be reasonable where an increase of collection trips per week might occur.
- The requirement of additional demands on trucks and drivers will be determined by the adopted schedules and the maximum load to be collected and transported within one trip.
- Predictably, the placing of additional bins will initiate conflicts in densely populated neighbourhoods with small availability in parking spaces.

Employees and staff

In terms of employees and staff, it is recommended that municipalities should engage a few additional staff members in waste management department who will only deal with:

i. bins related issues (size and quantity for a certain neighbourhood, location);

ii. routing, operation, maintenance of vehicles

iii. acceptable material;

iv. monitoring of purity levels

v. dedicated helpline for citizens' support

Detailed planning of logistics including tender procedures for additional bins and route planning will surely last some months. Procedures for evaluation of quality and quantity need to be established prior to starting or upscaling of any collection scheme. Coordination of logistics with awareness campaigns and treatment facility is a precondition of any initiating or upscaling.

9.2 Biowaste collection

In terms of collection bins and trucks:

- According to international experience, brown bins of 120 litres to 240 litres are mostly recommended for urban housing areas – for quality reasons with the bins of 120 litres being preferred. The 360 litres bins have proven in practice that they create a lot of problems during collection and should be avoided. In case of individual bins per property in rural areas maybe also 80 litres brown bins might be necessary.
- For fruit markets and similar large producers e.g. large hotels where the bin is placed in a separate area with access only for limited staff members: 660 litres or 770 litres containers might be an option to reduce handling time. But then truck and lifter should match to load one larger bin or two smaller (120 litres + 240 litres) ones.
- On any CAS the municipalities should also consider installing containers for separate collection of garden waste and bins for bio-waste.
- Some brown bins (as all other bins too) surely should be permanently in reserve at each municipality to replace or intensify the grid in case any necessity might occur – and they will occur.
- A full bio-waste bin of 770 litres might weigh about 300 – 400 kg – the municipality should validate the ability of the trucks lifters to move such bins.
- The packer plate trucks should have a storage basin or something similar for leachate collection from bio-waste (the storage basin should be emptied at the bio-waste treatment facility after each trip).
- Ensure that the press-containers that might occur from the transport of the separately collected bio-waste via transfer station, are tight, the type of condition sealing bands etc.

By the establishment of separate collection of biowaste, the collection frequency needs to be reexamined. Especially in the very hot southern areas of Greece and in the densely populated urban settlements and on islands with high touristic impact separate collection of bio-waste should take place at least three times a week although it seems best to collect bio-waste there daily – at least during summer months. Whereas on islands with high touristic impact municipalities should coordinate with 3 – 5 stars hotels, restaurants (for cooked products as part of bio-waste) and fruit markets in an early stage.

The collection frequency for each clustering should be taken by the municipalities based on their requirements. Examples of frequency changings are presented in Table 13.

Table 13: ***Example of changes in the frequency of collection after the introduction of separate collection of bio-waste***

Season	Urban areas	Rural areas	Islands with high touristic impact
Collection frequency prior introduction of separate collection of bio-waste			
MSW summer	daily or every sec. day	daily or every sec. day	daily
MSW winter[11]	daily or every sec. day	daily or every sec. day	daily
Collection frequency after the introduction of separate collection of bio-waste			
Bio-waste summer	Daily or every sec. day	twice per week or weekly	Daily or every sec. day
Bio-waste winter	Daily or second day or two times per week	weekly	Two times per week or weekly
Res. MSW summer	every second day	twice per week	every second day
Res. MSW winter	every second day or two times per week	weekly	weekly

Taking into consideration the possibilities for the modification of collection frequency, the pros and cons of the three bio-waste collection schemes are shown in Table 14. The best-adapted option could be chosen, based on suggestions on Table 14 as we as with specific aspects applying on each municipality. Green colour in the table indicates presumably preferred option for many cases – but final decision needs reflection within each municipality individually. Orange colour indicates that options might be combined.

Table 14: ***Pros and Cons for options of separate collection scheme for bio-waste related to scenarios (Ressource Abfall, 2019)***

	Urban areas	Rural areas	Islands with high touristic impact
Option a) Individual bins	Increase of number of (smaller = 80 litres to 240 litres) bins to be emptied will increase collection costs and requested truck capacities. (-) Huge difficulties with position of bins will occur – at least in parts of municipalities. (-) Might allow introduction of PAYT as waste bins are allocated to property. (+)	Increase of number of (smaller = 80 litres to 240 litres) bins to be emptied will increase collection costs and requested truck capacities. (-) Might allow lower collection frequency for both bio-waste and residual MSW – at least in winter, maybe also in summer. (+)	Increase of number of (smaller = 80 litres to 240 litres) bins to be emptied will increase collection costs and requested truck capacities. (-) For larger hotels etc. this might allow introduction of PAYT as waste bins are allocated individually. (+)

[11] For the islands with high touristic impact this means the period "without many tourists"

		Might allow introduction of PAYT as waste bins are allocated to property. (+)	
Option b) Keep System of kerbside collection – Modify frequency	Number of 120 litres or 240 litres brown bins will be difficult to install additional to the existing 1.100 litres residual bins. (-) High risk of fast accumulation (over weeks) of stinky leachate in brown bins (-)		
Option c) as Option b) plus obligatory compostable liners /bags	Such obligatory bags will significantly reduce leachates and odours from bio-waste collection bins. (+) Such obligatory bags will increase costs for the system. (-) Such system will work much better if no small bags of other materials will be allowed and in use in supermarkets etc. , as in Italy (see chapter 4.3).		For hotels etc. larger compostable bags are available too. These will reduce leachates and odours from bio-waste collection bins significantly. (+)

The use of obligatory compostable bags as in Italy has to be seen under the condition that in Italy for several years, there are laws implemented against using plastic bags in all supermarkets, etc. – even for the use of fresh vegetables and fruits. Only compostable bags are allowed. So, these biodegradable bags are widespread. Despite some debates in Germany about their degradability in regular treatment plant operation, these compostable bags are very recommendable under the climatic conditions of Greece, to avoid strong odour problems during collections, especially in urban areas and on islands with high touristic impact.

Furthermore, home composting or communal/neighbour composters might be a more feasible option especially for rural/remote/mountainous municipalities as most of the households in those areas have gardens or farms and wide-open spaces where they can apply them. As such, these municipalities which are in principle "poor" municipalities will save a part of the costs for collection, while providing additional motivation to their residents to engage more, by providing the produced compost from the neighbour composter for free (e.g. municipality of Vrilissia – **Annex 4**) to its residents.

Lastly, collecting bio-waste in households and kitchens in compostable liners or bags, as proposed and recommended at least for urban areas and islands with high touristic impact at the very least, is “not ideal” from a treatment point of view. But in combination with the much higher potential to be collected the efforts seem acceptable.

Considerations regarding treatment facilities are included in **Annex 3**.

9.3 Dry recyclables (paper & cardbpard, plastic, metal, glass)

According to the NWMP and the EU’s directives MS should promote and implement separate collection of dry recyclables fractions in order to succeed in achieving the set upcoming targets. For Greece it is highly recommendable to split the co-mingled collection system of paper, packaging plastic and metals, into four different collection streams, one per each fraction.

The collection bins for each fraction should be easily identifiable bins with specified colouring (either the bin or the lids of the bins). The colouring for each fractionis suggested to be homogenised throughout the country.

Densification of collection points (bins, green corners) and the improvement of collection frequency of all recyclables, is considered necessary in order to improve quality and quantity, as well as avoid issues of overflowing bins in densely populated areas. This will in time, most likely result in a slight reduction of density or frequency of residual waste bins.

Depending on the fractions certain issues need to be considered by the municipalities:

- For paper & cardboard, besides the packaging paper the existing co-mingled system is already collecting a certain part of the non-packaging paper. It is highly recommended to include the collection of non-packaging as well as the packaging paper and cardboard within the next year on a national level, either as part of the existing system (HERRCO), either as separate waste stream.
- For plastic and metal, according to international experience these two fractions are preferred to be collected together. However, according to the EU directives it is expected to be collected separately, when feasible to improve the quality of the collected material.
- For glass, separate glass collection scheme is regarded as necessary, both from a collection efficiency view as well as from financial efficiency view in regards to treatment plants (MRFs). The implementation of a separate collection of glass based on the three colours seems unnecessary, as most glass recycling companies have already the equipment to separate the collected glass by colour as well as especially in urban areas no additional space will be required for the placement of three bins at the same location

  Improved collection efficiency in regards to the “blue bells” is HERRCO’s responsibility, while for the RVMs of the other two PRO’s the respective PRO’s are responsible. For the “ blue bins” however, the collection which is under the municipality’s competence, it is recommendable to check whether a bi-weekly collection interval or an interval of ten days does not create any glass waste around the “blue bells” and the other PRO’s installations.

On islands with high touristic impact, it might be reasonable to place “blue bells” at larger hotels directly, which will allow access to the collection truck. These bells should be counted as those on public roads within the statistical evaluation. On islands with high touristic impact with no waste collection via trucks, different bins and collection schemes should be selected in order to ensure high collection efficiency. Separate collection and transport of glass has to be established also for such islands.

On any civic amenity site (CAS) the municipalities should also install containers for separate collection of paper including cardboard. Containers for the separate collection of the paper/cardboard should also be installed at the redefined recycling points (green corners, green points) which will be developed in each Municipality. Containers for the separate collection of the glass should also be placed at the recycling points (green corners, green points) which are or will be developed in each Municipality.

Moreover, the additional few staff members dealing with the installation of bins, quality of recyclables and advice to certain clients—mentioned already in chapter 9.1 - should also deal with the issue of the installation of additional bins/containers of the waste fractions. No additional staff is required by

the municipalities for the cases of Rewarding Packaging Recycling S.A. and AB Vassilopoulos, as the services of collection for those PRO's are not incurred by the municipalities.

As mentioned in the previous chapters the informal sector has significant implications in the existing system regarding the collected by the PRO's or the municipalities' material. Besides the proposition of upgrading their bins system (locked or underground bins), the municipalities should also consider recommendations and pilot projects financed by GIZ in other countries regarding the integration of the informal sector into the regular waste management schemes.

Lastly, it is of high importance in regards to the quality of the collected material to emphasize on the importance of the collection bins closed lids, especially referring to the paper and cardboard fraction, as it is a material easy to be contaminated and deemed unrecyclable when the material is exposed to weather conditions (rain, snow, etc).

Box 9: Scenarios for paper, plastic and metal collection (calculation example)

As up to now in most cases in Greece, there exists an urban municipality A with 17.200 inhab. is only using co-mingled collection system for paper and plastic waste plus metals. Within the existing situation, there are assumed that actually, 143 blue bins of 1.1 m³ volume with two collection days per week are in use. The 66 and the 77 of these blue bins, by changing their lids, shall be used for separate collection of paper and plastic/ metal respectively.

The municipality is making a survey in order to optimize the existing collection scheme and support the increased volumes of the three afore mentioned materials. There are two scenarios:

Option A)

- Same collection frequency (two times per week), install additional 33 blue bins of 1.1 m³ volume with yellow lids for paper & cardboard;
- Buy new collection truck(s) – if necessary - and get operation staff organised, if existing capacities are working to the upper limits.

Option B)

- Change collection frequency to three times per week and install no additional blue bins of 1.1 m³ volume with yellow lids for paper & cardboard;
- Buy new collection truck(s) – if necessary - and get more operation staff organised to increase collection frequency for all (old and new) bins.

Note: The average load of collection trucks or the volume limitations of collection trucks and other organisational issues were not taken under consideration.

Table A*: Calculation of available daily collection volume for paper in example municipality A*

Example Municipality A	Actual situation paper	Option A, increase No. of bins		Option B, intensify collection & increase bins	
Inhabitants (or beds plus inhab.)	17,200				
Bins (lt) 1,100	- 66	***New*** 33	***Total*** 99	***New*** 0	***Total*** 66
Collections per week	2		2		3
Weekly collection volume for paper (lt)	145,200		217,800		217,800

Available daily collection volume for paper per 100 inhab. (or beds plus inhab.)	207	311	311

Table B: Calculation of available daily collection volume for plastic/metal in example municipality A

Example Municipality A	Actual situation plastic	Option A, increase No. of bins		Option B, intensify collection & increase bins	
Inhabitants (or beds plus inhab.)	17,200				
Bins [l]		***New***	***Total***	***New***	***Total***
1,100	77	40	117	1	78
Collections per week	2		2		3
Weekly collection volume for plastic [l]	169,400		257,400		257,400
Available daily collection volume for plastic per 100 inhab. (or beds plus inhab.)	242		368		368

9.4 Cost of collection

The cost of collection depends on the aspects of the applied waste management system including the treatment end and its' efficiency, and can only be considered in a local context as each municipality has diverse approaches in waste management.

Concerning biowaste, the collection costs from other countries indicate an increase of costs by the introduction of an additional system of separate collection via a door-to-door system. Combined with strong engagement regarding higher efficiency of residual waste collection an overall increase in collection costs of about 10 % was achieved.

The individual amount regarding costs of separate collection of bio-waste mentioned in a Greek study of about 40 €/tn (MOU, 2019) is estimated to be quite low. International experiences have proven that for many cases the cost of separate collection of biowaste rises to approximately 80 – 120 €/tn. Data from pilot project areas indicate that at the present, specific costs for waste collection of MSW in Greece are at least in that range or higher than above-mentioned international values, with the most of the Greek figures excluding depreciation costs, resp. reinvestment capital for new trucks.

It should be noted that bio-waste is the less expensive fraction in regards to collection costs of MSW. However, all municipalities should expect and inform their citizen and enterprises about an increment in waste management costs through the increasing of the waste management fees.

Regarding dry recyclables, by amplifying separate collection of the different materials can result in the reduction of collection cost of waste management in general, as the collected quantity of residual waste will decrease and thus the collection frequency will be reduced. Additional savings can occur to

residual waste treatment due to the minimisation of the collected quantity. By applying variable waste charging schemes such as pay-as-you-throw, regarding the "emptying" or the size of the bins can also lead to a reduction of the collection frequency and thus to cost reductions (Eunomia, 2006).

Another factor to be considered on costs is the relative capture rate of the individually collected materials. The cost of collection for fractions tends to be higher with the collection of waste with lower bulk density (e.g. plastic or cardboard) or those with small proportions (plastic and cans). The quality of the collected materials affects the revenues from the materials sales/treatment which would also lead to significant reductions on the waste management cost (Eunomia, 2006).[12]

A useful tool for a detailed waste management cost accounting, including the entailed collection costs is provided by the report of "Guide to enhance cost accounting in municipal waste management in Greece" part of the overall project of GIZ.

[12] Eunomia (2016), Online available: https://ec.europa.eu/environment/waste/studies/pdf/eucostwaste.pdf, (Last vist: 12.05.2020)

10. Awareness campaigns and PR affairs

10.1 Biowaste

Awareness campaigns for separate collection of bio-waste should be started at an early stage of the first pilot project and need to be intensified and continued throughout the upscaling of the intended collection scheme until the entire municipality is covered.

Furthermore, it is essential to create a Public Relations (PR)-group consisted of volunteers from target groups, i.e. citizens, big producers, neighbourhood associations and Non-Governmental Organisations (NGOs) as well as municipality staff. Engaging stakeholders in the PR- group is expected to encourage active participation and to create a sense of "ownership" of the project, raising the sense of responsibility for its success.

Planning awareness & PR activities typically involve three phases of implementation

- The first phase of about 1-2 months prior start of the project
- The second phase of the awareness campaign is connected in time with the bin distribution
- The third phase is implemented in parallel with the operation of the system to provide continuous awareness, by reminding citizens of the pilot's benefits, communicating so far achievements and motivating greater participation through reminder letters, press releases etc.

Regular awareness campaigns should be initiated and repeated concerning the quality of collected bio-waste as well as other aspects of the scheme during the earlier or later implementation stage of a separate collection scheme.

Major elements of awareness and PR affairs for municipalities might be:

- Information to council members of the municipality in writing and verbally
- Information to journalists in writing and verbally
- Information to inhabitants in writing form– short notes why the separate collection is positive, leaflets concerning bio-waste collection scheme, waste calendars etc.
- Information to inhabitants via open councils/town hall meetings
- Information to inhabitants via specialised staff members of municipal waste management department (appearances in schools, cultural organisations, etc.)
- Information via participation at public markets, showing and distributing small kitchen bins
- Addressing new media and using SMART solutions – web pages, mobile applications, social media (Facebook, Instagram, etc.) – with monthly updates of certain aspects of bio-waste such as ways to prevent food loss by providing easily accessible and practical information on how to plan food purchases, store food and enjoy leftovers, quantity or quality aspects of the separate collection and recycling of bio-waste etc.

Municipalities require waste advisors within their regular staff to deal with these campaigns and PR affairs. Classic "horizontal actions" in PR campaigns within the Greek context need to be undertaken.

The “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, to the awareness and PR, it is important to note that before the first phase of the awareness campaign, a contact line dedicated to the pilot project must be set up by the municipality. The dedicated contact line should be communicated through all informative materials used (e.g. leaflets/brochures, posters, bins stickers etc.). Through the contact line, the target audience may require information, briefing, technical guidance or express complaints during project implementation. Properly trained staff must be allocated to this task daily.

Moreover, as PAYT systems have not been implemented in full scale as of today in Greece, 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 municipality, etc.

Recommendations concerning citizens’ engagement and incentives might include any bonuses, which might address the neighbourhood or parts of the municipality, which contributed to the success or improvement of the situation. Municipality of Voula-Vari-Vouliagmeni awards loyalty points plus discount entrance to beaches, to kindergartens, etc. Such incentives should have a clear relation to the improvement of the waste management situation. From the Minutes of Meetings (MoM) of this meeting, it was recognised that such benefits to the population should be legalised within Greek legislation.

Additional information on suitable input to the biowaste bin, and a suggestion on how to present it to the citizens is being provided in **Annex 5.**

10.2 Dry recyclables

Awareness campaigns for separate collection of paper should follow the same steps and elements as described in chapter 9.2 for the separate collection of bio-waste. They need to be intensified and maintained throughout the upscaling and enlarging of the intended collection scheme up until the municipality is fully covered by the required density of collection bins.

The overall principles to be adopted and followed regarding the awareness campaigns are:

1) Presence in schools;
2) Presence at a local as well as national level (mainly HRA and PRO’s task);
3) Presence of campaign in mass media and social media;

It is advisable to continue awareness campaigns steadily after the required density of collection bins has been achieved. Most important is the steady approach to quality. Liquids and organics inside the collection bins reduce the quality of collected material significantly. Difficulties concerning separation of fractions and different types of plastics increase due to humidity. Covers of bins need to be closed.

Additionally, regular campaigns should be initiated and repeated concerning the quality of collected paper as well as other issues that might show up during the earlier or later implementation stage of the separate collection scheme. Quality (no liquids, no organics) and unfolding of packaging boxes from cardboard might be two issues to be addressed regularly.

An indicative list with the acceptable materials regarding separate collection of paper and cardboard, additional information on the materials “new products“ which can be recycled into, along with some

environmental facts on their recycling, are available in **Annex 6** and **Annex 7** respectively. Moreover, is provided, a table of the symbols used in packaging products to indicate the recyclability of the product, in **Annex 8**.

Finally, bonus attractions and similarly positive activities for neighbourhoods with high recycling rates in source separation should be also considered. Such awareness campaigns should be coordinated with campaigns from HERRCO and other PROs.

11. Recommendations

In this chapter recommendations on all authoritarian levels are being presented. The recommendations addressing the municipalities are the summarised recommendations presented in the previous chapters. Additionally to the previous recommendations, in this chapter recommendations addressing the Ministry, HRA and the regions/FoDSA's have been added

11.1 Recommendation addressing Greece - national level

During project execution, different aspects were revised and led to the following recommendations:

YPEN

A. Revision of legislation

i. Support the adoption of the new EU Circular Economy Package in National Legislation including new counting methods for recycled quantities.

ii. Re-establish the landfill tax or re-evaluate the circular economy levy in place, in accordance to other EU MS.

iii. Update regularly the National Waste Management Plan based on calculations concerning total generated and reused and recycled waste quantities, relevant to the EU targets rates on an annual basis for at least the oncoming next 6 years.

iv. Set the intermediate target values towards the big challenge of catching up to European requirements internally or within the updated NWMP similar to the proposal shown in *Figure 15*.

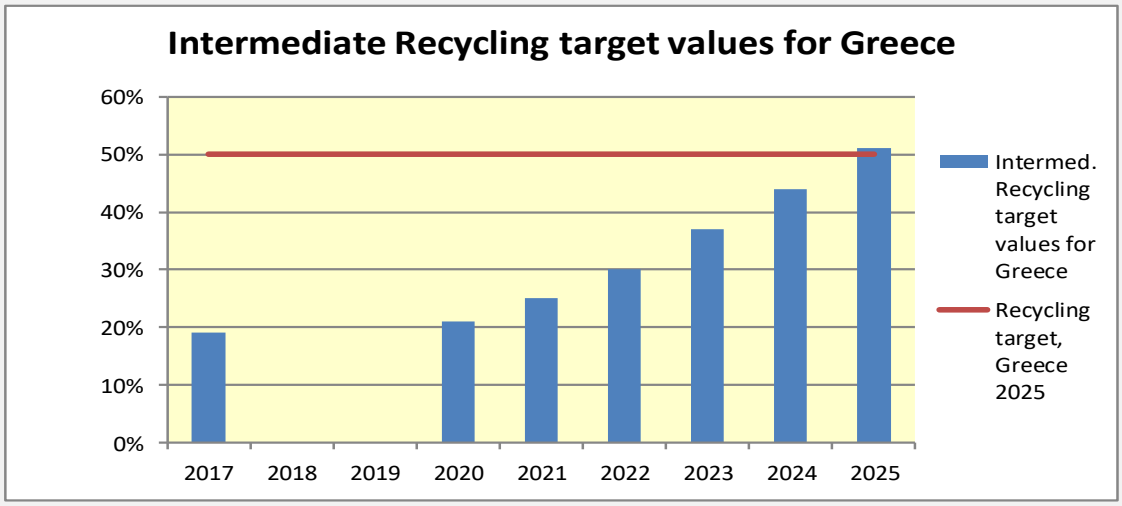


Figure 15: Proposal on Intermediate target values concerning follow-up

This figure of intermediate target values might also be used to follow-up the situation in each region or municipality.

v. New economic instruments such as DRS should be adopted as part of a stronger approach to recycling.

B. Follow-up

i. Adopt the actors on enforcement of strong and close follow-up of the legal framework concerning the collection of waste and treatment.

ii. Update or follow the updating of the "waste atlas" concerning treatment facilities regularly, differentiated into the categories:

   a. capacities planned;

   b. under approval procedure;

   c. under construction;

   d. in operation.

iii. From international experience, a quarterly to semi-annually update might be most reasonable. Regular exchange with YMEPERAA about internationally funded projects seems helpful. Such monitoring instrument as the "waste atlas" including evaluation of data supplied by FODSAs is a key issue for YPEN. Funds for updating either in-house or via external contractor should be reserved.

iv. Ensure strong and close follow-up by YPEN during the implementation of separate collection within the next years in relation to the regions and municipalities. Minister and General Secretary should support the staff regardless of their political orientation.

v. YPEN should follow up on the development of treatment capacities for separately collected bio-waste for each region based on data supplied from the regions. Governors and FoDSAs should be requested to supply data for treatment capacities on a semi-annual basis.

   YPEN should receive regular data feedback from each region and all the municipalities about progress – including "hard facts" data as really separately collected biowaste and the dry recyclables quantities as well as issues still to overcome – at least two times per year via E-Mail or other electronic options.

C. Economic Incentives

i. Ensure the reduction of impurities in the blue bin by using incentives and evaluating the content of impurities for each municipality individually at the MRF plant once in a quarter. Payments/fines might be calculated individually on the average of the last 4 results by the designated authorities – but not with a national average. If a change in legislation would be necessary to allow such an approach, this would be an urgent improvement.

ii. Ensure the implementation of the legally defined fines for the disposal of untreated waste.

iii. Raise within the next two to three years the circular economy levy of 10 euros per ton of waste, which is disposed of without any prior treatment, to a level which will incentivise separate collection and treatment – according to international experience surely reasonably higher than 50 € per tonne.

iv. Implement immediately the circular economy levy to charge all municipalities not complying with the national strategy and/or obligations (e.g. when municipalities deny to

	launch tendering procedures for environmental licensed waste projects and/or deny to operate constructed waste management facilities).
v.	Incentivise municipalities for additional actions on their way of enhancing separately collected bio-waste and paper waste volumes by showing separately the environmental levy amount in budgets (state and municipal level).
vi.	Support the utilization of the revenues from landfill tax / environmental levy to enhance the separate collection schemes (bins, trucks, awareness campaigns).
vii.	Establish a "Circular Economy fee" on single-use containers (especially plastic) and promote other incentives for reusable packaging.
viii.	Support the establishment of a PAYT system for the residual waste collection.
	D. Funding
i.	Devote a very reasonable part of the collected environmental levy amounts to fund additional pilot projects for separate collection of bio-waste and dry recyclables in areas outside Attica with different structure types (other than "urban"). The aim might be to have at least two pilot projects realised in each of the 13 regions.
ii.	Establish with close cooperation with the Ministry of Finance a simplified justification procedure for funding applications under ESPA framework (if possible) regarding the separate collection and more specific regarding the provided general economic services (YGOS). In this way, it will be easier for any interested municipality to prepare and submit funding proposals by its own means in a reasonable time for a typical supply equipment funding application.
iii.	Support funding of such regions and municipalities with other EU-sources that are performing better in the area of separate collection than others.
	E. Waste composition, Quality standards and Treatment
i.	Set quality standards for compost also as End-of-Waste criteria within a greek context. In addition to compost, evaluation standards are necessary as well for composting or digestion process examination and should be defined within the Greek legislation.
ii.	Request and support regular analyses of waste composition at regional level (residual MSW-composition) at treatment facilities. In parallel input waste analyses and output waste streams from all treatment facilities – including impurities - should be in line with recent EC decision 2019/1004 concerning the calculation of waste data. Results should be used for updates on the NWMP and the evaluation of the EPR systems.
iii.	Strongly support the integration of printed paper into the blue bin system with the contribution of publishers to the payment scheme.
iv.	Investigate the capacity of the existing sorting companies in Greece to cope with the increased quantities of separately collected materials (paper, plastic, metals, glass). Otherwise, recycling companies in international markets should be located. Investigate the capacity of the existing sorting facilities in Greece to cope with the increased quantities of

	separately collected dry recyclables (paper, plastic, metals, glass) as well as the marketability of them in the secondary market of recycled materials.
	F. Incentives
i.	Establish or support the establishment of rewarding systems for the citizens (e.g. reward as you recycle) by the Municipalities to promote the separate collection at the source.
ii.	Require all involved stakeholders in each region (Municipalities, FoDSA and Government representatives) to attend regular biannual exchange meetings regarding progress in and improvement of speed in separate collection of bio-waste and dry recyclables. The municipalities with the best results should be rewarded accordingly.
	G. Awareness
i.	Conduct a central awareness campaign addressing all recyclable waste streams (including biowaste), on a national level, through HRA, on which the municipalities will be able to base their campaigns on each municipality's' specificities.
ii.	Support campaigns concerning the separate collection of dry recyclables and bio-waste with extra funds. Campaigns should address not only in targeted groups such as pupils but also difficult to address parts of the population (aged people, etc). Competitions amongst municipalities might be one approach on how to spend comparably smaller amounts successfully

HRA/EPRs	
i.	Improve access to accurate annual statistics and ensure equal information and market access, control all producers and their annual reports on packaging placed on the market – including producers from e-shops and small producers.
ii.	Introduce a new electronic waste information system (or upgrade the existing DWR system) not only to track waste from producer to recycling, to provide accurate data and monitor performance against the targets set by NWMP but also for the compliance with the requirements of (EU) 2019/665 and 2019/1004 Decisions formats for the reporting on packaging and packaging waste.
iii.	EPR schemes should optimise market surveillance activities to identify obligated producers placing unregistered packaging on the market to guarantee that at least 95% of the packaging placed on the market is reported.

11.2 Recommendations addressing the regional level

The following recommendations are addressed to a regional level:

Regional Governance & FoDSAs	
i.	Regularly revise all 13 RWMP in accordance with the NWMP and the overall European targets into a technically and financially viable manner.
ii.	Ensure that the data being submitted by municipalities to the FoDSA are accurate, for example through the auditing by an independent third party to check the reliability of the data. Any violation should be severely penalised irrespective to the political ideals.
iii.	In regards to funding for the separate collection systems following the simplification of the procedures from the YPE, the regional governance/FoDSA's should establish a helpdesk to where the municipalities will be able to address for further clarifications such as the FoDSA of Attica is implementing for it's affiliated municipalities.

11.3 Recommendations addressing the municipalities – local level

The following recommendations are a summary of the main recommendations mentioned in the previous chapters.

Municipalities	
A.	**Setting-up and planning of the collection system**
i.	Regularly revise all LWMP in accordance with the NWMP and the overall European targets in a feasible way.
ii.	Improve the efficiency of the waste collection overall to reduce the cost to a feasible level – measures might include reduction of residual waste bin density and collection

	frequency as well as changes in daily operation hours for workers or drivers per shift etc,. This might include also other working models e.g. 4 out of 6 or 7 days (at least for drivers).
iii.	Coordinate with 3 – 5 - stars hotels, restaurants (for cooked products as part of bio-waste) and fruit markets, on the islands with high touristic impact.
iv.	Consider the option of a tourist tax to cover additional costs for separate collection, new transfer stations for dry recyclables and treatment facilities for bio-waste.
v.	Address the responsibility of larger companies and enterprises.
vi.	Consider potential inter-municipal cooperation in regards to collection, especially in rural and smaller urban areas.
vii.	Include capital costs (depreciation) into the annual budget for waste management – and regularly update the machinery (**about 8 to 10 years latest**). Useful cost accounting model is provided by the "Guide to enhance cost accounting in municipal waste management in Greece" part of the overall project of GIZ.
viii.	Engage a few staff members in waste management department dealing only with providing information to citizens about separate collection such as of bins, where to place, what to collect as well as for quality control to establish separate collection at source in different conditions of settlements and urbanisation.
ix.	Enhance separate collection though the placement of bins in CAS and the establishment of recycling corners/ green points.
x.	Ensure transparency for the residents through the publication on the municipality's website of the cost relating to waste management, and make the information easily accessible to their residents in regards to collection points, routes (timetable) and collected/recovered material of their municipality.
B.	**Responsibilities**
xi.	Guarantee the commitment of each mayor and each city council as it is necessary for a successful implementation of this guideline and, more important, to achieve the EU-obligations as a precondition for further financial support.
xii.	Identify all related costs to waste management and improve cost account using cost accounting tools such as the provided full cost accounting tool provided by the second study of the overall GIZ project "Guide to enhance cost accounting in municipal waste management in Greece" or similar tools.
C.	**Awareness**
i.	Intensify the approach to the whole waste management area, underlined by strategic public appearances from mayors and key administration members.
ii.	Increase the public awareness campaigns addressing not only schools and common areas but also vulnerable and difficult-to-approach population (Leave no one behind), in different languages (most commonly used languages in the municipality's jurisdiction).
D.	**Monitoring**
i.	Secure the required additional staff and ensure the efficient collection will be necessary.

ii.	Support “short-cuts” by learning from the others - via regular exchange amongst waste management departments in each Region or on a national level within the same type of settlement structure plus a benchmarking process concerning improving collection efficiency.

12. Conclusions and the way forward

The commitment of each mayor and each city council is necessary for a successful implementation of separate waste collection schemes and to achieve the EU-obligations as a precondition for further financial support. This commitment is the basis for all detailed approaches to implement separate collection and waste treatment schemes.

Awareness campaigns need the support and active participation of the leaders. The commitment of each mayor and each city council is also pre-condition to overcome additional financial demands of the waste management area.

In order to bridge the existing performance gap, a recommended system of separate collection is to target streams as follows:

a) Bio-waste via door-to-door collection as much as possible and/or kerbside collection

b) Separate collection of glass should be applied through bring-system

c) Plastic and metals should be collected together via kerbside collection only during the first year. After that period plastic and metals should be collected separately via respective bins.

d) All paper should be collected separately.

Assuming a stepwise approach by municipalities **after one year** it is at least or equivalently expected that the municipalities have achieved (Table 15):

Table 15*: Intermediate solution for separate collection schemes after one year*

Waste Fraction	Generally proposed collection scheme
Bio-waste	Kerbside collection started – for large hotels and other large producers door to door collection
Paper	Separate kerbside collection of paper.
Plastic	Kerbside collection of packaging plastic and metals with collection systems fully established– for large hotels and other large producers door to door collection
Metals	
Glass	Separate collection with bells as bring system or through the installations of the other PROs (“Recycling Houses”, Reverse Vending machines”)

Continuing a stepwise approach by municipalities **after three years** it is at least or equivalently expected that the municipalities have achieved (Table 16):

Table 16: Intermediate solution for separate collection schemes after three years

Waste Fraction	Generally proposed collection scheme
Bio-waste	Kerbside collection fully implemented (at least nearly fully for municipalities above 100,000 inhabitants) – for large hotels and other large producers door to door collection
Paper	Separate kerbside collection of paper with collection systems fully implemented.

Plastic	Separate kerbside collection of plastic with collection systems fully established – for large hotels and other large producers, door-to-door collection would be established.
Metals	Separate kerbside collection of metals and collection systems fully established – for large hotels and other large producers, door-to-door collection would be established.
Glass	Separate collection with bells as bring system and the other systems.

The detailed description of steps and instruments, aspects to be considered and their interaction as described within the guide are summarised in the following *Table 17***.**

Table 17: Ten key points for the way forward with separate collection in each municipality

General issues
1) Support and commit by local authorities (mayor and city council)
2) Start and continue awareness campaigns
3) Participate in the exchange of experiences among all waste management branches of municipalities in one region concerning "lessons learned" and the approaches to overcome difficulties within the separate collection of these waste streams – at least once a year
4) Evaluate your capabilities and the existing situation as well as the real cost of waste management in your Municipality. Establish a rewarding system to promote separate collection by your citizens as well as a PAYT system which will cover the total costs of each municipal SWM system.
For bio-waste:
5) If no experiences are available in your municipality or in similar municipalities: Start and implement a pilot project as described in chapter 4.5– duration: about one year.
6) Proceed to upscale of available pilot projects within the next years as described in chapter 4.5 – maximum duration for very large municipalities of more than 100.000 inhabitants: three years, each one-third of the population to be connected. Consider the requirements concerning minimising cost increase by more efficient waste collection both for residual waste as well as for bio-waste (see chapter 9).
7) Get the necessary treatment facilities organised and installed at your FODSA. Check and consider the differences from "normal MBT" as described in Annex 3.
For dry recyclables paper, plastic and metals
8) Check your situation in comparison with the respective evaluation tables and develop a concept of activities for closing the gaps as shown in the examples in chapters 4.5, 5.5, 6.5, and 8.5
9) Follow the South Aegean example and get "bells" for separate collection installed in a density of 1 per 300 inhabitants and touristic beds or lower
10) Accord stepwise approach with HERRCO and Rewarding Packaging Recycling S.A. and if necessary similar systems and implement improvement within the next year.

It is now important for Greece, in particular YPEN, to set up and follow annual intermediate goals to be achieved throughout the country (see proposal in Figure 15).

There is no separate collection without appropriate infrastructure and equipment. Municipalities need to assign a budget for appropriate equipment to allow citizens to take part in the countries recycling efforts and provide trust in a reliable system.

As improvement will require a lot of activities and the implementation of many steps in the municipalities it is recommended to start immediately – as some municipalities are already on the way to do so. The recommended actions and steps might need adjustment under the circumstances of each municipality. Municipalities will also need individual support in addition to this guideline.

The time until 2025 is short in relation to the challenges Greece is facing, and as such the municipalities should start making changes now.

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14. Annex

Annex 1: Clustering of Islands in relation to touristic impact

Island	Population	Distance (km²)	Hotel beds							Cluster	Municipal waste generation (tn/yr)*
			5*	4*	3*	2*	1*	Total	Ratio Beds/ Population		2015
Crete	623,065	8,336	44,248	58,959	33,321	36,758	9,010	182,296	0.29	Crete	366,248
Evia	210,815	3,670	430	3,181	5,496	6,010	1,011	16,128	0.08	Central Greece	94,837
Lesvos	86,436	1,633	314	1,035	3,304	2,004	239	6,896	0.08	North Aegean Islands	38,431
Rhodes	115,490	1,401	32,321	37,268	15,078	11,229	1,720	97,616	0.85	South Aegean - Dodecanese	95,200
Chíos	51,390	842	119	1,156	921	584	150	2,930	0.06	North Aegean Islands	21,020
Kefalonia	35,801	781	938	3,205	2,489	3,988	244	10,864	0.30	Ionian Islands	24,512
Corfu	102,071	593	9,383	13,061	11,561	10,919	2,024	46,948	0.46	Ionian Islands	65,568
Lemnos	16,992	478	631	206	523	475	144	1,979	0.12	North Aegean Islands	7,423
Samos	32,977	477	845	769	3,580	4,187	454	9,835	0.30	North Aegean Islands	12,770
Naxos	20,877	430	300	910	2,091	2,770	595	6,666	0.32	South Aegean - Cyclades	12,950
Zakynthos	40,759	406	4,117	8,860	10,406	10,349	440	34,172	0.84	Ionian Islands	25,606
Thassos	13,770	380	929	2,099	2,577	4,238	1,372	11,215	0.81	North Aegean Islands	
Andros	9,221	380	39	96	722	340	122	1,319	0.14	South Aegean - Cyclades	6,805

Island	Population	Distance (km^2)	Hotel beds							Cluster	Municipal waste generation (tn/yr)*
			5*	4*	3*	2*	1*	Total	Ratio Beds/ Population		2015
Lefkada	22,652	303	204	860	1,390	2,999	158	5,611	0.25	Ionian Islands	14,884
Karpathos	6,226	300	750	879	1,868	2,644	122	6,263	1.01	South Aegean - Dodecanese	7,130
Kos	34,396	290	18,693	16,943	8,038	8,642	174	52,490	1.53	South Aegean - Dodecanese	33,715
Kythira	3,973	280	0	173	566	318	36	1,093	0.28	Attica	2,604
Icaria	8,423	255	0	0	441	469	178	1,088	0.13	North Aegean Islands	3,206
Skyros	2,994	209	0	179	281	259	20	739	0.25	Central Greece - Northern Sporades	
Paros	13,715	195	411	1,603	2,049	2,280	435	6,778	0.49	South Aegean - Cyclades	9,035
Tinos	8,636	194	0	585	745	896	86	2,312	0.27	South Aegean - Cyclades	4,450
Samothrace	2,859	178	0	0	529	69	26	624	0.22	North Aegean Islands	1,029
Milos	4,977	151	84	107	245	875	167	1,478	0.30	South Aegean - Cyclades	2,924
Kea	2,455	132	74	38	34	173	32	351	0.14	South Aegean - Cyclades	3,420
Amorgos	1,973	121	89	0	154	246	0	489	0.25	South Aegean - Cyclades	1,397

Island	Population	Distance (km^2)	Hotel beds							Cluster	Municipal waste generation (tn/yr)*
			5*	4*	3*	2*	1*	Total	Ratio Beds/ Population		2015
Kalymnos	16,179	110	0	253	520	1,033	0	1,806	0.11	South Aegean - Dodecanese	7,726
Ios	2,024	108	118	325	460	1,050	267	2,220	1.10	South Aegean - Cyclades	2,230
Mykonos	10,134	105	4,641	3,932	2,046	1,288	879	12,786	1.26	South Aegean - Cyclades	13,264
Kythnos	1,456	99	0	0	30	163	0	193	0.13	South Aegean - Cyclades	1,735
Santorini	15,550	91	2,653	4,623	2,879	2,780	1,028	13,963	0.90	South Aegean - Cyclades	17,825
Island with high touristic impact					> 0,25 and more than 1.000 beds or > 0,50					based on columns ratio of beds per population and total number of beds	
Island similar to rural structure					< 0,25 or less than 1.000 beds						
The data regarding the number of beds per island are from Greek Hotel Chamber (Hotel's capacity per Region 2018)											

Annex 2: Key elements of municipal status on separate collection

	Parameters Bio-waste	Urban	Islands with high touristic impact	Rural, Remote & Mountainous
Advanced Status	*Density of collection points*	≤1 per 60 inhab.	≤1 per 60 beds plus inhab.	≤1 per 100 inhab.
	Collection frequency	In summer daily, in winter at least 2 times per week		In summer at least 3 times per week, in winter at least once per week
	Publicity campaigns concerning good quality & quantity	Regular campaigns, citizens are informed frequently incl. internet and app		
	Marketing of compost and energy	Marketing channels are established and based on several different partners such as the citizens, the agricultural and the soil industry		

	Parameters Bio-waste	Urban	Islands with high touristic impact	Rural, Remote & Mountainous
Medium Status	*Density of collection points*	1 per 60 - 1 per 100 inhab.	within 1 per 60 - 1 per 100 beds plus inhab.	1 per 100 - 1 per 160 inhab.
	Collection frequency	in summer at least 3 times per week, in winter at least once per week		in summer at least 2 times per week, in winter at least once per week
	Publicity campaigns concerning good quality & quantity	Some campaigns and information via internet		
	Marketing of compost and energy	Marketing channels are established but based only on agriculture		

	Parameters Bio-waste	**Urban**	**Islands with high touristic impact**	**Rural, Remote & Mountainous**
Low Status	*Density of collection points*	1 per 100 inhab.	Less than 1 per 100 beds plus inhab.	Less than 1 per 160 inhab.
	Collection frequency	In summer 2 times per week or less, in winter once per week		In summer and winter once per week
	Publicity campaigns concerning good quality & quantity	No or rare information about separate collection of biowaste		
	Marketing of compost and energy	Marketing channels are still to be established		

	Parameters Paper-plastic	**Urban**	**Islands with high touristic impact**	**Rural, Remote & Mountainous**
Advanced Status	*Available daily collection volume*	paper: > 310 l per 100 inhabitants plastic: > 365 l per 100 inhabitants	paper: > 310 l per 100 beds plus inhab. plastic: > 365 l per 100 beds plus inhab.	paper: > 190 l per 100 inhabitants plastic: > 220 lper 100 inhabitants
	Collection frequency	At least 2 times per week	In summer at least 2 times per week, in winter at least biweekly	Once per week
	Publicity campaigns concerning good quality & quantity of paper	Regular campaigns, citizens are informed frequently incl. internet and app		

	Parameters paper-plastic	**Urban**	**Islands with high touristic impact**	**Rural, Remote & Mountainous**
Medium Status	*Available daily collection volume*	paper: 190 l to 310 l per 100 inhabitants plastic: 220 l to 365 l per 100 inhabitants	paper: 190 l to 310 l per 100 beds plus inhab. plastic: 220 l to 365 l per 100 beds plus inhab.	paper: 120 to 190 l per 100 inhabitants plastic: 220 l to 365 l per 100 inhabitants
	Collection frequency	Once per week	In summer at least once per week, in winter at least biweekly	
	Publicity campaigns concerning good quality & quantity of paper	Some campaigns and information via internet		

	Parameters paper -plastic	**Urban**	**Islands with high touristic impact**	**Rural, Remote & Mountainous**
Low Status	*Available daily collection volume*	paper: < 190 l per 100 inhabitants plastic: < 220 l per 100 inhabitants	paper: < 190 l per 100 beds plus inhab. plastic: < 220 l per 100 beds plus inhab.	paper: < 120 per 100 inhabitants plastic: < 150 per 100 inhabitants
	Collection frequency	Biweekly	Biweekly or less	
	Publicity campaigns concerning good quality & quantity of paper	No or rare information about separate collection of paper		

Advanced Status	Parameters Glass	Urban	Islands with high touristic impact	Rural, Remote & Mountainous
	Density of collection points glass	1 per 300 inhab. or less	1 per 300 beds plus inhab.	1 per 300 inhab. or less
	Collection frequency	At least once per week	In summer at least once per week, in winter at least biweekly	At least biweekly
	Publicity campaigns concerning good quality & quantity of glass	Regular campaigns, citizens are informed frequently incl. internet and app		

Medium Status	Parameters Glass	Urban	Islands with high touristic impact	Rural, Remote & Mountainous
	Density of collection points glass	Within the range of 1 per 300 to 1 per 500 inhab.	Within the range of 1 per 300 to 1 per 500 beds plus inhab.	Within the range of 1 per 300 to 1 per 500 inhab.
	Collection frequency	Once per ten days	In summer at least once per ten days, in winter at least once a month	Between biweekly and once a month
	Publicity campaigns concerning good quality & quantity of glass	Some campaigns and information via internet		

	Parameters Glass	**Urban**	**Islands with high touristic impact**	**Rural, Remote & Mountainous**
Low Status	*Density of collection points glass*	Less than 1 per 500 inhab.	Less than 1 per 500 beds plus inhab.	Less than 1 per 500 inhab.
	Collection frequency	Biweekly or less	In summer less than once per ten days, in winter less than once a month	Less than once a month
	Publicity campaigns concerning good quality & quantity of glass	No or rare information about separate collection of glass		

Annex 3: Bio-waste treatment facilities information

Various solutions and technologies for treatment of bio-waste exist and are being implemented at different scales around the EU. Such solutions include composting and AD that recover nutrients and generate bioenergy. Best Available Techniques (BAT) for treatment of separated collected bio-waste are described in the JRC Reference Document for Waste Treatment (JRC, 2018).

The production of compost, digestate and biogas exists at the commercial technology readiness level and is supported by many industrial actors all over Europe. Within this guideline only a few general issues relevant for treatment facilities are mentioned for a) composting plants and b) AD plants.

Issues to be considered for the treatment of separately collected bio-waste in **composting facilities**:

- Separately collected bio-waste is more humid than MSW (the facility visited near Athens reported of around or above 60 % water content).
- Separately collected bio-waste needs separate reception area (most presumably a flat bunker with some inclination and leachate collection).
- Separately collected bio-waste might need other feeding to tunnels than simple belts.
- Composting requests bag openers (or similar technical equipment) at the early stage of process to open bagged quantities as bags – compostable and other ones – will arrive with bio-waste inside.
- Composting requests structure material, in general 20 % - 30 %, depending on the humidity of the collected material via source separation.
- Composting requests water (at least during summer) as the evaporation is the physical principle that allows cooling of the heap to a maximum of about 65°C. So even humid input material needs external water to support cooling during maybe the third or fourth week of composting. Underground rainwater tanks are necessary.
- Composting in tunnels or in closed halls (at least for the first four to five weeks) is a rather suitable technological approach for the treatment of separately collected bio-waste. Due to odour risks only very low quantities of bio-waste (<< 1,000 tn/yr) might be treated in open windrows under roof and in a distance to housing areas of surely more than 1 km.
- Composting facilities in general require a roof because for the final treatment (at least screening and wind-shifting in most cases) after about 12 weeks the compost should not exceed 30 % - 35 % water content. During autumn, winter and spring rainfall on open windrows surely will lead to higher water content, which means no good screening results are possible. The composting area will be blocked by material waiting to dry naturally and the operation of facility is getting into poor conditions again causing odours and presumably complaints from neighbours.
- Composting requests a longer time than present minimum legal requirement from Greece (of in total 7 weeks) in case compostable liners should be degraded to compost.
- Composting requests a final treatment of product with screening, e.g. < 10 mm. Efficient screening requires an input with less than 35 % water content. Wind-shifting of overflow in general is regarded as pre-condition for reuse of this fraction as structure material – at least for a few cycles.
- Composting facilities require a reasonably large storage area for products.

Issues to be considered for the treatment of separately collected bio-waste in **AD facilities**:

- Separately collected bio-waste needs separate reception area (most presumably a flat bunker with some inclination and leachate collection).
- Dewatering of digestate is a costly issue. Therefore, part stream digestion of only about 50% - 60 % of input and then mixing the remaining input with digestate might avoid such technical facilities – but individual checking of input material its humidity should be considered.
- Digestion facilities need a user for heating/cooling from the exhaust gas of CHP units at the facility or with the industrial client, hospital or school in a distance of in general less than 3-5 km for effective use of energy. Such effective use of energy is also necessary from an economic point of view (revenues).
- After digestion stage there is a composting part necessary in general.

Both composting and AD facilities for separately collected bio-waste should allow unloading of leachates from packer plate trucks or press-containers to a special (underground) bio-waste leachate collection tank. These leachates then should be added to the processes.

Very short excursion to costs

Existing gate fees in Greece of 40 – 70 €/tn very often don't contain all costs. Depreciation costs, for example, are very often not included, as they are very often also not included in existing costs for waste collection. Therefore, replacement of trucks or machinery at a treatment facility is very often not possible within the regular budget.

Under these circumstances, it is not possible to compare treatment costs from many Western and Central European Countries, which include capital costs, with the figures, e.g. mentioned in the recent report from MOU, 2019.

Composting and digestion plants in Central European countries rarely work with less than 40 to 50 €/tn. Very large open composting facilities such as many in Eastern Germany with very low emission control measures offer cheaper rates. In general AD plants create higher investment costs but have higher revenues from the generation of electricity and heat. Costs of about 100 €/tn for final disposal of residual waste occur in general in Central European countries independent from type of treatment in waste incineration plants or MBTs. So, composting of separately collected bio-waste induces reasonably fewer treatment costs there.

Economies of scale might be estimated to be in general reasonable for:

a) Composting plants with 4 – 5 weeks of operation in tunnels or closed hall and then for further 8 weeks under roof: More than 10,000 tn/yr to 15,000 tn/yr
b) Composting plants that are almost completely operated in tunnels, closed halls or have a similar closed technique (for composting including final maturation): More than 20,000 tn/yr
c) For AD plants with later composting of digestate in tunnels: More than 25,000 tn/yr

These are rough figures based on international experiences. There surely exist e. g. smaller AD plants with later composting of digestate in tunnels in MS. Each individual case may have its own detailed calculation and planning. These figures indicate that in a wider range inter-municipal cooperation will be more cost-effective than small scale solutions for each municipality individually. But for e.g. for smaller islands or regions with a lot of complicated (=expensive) transport issues lower figures might be reasonable.

Annex 4: Good Practice examples from Greek municipalities

There exist a number of good practice examples applied in Greek Municipalities. Following some indicative case studies are presented.

Municipality of Halandri [13]
Challenge: The municipality of Halandri is consisting of a high ratio of open green areas per citizen, a wide range of business activities especially in the service sector and the food industry and a dense population of 70,000 residents. A significant challenge was considered the engagement and awareness of residents as well as the vandalisation of the bins by waste pickers.
Description: (what has been done/initiated/..): The municipality of Halandri implements separate collection on five (5) waste streams: • Bio-waste - brown bins; • Printed paper and paper & cardboard packaging waste - yellow bins; • Packaging glass – blue bins & blue bells; • Residual MSW – green bins; • Other waste (used tyres, end-of-life vehicles, used lubricants, batteries and accumulators, waste of electric and electronic equipment, etc.); The municipality has contracts with EPR schemes (HERRCO, etc.) The municipality in June of 2016 launched a 3-year separate collection of bio-waste pilot program, "Waste4Think", under the Horizon 2020 EU program. • Initially, 1,000 residents participated, upscaling in 2019 to Agia Varvara area with an additional 4,000 participants; • Brown bins of 30lt and 120lt were distributed to the participants with a ratio of 1 bin (120lt) every three (3) households. The 120lt bins were locked with the participants of the designated area receiving the keys, to avoid contamination. • Initially, both yellow (paper/cardboard) and brown (bio-waste) bins were locked, to ensure the purity of the collected material, however, the yellow bins were breached and vandalised by waste pickers, which resulted in unlocked yellow bins to avoid repairing/replacement cost. • In collaboration with the municipality's stakeholder, the Technical University of Athens used the collected bio-waste to either produce Food Residue Biomass (FORBI) for biogas production or compost in open windrows. The compost was produced by the collected green waste and the produced FORBI Different collection systems are implemented depending on the type of waste (kerbside collection, and with different collection frequency per waste bin: • Green bin – kerbside collection – daily; • Blue bin – kerbside collection – three times per week; • Yellow bin – separate collection – twice per week; • Blue bells – separate collection – contact with HERRCO (approx.. once every 10 days); • Brown bins – twice a week; • Green waste – side road collection point – 5 times per week
Results: The municipality achieved approximately 300kg being collected daily from the pilot area and the upscaling area (Agia Varvara). The recycling rate in the designated area (Agia Varvara) exceeds 75%, and have achieved a 40% separate collection of food waste, with significant purity levels: ○ Blue bins – 85%;

[13] MOM 22 October of 2019 & Niakas Spyros (2018). Διαχείριση Υπολειμμάτων τροφών στο Δήμο Χαλανδρίου.

Municipality of Halandri [13]
○ Yellow bins – 95%; ○ Brown bins – 99%; The participants on the designated areas of the piloting and the upscaling (Agia Varvara) are currently disposing to the green bins (residual/mixed waste) less than 10% of their bio-waste. The biogas produced from FORBI has been fuelling the municipality's garbage trucks that have been specifically converted to run with biogas leading to significant savings on fuelling costs; The composting of the collected material (green waste and FORBI) was completed in 40 days, significantly reducing composting time (green waste composting time takes months). During the past years, the ration of the distributed green, blue, and yellow bins has been shifted to one (1) bin of each waste stream.
Costs: No available data.
Conditions for success: The city council is fully committed to the project. Communication and dissemination of the municipality's waste management and recycling actions have been communicated to the residents, to ensure their engagement, including: • The distribution of brochures and flyers on good practices of recycling; • The use of on-line tools for the residents through: ○ an up-to-date municipality website; ○ the use of various social media (e.g. Twitter, Facebook) promoting awareness actions regarding re-use and recycling in the municipality; ○ available timetable to the residents of collection on the municipality's website; • Organizing and/or participating in workshops, social events, etc.; • Public releases of a series of articles, press releases, etc. • Promotion and communication events in civic amenities sites, schools (kindergardens, primary, secondary, high and technical schools); The municipality has introduced GPS and informatics systems, in bio-waste and paper/cardboard collection vehicles.

Municipality of Voula-Vari-Vouliagmeni[14]
Challenge: A Municipality with significant cultural and income variations between the 3 regions of the municipality (Voula-Vari-Vouliagmeni), characterized by low population density, and large touristic establishments. Initially, sceptisims were expressed regarding the scheme, based on lack of awareness within the city council board, the employees and the residents. In regards to the infrastructure the municipality was lacking the required space and facilities (composting and material sorting facilities, green points, transfer station, lack of equipment, etc.), with the residents opposing the construction of the facilities within their community. A significant challenge for the municipality in order to implement and promote the PAYT system was its inability to provide monetary incentive to its residents in regard to the imposed municipal fee due to barriers from existing legislation. Finally, the market potentials of the products from separate collection of bio-waste "Vita Green" and "Vita Green Plus".

Description: The municipality of Vari-Voula-Vouliagmeni implements separate collection of six (6) waste streams:
• Bio-waste – brown bin;
• Packaging glass waste – "Blue Bells", and door-to-door collection;
• Printed paper and packaging paper – door-to-door collection;
• Metals and packaging waste of beverages and milk (PMD) – door-to-door collection;
• Residual (mixed) waste – green bin
• Green waste – green points
Additionally, package and packaging waste is being collected through the "Blue Bins" system.
The municipality has contracts with EPR schemes (HERRCO) and implements different collection system according to the characteristics of the households, type of waste and the area (door-to-door, kerbside, communal, etc.)
In October of 2019 the municipality runs a pilot program "Zero Waste" on separate collection of 5 waste streams, including bio-waste, in the area of "Pigadakia" counting 1,000 inhabitants:
• Bags were distributed for free per household for separate collection per waste stream:
  ○ food-waste – paper bags;
  ○ Paper – blue bags;
  ○ Plastic, metals & packaging waste of beverages and mils (PMD) – orange bags
  ○ Residual waste – biodegradable bags
• Brown bins were distributed for separate collection of bio-waste using kerbside collection or door-to-door collection;
• A time schedule of separate collection for each waste stream was created and communicated to the participants;
• Within the pilot area PAYT (Pay As You Throw) schemes and BAS (Benefit As Save) are implemented;
• The "Blue Bins" have been removed from the piloting area in order to enhance the resident's engagement to the implemented system;
• The program was addressing residents as well as enterprises (66 enterprises participate in the program);
• The collected bio-waste material is constituted by green/garden waste and food waste;
• The municipality cooperates with the company WATT S.A. to produce standard soil conditioner from the collected green waste under the brand name "Vita Green" with a contract of 10,000 tonnes/year.

[14] MOM Vari-Voula-Vouliagmeni 10th October of 2019 & Municipality of Vari-Voula-Vouliagmeni (2019)

Municipality of Voula-Vari-Vouliagmeni[14]
• The participants were rewarded by receiving recycling points where the residents can redeem in various municipal services such as kindergartens, etc.
Results: The municipality diverted more than 35% at the end of 2019 of its co-mingled waste from landfill. The municipality constructed a greenhouse growing flowers to be used for the green public spaces using and "Vita Green" as a soil conditioner to test the quality of the product. The successful production of "Vita Green" product led to the production of "Vita Green Plus" produced from green and organic waste of A+ quality.
Costs[15]: The project was financed by the municipality's own resources and the European Interreg Programme. According to a very detailed cost accounting, the total cost for waste management for 2018 is calculated to approximately EURO 7.5 million, amounting to 75% of the municipality's budget being which is being channelled to waste management. Operational cost for the cleaning and recycling services per inhabitant in the municipality amounts to: • Direct cost of 74.74 € per inhabitant. • Indirect cost of 78.32 € per inhabitant
Conditions for success: The city council is fully committed to the project. Communication and dissemination of the municipality's waste management and recycling actions have been communicated to the residents, to ensure their engagement, including: • The designing and distribution of brochures and flyers for separate bio-waste collection recycling; • Organizing awareness • s campaigns on the produced from the collected bio-waste standard soil conditioner; • Easily accessible information and guidelines to the residents through the municipality's website, social events, enhancement of voluntary civil and environmental protection groups; • Door-to-door approach, distribution of information material, and display of posters in civic amenity sites and enterprises, • Promotion through radio and television media; • Organising events, workshops, and dissemination actions in civic amenity sites, and schools. Transparency of the municipality's actions and costs through their publication in the municipality's website. A special communication line was created to provide information to any interested resident/enterprise. Training of the collection personnel and residents. The municipality implemented "SMART" waste management solutions including telematics in the optimization of collection routes, "SMART" bins with sensors indicating fill-level and location of bins

[15] The data are derived from the municipality's LWMP of 2015.

Municipality of Vrilissia*
Challenges: The municipality of Vrilissia has a population of 30,660, indicator of Green per inhabitant is 14m^2 and 15,000 households. Due to many open green spaces in the municipality large amounts of green waste are being generated. Mainly challenge was considered the engagement and education of the residents and personnel.
Description: (what has been done/initiated/..): The municipality of Vrilissia implements a separate collection of twelve (12) waste streams: - Green waste – door-to-door collection - Food waste (public markets)– hand gathering for the markets; - Household food waste – Bring points throughout the urban network; - Package waste – "Blue Bins" - Glass ("Blue Bells" system) - C&D waste – door-to-door collection - Paper and cardboard waste ("Yellow bins" system) - Electrical & Electronical equipment – Bring points - Batteries & Accumulators - Tyres (municipal vehicles) - End-of-Life vehicles, door-to-door collection - Fabrics - Residual waste – green bins The municipality has contracts with EPR schemes (HERRCO, EDSNA) and implements different collection system according to the characteristics of the households, type of waste and the area (door-to-door, communal, bring points, etc.) - Separate collection of green waste is being implemented through a door-to-door collection with a frequency of 2-3 times per week. - Separate collection of bio-waste from public market is being implemented by hand gathering once per week on the day of the public market. - Household food-waste is being collected through bring points throughout the urban network six (6) days per week. - Separate collection of C&D waste is being implemented through door-to-door collection with a frequency of 2-3 times per week. Today, a "Source Separation" composting program is fully implemented all over the urban network, which developed as follows: • Bio-waste collection initiated in 2014, starting from gardens (green waste) as this target source generate constant and significant amount of bio-waste. • Door-to-door awareness campaign took place firstly at the public grocery market (producers and consumers) and then at the west region of the municipality, which was selected for a pilot composting program. • Separate collection of food waste from the public market and the local groceries and supermarkets initiated in 2016 • Brown bins of 1100 L were placed on the selected region of Vrilissia. and every year the number of bins is increased. - Bags were distributed for free per household for separate collection of bio-waste - Brown bins of 10lt and 30lt were distributed for separate collection of food waste;

Municipality of Vrilissia*
- The participants were rewarded by receiving recycling points through the "Follow Green" recycling rewarding platform by gaining points to be redeemed in local businesses; - Pilot composting in neighbourhoods is implemented, including "adoption" of composters placed in 5 parks, conduction of experiential workshops and training of the participants. The produced compost is distributed for free to the participants. - Distribution of home composters of 450lt to households - The collected bio-waste material constitutes of green/garden waste and food waste from households, public markets, businesses producing food waste, supermarkets, grocery stores, etc.);
Results: The municipality in 2018 achieved a 36% separate collection of MSW, 26% of bio-waste source separation, and reduced to 50% the landfilling of its municipal solid waste. Reduced the municipal fee for cleaning and waste management services by 25%.
Costs: (if any reliable large scale data are available): No available data.
Conditions for success: The city council is fully committed to the project. An absolute co-operation is achieved between public and private organisations. Continuous and innovative communication and dissemination of the municipality's waste management and recycling actions have been communicated to the residents, to ensure their engagement, including: • The designing and distribution of brochures and flyers for separate bio-waste collection recycling; • Creation of an on-line platform (www.fisikolipasma.gr) to raise awareness, inform and educate residents on composting, proper separate collection of organics, what to put in the brown bin, as well as on the composting procedure; • Easily accessible information and guidelines to the residents through the municipality's up-to-date website, social events, workshops; • The use of the inter-municipal reward recycling platform "Follow green" promoting recycling by training and educating the residents through games, articles on recycling, etc. while gaining redeemable points to local businesses; • Door-to-door approach, distribution of information material, and display of posters in civic amenity sites and enterprises, • Organising events, workshops, and dissemination actions in civic amenity sites, and schools. • Distribution of questionnaires in regards to the PAYT system; • Follow-up of composting procedure (after 6 months) by a composting consultant; • Training of the personnel and residents.

Annex 5: Proposal for suitable input for separate collection of bio-waste

	YES PLEASE		NO THANK YOU	
	From the kitchen	**From the balcony or garden**	**Material**	
Bio-waste	Potting soil	Dead plant parts	Aluminium foils	Porcelain
	Bread leftovers	Tree prunings	Binding	Juice boxes
	Eggshells	Flowers	Flower wire	Chipboard, Plywood
	Meat leftovers nad seafood	Potting soil	Tins	Vacuum cleaner bags
	Vegetable waste	Diseased plants *	Cling films	Road sweepings
	Household roll paper	Fallen fruit	Glass	Animal carcasses
	Coffee filter and gound	Grass cut & Wild herbs "Weed"	Grill and oven ash	Composite paper
	Chocolate	Hedge cut	Rubber	Nappies
	Potato grounds, potato & onion peels	Legumes	Illustrated	Cigarette ashes, filters
	Paper handkerchiefs	Haulm	Impregnated woods	Leather
	Bones	Cabbage parts	Yoghurt cups	Metals
	Food scraps (including spoiled)	Plant waste, seeds, roots	Cat litter	Milk cartons
	Flour products	Wood wool, bark (untreated)	Ceramics	Paper cardboard
	Dairy products	Brushwood & sawdust	Cork	Plastic bags
	Nut peels	Hedge clippings	Faeces	Feaces-
	Fruit waste/husks and stones	Green refuse	Lacquered wood	Plastics
	Flowers cut or potted (not the pot)	Straw & Hay	-	-
	Tea/ tea bags	Feathers & Hair	-	-

*Except plants with special diseases, not anle to be inerted during the composting process

Annex 6: Proposal for suitable input for separate collection of dry recyclables

	YES PLEASE	NO THANK YOU!	HELPFUL TIPS
Paper / cardboard	**Paper Packaging:** wrapping paper and paper bags. **Cardboard Packaging:** • cardboards from WEEE; • cereals; • pizza; • biscuits; • sugar; • detergents; • toothpaste; • cigarettes packaging etc. **Other paper:** • Printed paper, bills, newspapers, magazines (even plasticized ones); • Envelops; • Non-reusable books; • Forms; • Handicraft paper/cardboards; **Cardboard roll** from toilet paper and kitchen paper, etc.	**Used napkins, tissues, toilet and kitchen papers** **Dirty fast food packaging** **Wet or dirty paper:** Dirty napkins or coated paper not only are unsuitable for recycling but furthermore they "contaminate" the rest of the recyclable materials deeming them unrecyclable. **Milk or beverage cartons (TetraPack) and coated cream and yoghurt pots.** **Paper packaging containing lubricant oils** fall under the management is under the PRO "Centre for Environmental Alternative Management - KEPED S.A."	The packaging disposed of in the separate collection bin must be empty and rinsed Books in good condition should be prioritized for reuse by collecting and distributing them to designated reuse centres of each municipality (e.g. green points). Certain packaging such as TetraPack due to the different layers (plastic and cardboard) are most likely are inseparable and therefore not fit for recycling. Before they are placed in the recycling bin we should check whether the appropriate recycling label is on. Flatten or fold cardboard boxes – Remove parts of the packaging which are not made of paper (such as plastic handles) Printed papers from public services (Ministries, Hospitals, etc.) and/or companies should be disposed after document destruction due to data protection reasons Used/Dirty paper and dirty fast food packaging must be disposed at the mixed waste/green bin.

	YES PLEASE	NO THANK YOU!	HELPFUL TIPS
Plastic	**Plastic packaging:** • Bottles of water, milk, soft and alcoholic drinks, cooking oil; • Food containers – ketchup, salad dressing, jam, jelly, honey etc.; • Detergents, all-purpose cleaning products; • Cosmetic containers - shampoos, conditioners, showerbaths, deodorants; • Wrapping paper, Oven film; **Pre-packaged food** from supermarkets (cheese, charcuterie goods, take-out and carry-home containers, etc.). • Yoghurt pots, butter • Rice or pasta packaging **Other plastic waste:** • Toys without the mechanical and/or electric parts; • Plastic cups, cutlery and plates, plastic trays; • Plastic CD/DVD cases; • Plastic wrapping foil; • Plastic hangers; • Office equipment; • Plastic bags; • Brushes, etc.	**Bulk plastics:** tables, chairs, pots, crates, plumping parts, doors, window frames, tiles etc. should be led to drop-off points e.g. Green Points or separately collected by the municipality's pertinent service (bulk collection). **Plastic toys operating with batteries** fall are under the management of Packaging Recycling S>A. for WEEE **Used car tires** fall under the PRO of ECO-ELASTICA. Must be managed through this PRO or led to green points from which the PRO will collect it. **Plastic packaging containing lubricant oils** fall under the management is under the PRO "Centre for Environmental Alternative Management - KEPED S.A." **Plastic packaging containing anti-freeze fluids, insecticides, paints/solvents** fall under the minor quantities of hazardous waste and must be collected separately in drop-off points e.g. Green Points and in other designated collection points of each municipality. **Biodegradable plastic, potato chips bags** **Shoes, flip flops** **Plastic agrochemical packaging** expired or not (pesticides, herbicides, fungicides)	Plastic packaging must be empty and rinsed. Squish down your containers when possible. It is advisable to remove the caps from the bottles led to recycling. Bulk plastic objects often contain other materials as well. These must be collected either in drop-off points e.g. Green Points or through the municipality's bulk collection service. Plastic shoes and flip-flops should be separately collected either in drop-off points e.g. Green Points or to be led for reuse, and/or upcycling. TetraPack packaging and object under the "other plastic waste" category is suggested to be collected through the mixed waste/green bin and any recovery will occur in the MBTs Agrochemical plastic packaging waste must be decontaminated before being entrained in a recycling process. The containers fall under the household hazardous waste and must be led to designated drop-off points to be treated as such by the municipality.

	YES PLEASE	NO THANK YOU!	HELPFUL TIPS
Glass	**Glass packaging:** • Bottles of water, juices, soft and alcoholic drinks, wines; • Jars (food, honey, jams); • Bottles of cooking oil; • Containers of perfumes etc. **Other glass objects:** • Glasses, plates, trays, ashtrays, cups, ornamentals, broken glass, etc..	**Glass objects** such as mirrors, glass screens, aquariums, and bulky glass objects not fitting in the bins must be led to designated collection areas e.g. Green Points **Light bulbs** should be collected separately through the certified EPRS.	Glass packaging (without the caps on the case of bottles) should be empty and rinsed. Remove any contaminants (plastic, rubber, metal). Depending on the implemented system a separation by colour (clear, green, brown) might be required **Note:** glass objects might not be solely glass (depends on the composition of the product). It is advisable to have proper labelling on glass recyclables.

	YES PLEASE	NO THANK YOU!	HELPFUL TIPS
Metals (Aluminum & Ferrous)	**Aluminum packaging:** soft and alcoholic drinks cans, etc. **Ferrous packaging:** • Condensed milk cans; • Tuna, pet food; • Tomato concentrates, tinned products of any kind, etc. **Other metal waste:** • Cutlery and tableware; • Cooking oil and feta cheese drums; • Aluminum trays; • Clothe hangers; • Aerosol cans, gas canisters and other pressure vessels; • Metal grills etc. **Aluminum foil:** Make sure whether the operator is accepting aluminum foil.	**Aluminum frames, doors and shuttering's** must be collected separately in drop-off points e.g. Green Points, or by the municipality's bulks collection service. **Bicycles** should be either promoted for reuse or collected in drop-off points e.g. Green Points. The Green point can operate as a mediator between the citizens and businesses offering repairing services. **Metal kitchenware** (cooking and coffee pots, kettles, etc.), should be collected in drop-off points e.g. Green Points, and if possible led for reuse. **Metal packaging containing lubricants oils** fall under the management is under the PRO "Centre for Environmental Alternative Management - KEPED S.A." **Metal packaging containing anti-freeze fluids, insecticides, glue, varnish etc.** fall under the hazardous waste and must be collected separately in drop-off points e.g. Green Points. **Electric irons/ WEEE** fall under the WEEE EPR responsible for collecting all electric and electrical equipment, or it can be led designated drop-off points e.g. Green Points. **Metal agrochemical packaging** expired or not (pesticides, herbicides, fungicides)	Metal packaging should be empty and rinsed. Contaminants such as plastic or paper should be removed before the waste is placed in the bin. Aerosol cans, gas canisters and other pressure vessels must be completely empty before placed in the bin. Small metal kitchenware before placed in the bin must be free of the plastic parts such as handles. Aerosol cans containing flammable material or chemically unstable materials along with containers with residues of varnish, paint, solvents, etc. must be separately collected in designated drop-off points e.g. Green Points. Agrochemical and packaging metal packaging waste must be decontaminated before being entrained in a recycling process. The Agrochemical and packaging containing anti-freeze fluids, insecticides, glue, varnish, etc containers fall under the household hazardous waste and must be led to designated drop-off points e.g. Green Points to be treated as such by the municipality.

Annex 7: “New life” of recyclables and environmental facts

Material	Recycling into new products	Environmental facts
Paper, printing paper and cardboard	Cardboard and corrugated board contain high recycled material. Paper recycling is finite because fibres get weaker as the material is recycled.	One (1) tonne of recycled paper saves more than 2.5m^3 of landfill space. One tone of recycled paper saves 17 trees, 26,500 litres of waters and 1,750 litres of oil. The 17 trees saved (above) can absorb a total of 250 pounds of carbon dioxide from the air each year. Burning that same ton of paper would create 1500 pounds of carbon dioxide For every virgin paper pulp, 2.2 and 4.4 tonnes of wood are cut. Recycling 1 kg of paper instead of landfilling it avoids almost 1 kg of CO^2 emissions, as well as methane emissions. In 2016 Europeans generated 86.7 million tonnes of packaging waste of which 41% was paper and cardboard. When paper is landfilled the decomposition emits methane gas (one of the greenhouse gases) which is at least 20 times more hazardous than CO^2 . A cardboard produced from recycled materials has energy savings of 50% and water use savings of 99%.

Symbol	Name of Plastic	Where you'll find in your home	Recycling into new products	Environmental facts
1 PETE	Polyethylene Terephthalate, PET or PETE	PETE (PET) plastic is used in a wide variety of products such as drink and food containers. It can also be spun into fibres and yarns to make textiles - you know it as polyester! These are some of the common uses: • Beverage containers (soda, water, beer, juice, wine etc.) • Carpeting • Food containers (carry-home containers, ketchup, salad dressing, cooking oil, peanut butter, jam, jelly, etc.) • Microwave trays • Oven film • Strapping • Hand soap	PETE (PET) plastic is recyclable and highly sustainable in terms of strength, versatility and recyclability with the potential to be recovered and recycled multiple times over. It can be turned into a variety of new products such as: • Food and beverage bottles and containers • Fill for comforters, sleeping bags and jackets • Film and sheet plastic • Fleece clothing • Carpets • Strapping rope • Automotive parts • Construction material etc.	PETE (PET) bottles are 100% recyclable. Plastic items decomposition depending on the type of plastic may take 50 to 600 years Recycling plastics requires significantly less energy than the production of new products from virgin materials. Recycling one plastic bottle saves energy to run for 6 hours a 60-watt light bulb. One (1) tone of PET containers recycling saves 6.76 metres of landfill space. 7.6 kilograms of water are required to make 1 kilogram of PET plastic. Fourteen (14) 20 oz. PET bottles are enough to create an extra-large T-shirt[28]. Plastics can take up to 1,000 years to dissolve in the environment.

Symbol	Name of Plastic	Where you'll find in your home	Recycling into new products	Environmental facts
2 HDPE	High-Density Polyethylene, HDPE	This is another very popular type of plastic that you will find all over your house - from the kitchen to the bathroom to the utility room to the backyard. Check out how versatile HDPE plastic is: • Beverage containers - milk, water, juice • Freezer bags • Cereal box liners • Cleaning product containers - laundry detergent, bleaches all-purpose cleaners • Cosmetic containers - shampoo, conditioner, hand soap, etc. • Shipping containers • Thin-film plastic shopping bags • Wire and cable coverings • Wood composites • Containers of motor oil • Rigid agricultural pipes • Crates	HDPE plastic products is the most commonly recycled plastic The recycling process is relatively easy and cost-effective. Recyclable HDPE can be turned to a variety of every-day products including: • Crates • Film plastic and sheeting • Floor tiles • Gardening tools, flower pots, and hardscape materials (edging, etc.) • Non-food bottles - shampoo, conditioner, cleaning products, laundry cleaners, motor oil, antifreeze • Plumbing pipes • Plastic lumber (used in playgrounds, picnic tables, etc.) • Plastic rope • Children's toys • Recycling bins	The average plastic bag can take up to 1,000 years to dissolve in the environment. Recycling HDPE plastic bags to new bags uses: • 67% less energy • 90% less water • 33% fewer sulfur dioxide emissions • 50% fewer nitrous oxide emissions • 87% fewer carbon dioxide (CO^2) emissions Recycling ten (10) plastic HDPE bottles can power up a laptop for over 24 hours.

Symbol	Name of Plastic	Where you'll find in your home	Recycling into new products	Environmental facts
3 PVC	Polyvinyl Chloride, PVC	By and large, any flexible, durable plastics products are likely to be made with PVC. Vinyl takes on many forms and can be found in a wide range of consumer goods, including: • Baby dishes and utensils • Bags, luggage & cushions • Blister packs and clamshells containers • Camping, leisure & toys • Decking & Vinyl flooring • Faux leather products - shoes, handbags, briefcases, etc. • Food shrink wrap, flexible films, etc. • Garden & drinking hoses & pipes • Medical equipment - tubes, blood bags • Raincoats, shoes, boots, shower curtains • Varnishes • Vinyl siding • Window frames • Wire insulation	PVC is very difficult to recycle, due to the different formulations which make it difficult to separate them for recycling and thus breaking down into their original components is nearly impossible. Less than 1% of PVC is recycled. PVC can turn into several inferior to quality products, such as: • Binders • Cables • Carpet backing • Decking and fencing • Film plastic • Flooring - mats, tiles, resilient flooring • Park benches • Pipe • Speed bumps & traffic cones PVC products should not be reused for application with food of children's use.	PVC is considered as poisonous due to its components in toxic chemicals - dioxins (vinyl chloride monomer, ethylene dichloride, and other pollutants) for human health and the environment (surface and ground-water, air poisoning) Dioxins are created as a byproduct of the manufacturing of PVC which is composed partly of chlorine and are highly toxic affecting human health (developmental and reproductive disease, immune system damage, and cancer). Dioxins from PVC products can leach out throughout the entire products life-cycle. Disposal of PVC is through incinerators or landfilling. Due to its containment of chlorine incineration of PVC products creates more dioxin, which then is emitted into the atmosphere and waterways. 80% of all dioxin emissions to the atmosphere is derived from the operation of medical waste incinerators, backyard burn barrels, secondary copper smelters, and municipal solid waste incinerators. Landfilling of PVC results in poisoning of landfills and groundwater by dioxins.

Symbol	Name of Plastic	Where you'll find in your home	Recycling into new products	Environmental facts
4 LDPE	Low Density Polyethylene LDPE	Although plastic bags are perhaps one of the best-known uses of plastic #4, there are many other types of consumer goods made with this material: • Adhesives • Clear plastic bags - dry cleaning, bakery goods, household garbage, bin liners, frozen food bags • Coatings in paper milk cartons and paper coffee cups • Flexible food containers - squeezable honey, jam • Food container lids • Grocery bags • Ice cream lids • Sandwich bags • Sealants • Squeezable bottles • Shrinkwrap • Toys • Wire coverings • Wrap	LDPE plastics are recyclable and can turn into several new products including: • Compost bins and garbage cans • Black bin bags • Black agricultural film • Black irrigation pipes • Bubble wrap • Film plastic • Flooring • Furniture • Garbage can liners • Panelling • Plastic lumber • Shipping envelopes	LDPE products are considered less toxic and relatively safe to use in regards to other plastics. LDPE bags are disintegrating quicker than HDPE plastic bags however, due to the higher cost in producing them they are not preferred by retailers and still cause a threat to the environment. Things like plastic bags pollute our oceans and other wild habitats, posing threats to wildlife. It is estimated that hundreds of leatherback turtles die because they swallow plastic trash.

Symbol	Name of Plastic	Where you'll find in your home	Recycling into new products	Environmental facts
5 PP	Polypropylene PP	Though not quite as widely used in everyday life as HDPE or LDPE plastics, plastic #5 can be found in many hidden products used in many regular routines: • Appliances & toys • Automotive parts • Bottle & bottle caps • Carpeting and crates • Flexible packaging: food containers (thin walls) - yoghurt, deli foods, margarine, ketchup, syrup etc. • Food trays & Microwave meal trays • Furniture & Loudspeakers • Labelling • Luggage • Medicine bottles and containers • Pots • Straws • Thermal underwear;	PP is 100% recyclable, in general, is mixed with virgin PP up to 50% to turn into several new products including: • Auto parts - battery cases, signal lights, battery cables • Bike racks • Brooms and brushes • Film sheeting • Garden rakes • Ice scrapers • Plastic trays • Playground equipment • Shipping containers and pallets • Storage bins PP is considered safe for re-use.	Despite the wide use of PP only 1% is recycled PP takes up to 20-30 years to decompose. Due to PP additives (e.g. lead & cadmium) many environmental issues. Incineration of PP could result in the releases of dioxins and vinyl chloride to the atmosphere.

Symbol	Name of Plastic	Where you'll find in your home	Recycling into new products	Environmental facts
6 PS	Polystyrene, PS	PS plastics are common plastic material mainly used in: • CD and DVD cases and video cartridges • Electronic housing • Foam form: disposable tableware, food service items - cups, plates, bowls, takeout containers, meat trays, yoghurt pots, egg cartons • Medical products & bottles • Packaging material – Styrofoam: packing "peanuts" (packaging), furniture, electronics, shipping containers, loose fill (packing peanuts), protective covers for toys and electronics • Plastic cutlery • "Solo" cup (drinking from at a tailgate) • Smoke detectors (within) • Toys • Vending cups	Recycling PS plastics is less common than some other types, but when it is recycled, it can be made into a whole range of new products: • Casings for electronics - cameras, video cassettes • Desk trays • Foodservice items - foamed egg cartons • License plate frames • Light switch plates • Packaging material - expandable polystyrene foam (EPS) • Plastic mouldings – architectural • Rulers • Thermal insulation • Thermometers • Vents	Generally, Ps is considered as non-toxic and odourless. Due to the PS weak structure and it leigh weight, is easy to degrade and disperse throughout the natural environment. It is found in beaches and shores all around the world while mass ingested quantities have led to significant consequences to marine species health. There are concerns that styrene from polystyrene food containers can migrate from the foam into the food or beverage, posing health problems for those consuming the product. As with most things in landfills, polystyrene doesn't generally biodegrade over time. Instead, it just forms a lumpy mess that can form leachate and pollute groundwater as a result. Slow to biodegrade resulting being a litter hazard as it is being thrown away in a very short useful lifespan. Is flammable and emits CO^2 and water when incinerated

Symbol	Name of Plastic	Where you'll find in your home	Recycling into new products	Environmental facts
7 OTHER	All other plastics including acrylic, polycarbonate, polylactic fibres, nylon, fibreglass	Plastic #7 can be found in the following products: • Baby bottles • Bio-based plastics made from potato, sugar, or corn derivatives (PLA or compostable labelling) • Citrus juice bottles • Ketchup bottles • Large reusable water bottles and containers • Melamine • Oven baking bags • Plastic plates and cups • Sippy cups • Water cooler bottles	Other plastics do not have standardized reuse and recycling protocols making it hard if not impossible to re-use or recycle. It would be advisable to avoid buying these types of products.	The potential leaching of chemicals (BPA – disruptor of endocrine) into packaged food or drink products

Material	Recycling into new products	Environmental facts
Glass	Glass can be recycled indefinitely without any alterations to the performance of the material.	Every month, we throw out enough glass bottles and jars to fill up a giant skyscraper. All of these jars are recyclable! The energy saved from recycling one glass bottle can run a 100-watt light bulb for four hours or a compact fluorescent bulb for 20 hours. It also causes 20% less air pollution and 50% less water pollution than when a new bottle is made from raw materials. Glass packaging can be recycled into a new product in a month. Every tonne recycled saves up to 582kg of CO^2 through the supply chain, along with a reduction of aire and water pollution of 20% and 50% respectively. (FEVE, 2020) A modern glass bottle would take 4000 years or more to decompose -- and even longer if it's in the landfill. Mining and transporting raw materials for glass produces about 385 pounds of waste for every ton of glass that is made. If recycled glass is substituted for half of the raw materials, the waste is cut by more than 80%.

Material	Recycling into new products	Environmental facts
Metal	Metals can be recycled infinitely without any alterations to their characteristics. At least 50% of the produced cans contain recycled metal. Packaging of metals is 100% recyclable	Recycled aluminum saves 90% of the energy required for the production of a new one. Energy accounts for 30% of primary aluminium production costs, but recycling of aluminium scrap uses only 5% of the energy of primary production The benefits of recycling are substantial too. It's estimated that overall, manufacturing steel from recycled metal gives average reductions of: • 86 per cent in air pollution • 40 per cent in water use • 76 per cent in water pollution (ASM, 2015) A 75% and 95% of energy saving is achieved for steel and aluminum cans respectively, made from recycled material compared to the use of virgin materials.

Annex 8: Recycling Symbols on product packaging

Symbol	Explanation
	The Green Dot The Green Dot does not necessarily mean that the packaging is recyclable, will be recycled or has been recycled. It is a symbol used on packaging in some European countries and signifies that the producer has made a financial contribution towards the recovery and recycling of packaging in Europe. The basic idea is for the consumer to know that the company is responsible for the disposal of its products.
	Mobius Loop This indicates that an object is capable of being recycled, not that the object has been recycled or will be accepted in all recycling collection systems.
	Mobius Loop with percentage This symbol, like the one above, indicates that the product is suitable for recycling. The percentage listed internally is the percentage of recycled material contained in the product.
1 PET	**Plastic resin code 1** Refers to the type of plastic that is recycled. PET or polyethylene bottles are used for packaging water, soft drinks and are easily recycled.
2 HDPE	**Plastic resin code 2** The HDPE (high-density polyethylene) symbol is found on detergent packaging, garbage bags, juices and means that the plastic can be recycled.
3 PVC	**Plastic resin code 3** PVC (poly-vinyl chloride) has been replaced by PET in the food industry. It is more difficult to be recycled than the rest, while its burning releases toxic substances.
4 LDPE	**Plastic resin code 4** Refers to low-density polyethylene plastic such as food bags and plastic supermarket and store bags.

Symbol	Explanation
	Plastic resin code 5 PP (polypropylene) is more common in straws, bottle caps, sauce bottles and some medical syrups. PP (polypropylene) can be recycled.
	Plastic resin code 6 PS (polystyrene) is the material used in disposable plastic items (glasses, dishes, etc.), CD-DVD cases and it can be recycled.
	Plastic resin code 7 It refers to the category of plastics that are not classified in the previous ones and is usually used in sunglasses, computer cases and large water bottles.
	Glass The symbol is present on glass packaging (bottles, jars, etc.) and encourages recycling.
	Recyclable aluminium When there is this symbol on a product, it means that it is made of recycled aluminum and can be recycled again.
	Recyclable steel The product with this symbol is made of recyclable steel that can be recycled again.
	Paper, card and wood FSC's “tick tree” logo - a global forest certification system. The Forest Stewardship Council (FSC) logo identifies wood-based products from well managed forests independently certified in accordance with the rules of the FSC.
	Compostable Products certified to be industrially compostable according to the European standard EN 13432/14955 may bear the 'seedling' logo. Never place compostable plastic into the recycling with other materials; as it is designed to break down it cannot be recycled and contaminates recyclable materials. Plastics that carry this symbol can be recycled with your garden waste through your local authority.

Symbol	Explanation
	Home composting In addition to the seedling symbol for industrial composting, you may see this one which means that it is suitable to be home composted.
	International ecological symbol the Tidyman established by Keep Britain Tidy This symbol is not associated with recycling but is a request to the responsible citizens to discard the product in the most appropriate way. It can also be placed at a point where there is a trash can.
	Waste electricals It is used for electrical and electronic devices and means that they have been produced after 13 August 2005, and that they should not be disposed of in common bins with household waste but should be disposed of separately for recycling.
	EU Ecolabel The blue-green daisy was the former EU's eco-label, now replaced by the square shape with the indication '*EU Eco-label*'. It is a volunteer brand that certifies improved environmental performance of specific products and / or services among others in the same category and is awarded by a third independent body based on multiple criteria that have emerged after evaluation of the life cycle analysis.
	Blue Angel The Blue Angel is the German eco-label with the same principles that apply to the EU eco-label. It is one of the first national eco-labels with a wide range of products.

Annex 9: Summarised Action Plan and Roadmap for bio-waste pilot project

A brief graphical presentation of the road map is given in the following Figure.

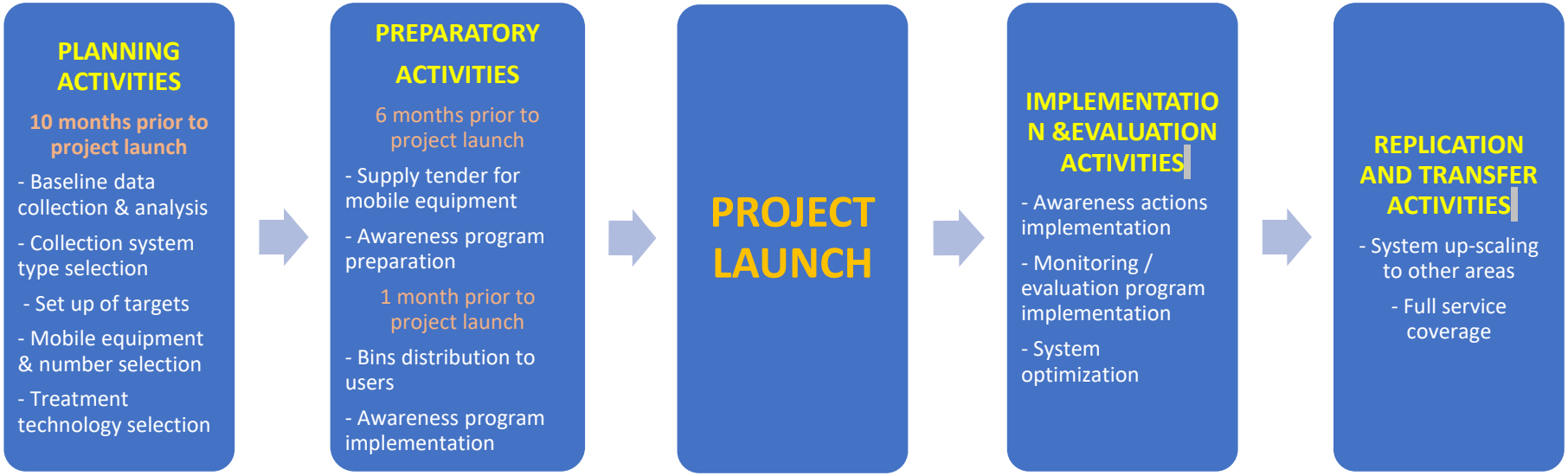

Figure 16: Proposed Roadmap for the implementation of separate collection of bio-waste for 6 muncipalities in Attica (Panagoulopoulos Alex, 2019)