


# GUIDE TO ENHANCE COST ACCOUNTING IN MUNICIPAL WASTE MANAGEMENT IN GREECE



## FINAL REPORT

VOL.1

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ISSUED BY: I.FRANTZIS & ASSOCIATES LTD AND BLACKFOREST SOLUTIONS GMBH



Federal Ministry  
for the Environment, Nature Conservation  
and Nuclear Safety



**giz** Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH



## BACKGROUND

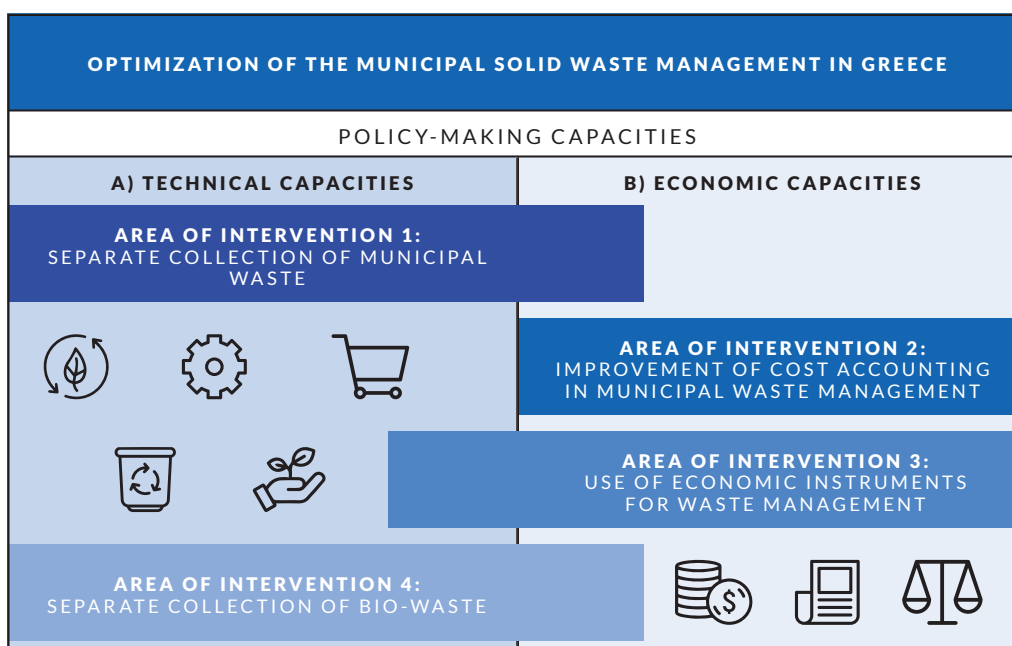
The Greek government asked the European Commission (EC) for support in specific areas (including the improvement of municipal waste management, regulatory issues of the waste sector, the management of specific waste categories) in order to raise the quality and quantity of recycling, to improve data quality and to effectively use economic instruments. To achieve the aforementioned goals, the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) provides "[Technical support for the implementation of the National Waste Management Plan \(NWMP\) of Greece](#)" from 2018 to 2020. The project is 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 jointly 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 mid-2020 by supporting four areas of intervention (AI) linked to the optimization of municipal waste management in Greece. The areas of intervention are:

- 1. SEPARATE COLLECTION OF MUNICIPAL WASTE**
- 2. IMPROVEMENT OF COST ACCOUNTING IN MUNICIPAL WASTE MANAGEMENT**
- 3. USE OF ECONOMIC INSTRUMENTS FOR WASTE MANAGEMENT**
- 4. SEPARATE COLLECTION OF BIO-WASTE**





**Classification of the four areas of intervention (BFS 2019)**

The study “Guide to enhance cost accounting in municipal waste management in Greece” was prepared as the final deliverable for area of intervention 2 of the contact ‘Optimizing municipal waste management in Greece - introducing effective separate waste collection and cost accounting, and making use of economic instruments’. The purpose of this study is to collect data and analyse the status of the

cost accounting system for waste management in Greece, in order to propose a suitable methodology for setting a transparent FCA system. Recommendations will be drawn for the establishment of a monitoring or benchmarking system at a municipal and national level, and concrete proposals on the improvement of legislation and regulations will be provided.

## DISCLAIMER

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

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

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## TABLE OF CONTENT

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<b>BACKGROUND</b> .....	ii
<b>DISCLAIMER</b> .....	iii
<b>LIST OF ABBREVIATIONS</b> .....	viii
<b>KEY DATA</b> .....	1
<b>Executive Summary</b> .....	2
<b>1. Introduction</b> .....	7
1.1 Objectives of the study.....	7
1.2 The concept of costs.....	8
1.3 Introducing Full Cost Accounting (FCA).....	8
<b>2. Methodology and financial equations</b> .....	10
<b>3. Guidelines for improvement in cost accounting</b> .....	13
3.1 General.....	13
3.2 Findings on the cost accounting for MSW in Greece.....	13
3.2.1 Legislation.....	13
3.2.2 Budget Auditing Documentation and Responsibilities.....	14
3.3 Classification of waste management activities in Greece.....	15
3.4 Meetings with municipalities.....	16
3.5 Basics / Methodical procedure for the preparation of a full cost calculation in the field of waste management.....	19
3.5.1 General description / requirements.....	19
3.5.2 Collection and transport costs.....	19
3.5.3 Treatment / disposal costs.....	24
3.6 Monitoring / Benchmarking.....	24
3.7 Determinants of waste management costs in Greece.....	25
3.7.1 Determinants of collection and transportation costs.....	25
3.7.2 Determinants of treatment costs.....	28
3.7.3 Summarizing and breakdown of MSW costs.....	28
3.8 Good practices in EU countries.....	29
<b>4. Recommendations for improvement of cost accounting</b> .....	31
4.1 General recommendations.....	31
4.2 Recommendations addressed to involved Ministries/authorities (national level).....	31
4.3 Recommendation addressing the municipalities.....	32
4.3.1 Recommendations for increasing efficiency in cost calculations.....	32
4.3.2 Recommendations regarding increasing efficiency of waste management.....	33
4.3.3 Recommendations regarding information to the public.....	33
4.4 Recommendations regarding responsibilities.....	33
<b>5. Conclusions and the way forward</b> .....	35

<b>6. References</b> .....	<b>37</b>
<b>7. Annexes</b> .....	<b>38</b>
7.1 Annex 1.....	38
7.2 Annex 2 Example of “FCA -tool waste management”.....	60

## LIST OF FIGURES

---

Figure 1: Objectives of cost accounting scheme.....	1
Figure 2: Methodology for cost accounting of municipal waste management (BFS, 2019)....	4
Figure 3: Step-by-step process for collection and transportation costs (INFA GmbH, 2019).....	18
Figure 4: The three-step model of the INFA / VKU comparison of benchmarks - waste management benchmarking model in Germany (INFA, 2019).....	19

## LIST OF TABLES

---

Table 1: Classification for cost accounting.....	10
Table 2: Waste management cost allocation of 17 municipalities (HPC-PASECO, 2015).....	12
Table 3: Example (extract) “detailed personnel cost calculation” .....	15
Table 4: Example (extract) “detailed vehicle cost calculation” .....	16
Table 5: Extract from the cost calculation model - see annex for full model (INFA GmbH, 2019).....	21
Table 6: Extract from the cost calculation model - see annex for full model (INFA GmbH, 2019).....	21
Table 7: Extract from the cost calculation model - see annex for full model (INFA GmbH, 2019).....	23
Table 8: Key points for the way forward with FCA.....	30



## LIST OF ABBREVIATIONS

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ARF	ADVANCED RECYCLING FEES
AI	AREA OF INTERVENTION
BFS	BLACK FOREST SOLUTIONS GMBH
BMU	GERMAN FEDERAL MINISTRY FOR ENVIRONMENT, NATURE CONSERVATION AND NUCLEAR SAFETY
CUR	CAPACITY UTILIZATION RATE
DRS	DEPOSIT-REFUND SCHEMES
EC	EUROPEAN COMMISSION
EPA	ENVIRONMENTAL PROTECTION AGENCY
EPR	EXTENDED PRODUCER RESPONSIBILITY
EU	EUROPEAN UNION
EWC	EUROPEAN WASTE CODE
FCA	FULL COST ACCOUNTING
FODSA	SOLID WASTE MANAGEMENT ORGANIZATIONS
GIZ	DEUTSCHE GESELLSCHAFT FÜR INTERNATIONALE ZUSAMMENARBEIT
HRA	HELLENIC RECYCLING AGENCY
INFA	INSTITUT FÜR ABFALL, ABWASSER UND INFRASTRUKTUR - MANAGEMENT GMBH
INH	INHABITANT
JMD	JOINT MINISTERIAL DECISIONS
KEDE	CENTRAL UNION OF MUNICIPALITIES OF GREECE
KYSOIP	GOVERNMENT COUNCIL FOR ECONOMIC POLICY
MBT	MECHANICAL AND BIOLOGICAL TREATMENT
MOM	MINUTES OF MEETINGS
MSW	MUNICIPAL SOLID WASTE
NIMBY	NOT IN MY BACK YARD
NSRF	NATIONAL STRATEGIC REFERENCE FRAMEWORK
NWMP	NATIONAL WASTE MANAGEMENT PLAN
NWPSP	NATIONAL WASTE PREVENTION STRATEGIC PLAN
PASECO	PASECO SP LTD
PAYT	PAY AS YOU THROW
PROS	PRODUCER RESPONSIBILITY ORGANIZATIONS
RDF	REFUSED DERIVED FUEL
RWMP	REGIONAL WASTE MANAGEMENT PLANS



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<b>SGSCO</b>	<b>GENERAL SECRETARIAT OF COORDINATION OF THE GREEK GOVERNMENT</b>
<b>SWM</b>	<b>SOLID WASTE MANAGEMENT</b>
<b>SRSS</b>	<b>STRUCTURAL REFORM SUPPORT SERVICE</b>
<b>TORS</b>	<b>TERMS OF REFERENCES</b>
<b>VKS</b>	<b>GERMAN ASSOCIATION OF MUNICIPAL WASTE MANAGEMENT AND CITY CLEANING</b>
<b>VKU</b>	<b>GERMAN ASSOCIATION OF MUNICIPAL ENTERPRISES</b>
<b>YO</b>	<b>MINISTRY OF FINANCE</b>
<b>YPEN</b>	<b>MINISTRY OF ENVIRONMENT AND ENERGY</b>
<b>YPES</b>	<b>MINISTRY OF INTERIOR</b>



### Assignment

**OPTIMIZING MUNICIPAL WASTE MANAGEMENT IN GREECE - INTRODUCING EFFECTIVE SEPARATE WASTE COLLECTION AND COST-ACCOUNTING, AND MAKING USE OF ECONOMIC INSTRUMENTS.**

### Area of Intervention

**2- IMPROVEMENT OF COST ACCOUNTING IN MUNICIPAL WASTE MANAGEMENT.**

### Project Name

**TECHNICAL SUPPORT FOR THE IMPLEMENTATION OF THE NATIONAL WASTE MANAGEMENT PLAN (NWMP) OF GREECE (68.3045.9)**

PROJECT REGION: **GREECE**

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### Client / Project Executing Agency



**DEUTSCHE GESELLSCHAFT FÜR INTERNATIONALE ZUSAMMENARBEIT GMBH (GIZ)**

PROJECT LEADER: **EVA RINGHOF**  
eva.ringhof@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).**

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### Consultants

**INFA GMBH:** SUBCONTRACTOR  
INTERNATIONAL EXPERT:  
**DIETER OELGEMÖLLER** - oelgemoeller@infa.de

**I.FRANTZIS & ASSOCIATES LTD:** SUBCONTRACTOR  
NATIONAL EXPERT:  
**MARIA PISIMISI** - pisimisi@i.frantzis.com

# Executive Summary

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This guide on “Cost accounting” aims to provide guidance to municipalities in Greece regarding FCA. To be more precise, it aims to enhance the applied methodologies of cost accounting in municipal waste management, through the development of a model guideline.

This model guideline has been developed, as the need for a FCA system was identified, during the acquisition and the analysis of our data. The model is namely a step-by-step procedure, addressed to municipalities and authorities, to ensure the transparency of the FCA system, that could henceforth support the establishment of a national monitoring system.

Currently, in Greece cost accounting methods in waste management applied by municipalities, are neither well-structured nor complete, keeping thus the potential for cost optimization and improvement of services highly restrained. As a result, the associated fees charged to the citizens do not strictly represent/reflect the actual MSW management costs.

The implementation of the FCA model in Greece aims to help the municipalities and the monitoring authorities (e.g. FODSA, Ministries) identify MSW management costs especially the ones easily overlooked, and estimate the peaks and valleys in MSW cash expenditures. Furthermore, the model aims to make MSW costs transparent and understandable to the citizens, evaluate the streams of MSW services promoting planning and decision-making, estimate future costs that could lead to renegotiate with the representatives of the private sector, upscale MSW applications and programs, and adopt a business-like approach to MSW management.

During the conduction of the report several challenges have been risen, with the most

significant being the gathering of reliable data that would allow to analyse different options of improving the cost accounting system of the Greek municipalities. The issue lies in the limited literature on waste management costs, and the barrier the existing legislation opposes by not favouring the implementation of a FCA model. Moreover, the diversity of the applied MSW management systems presents challenges by affecting the complexity of logistics and processes, increasing the difficulties to record and assess the involved full costs, etc. An area which presents a considerable scope for optimisation of the system, and potentially significant reductions in cost to municipalities and, hence, householders.

To assess the existing situation on cost accounting, an extensive literature review has been conducted regarding the existing legislation and the aspects of cost accounting (e.g. determination of budget according to law, required budget auditing documentation).

Besides the literature review meetings have been conducted with seven (7) municipalities of the Attica region, six of them in West Attica (municipality of Peristeri, municipality of Egaleo, municipality of Agia Varvara, municipality of Haidari, municipality of Nikea-Agios Ioannis-Rentis, municipality of Korydallos) and the municipality of Vari-Voula-Vouliagmeni. Questionnaires were shared with them in order to assess the existing situation concerning cost accounting. The general conclusion from the meetings and the results from the questionnaires was that the municipalities are at a very low-level regarding cost accounting processes.

The developed FCA tool was based on a calculation model differentiating the costs regarding the types of costs (e.g., personnel costs, material costs, capital

costs, overhead costs, etc.), cost centres (e.g., costs of waste collection department, waste treatment department, landfill department, workshop, administration, etc.), cost objects (e.g., waste collection, use of transfer station, waste treatment etc.).

The stepwise approach provided is the accurate determination of the costs by developing checklists, and apply a breakdown of the costs with concrete data. An example extract from the FCA model is being presented regarding the determination of collection and transportation cost (see chapter 3.5.2 & 3.7.1). Regarding treatment/disposal the determination of the “gate fee” and “tipping fee” is determined using assessment tools (cost-benefit analysis or life cycle analysis in order to cover their revenues, which in most cases in Greece include solely operation and maintenance costs) (see chapter 3.7.2).

The identification of potential cost saving can be determined through a continuous monitoring and benchmarking of the system. The main issues of benchmark are efficiency, quality, and sustainability in the field of waste management.

Good practices from Greek and European municipalities indicate that a FCA process is effective to optimise waste management practices, and certain enhancements should take place. The main recommendations other than the implementation of a FCA are pointing toward a clear legal framework especially regarding responsibilities and procedures, public awareness and personnel training.

The recommendations of the report is addressed in a national as well as in a regional and local level. In general it is recommended the application of FCA in municipalities to ensure an effective and efficient management of solid waste.

Furthermore, on a national level the

main recommendations are addressed to Ministries and authorities and include:

- The establishment of a strategic legal framework regarding FCA including a calculation method common for all involved parties demanding full cost recovery, transparency of the waste management costs, cost evaluation (comparable with similar) on a national level / benchmarking, publication of waste management costs at a national level and benchmarking results, etc. (see chapter 4.2).
- Assessment of the strategic legal framework through the acquisition of necessary data etc.
- Establishment of continuous monitoring and benchmarking through the FCA model.

On a local, municipal level the main recommendations include:

- The establishment of an autonomous waste management department within the department of the municipalities that would be responsible to compile the information needed to report on FCA, establish a monitoring system, and evaluate cost parameters.
- Collect the necessary data to be used for the FCA model (see chapter 4.3.1)
- Train the personnel regarding the implementation of FCA.
- Increase efficiency in waste management through the analysis of the data provided by the FCA model.
- Publish the FCA details concerning waste management.



# περίληψη των κυριότερων σημείων

Ο παρών οδηγός με θέμα την «Κοστολόγηση» αποσκοπεί στο να παρέχει καθοδήγηση στους ελληνικούς Δήμους όσον αφορά στην Πλήρη Κοστολόγηση (όπως αναφέρεται στη διεθνή βιβλιογραφία). Πιο συγκεκριμένα, αποσκοπεί στην βελτίωση των εφαρμοζόμενων μεθοδολογιών κοστολόγησης στη διαχείριση των αποβλήτων σε επίπεδο Δήμων.

Το παρόν πρότυπο οδηγιών προέκυψε εξαιτίας την ανάγκης που διαπιστώθηκε κατά την διάρκεια της συλλογής και της ανάλυσης των δεδομένων, για ένα σύστημα Πλήρους Κοστολόγησης. Το πρότυπο παρουσιάζει μια βήμα προς βήμα διαδικασία, απευθυνόμενο σε δήμους και φορείς με στόχο να εξασφαλίσει τη διαφάνεια του συστήματος Πλήρους Κοστολόγησης. Το τελευταίο στην συνέχεια θα λειτουργήσει υποστηρικτικά στην καθιέρωση ενός συστήματος παρακολούθησης σε εθνικό επίπεδο.

Οι μέθοδοι που εφαρμόζονται σήμερα από τους ελληνικούς δήμους παρουσιάζουν αφενός κακή δομή και αφετέρου ελλείψεις, σε βαθμό που περιορίζουν τη δυνατότητα βελτιστοποίησης του κόστους και αναβάθμισης των παρεχόμενων υπηρεσιών διαχείρισης των Αστικών Στερεών Αποβλήτων (ΑΣΑ).

Η εφαρμογή του μοντέλου Πλήρους Κοστολόγησης στην Ελλάδα, αποσκοπεί να προσφέρει βοήθεια στους δήμους και στις αρχές που θα επωμισθούν την παρακολούθησή του (π.χ. ΦοΔΣΑ, Υπουργεία) να αναγνωρίσουν τα κόστη διαχείρισης των ΑΣΑ, ειδικά στα κόστη που εύκολα παραβλέπονται, και να εκτιμήσουν τις ακραίες τιμές στις καμπύλες υπολογισμού των δαπανών των ΑΣΑ. Επιπλέον το μοντέλο στοχεύει στην διαφάνεια και απλούστευση του κόστους των ΑΣΑ με σκοπό να γίνουν πιο εύληπτα και κατανοητά από τους πολίτες, στην αξιολόγηση των υπηρεσιών που αφορούν τα ξεχωριστά ρεύματα ΑΣΑ προωθώντας με αυτό τον τρόπο τον σχεδιασμό και την λήψη αποφάσεων, στην εκτίμηση του μελλοντικού κόστους της διαχείρισης αποβλήτων, παρέχοντας με αυτό τον τρόπο ένα εργαλείο

για την επαναδιαπραγμάτευση των συμβάσεων με τον ιδιωτικό τομέα, στην αναβάθμιση των εφαρμογών και λογισμικών που χρησιμοποιούνται στην διαχείριση των ΑΣΑ και τέλος στην υιοθέτηση «επιχειρησιακής» προσέγγισης στη διαχείριση των απορριμμάτων.

Κατά την εκπόνηση της μελέτης προέκυψαν προβλήματα και προκλήσεις με σημαντικότερη αυτή της συλλογής αξιόπιστων στοιχείων, τέτοιων που να επιτρέπουν την ανάλυση και δημιουργία σεναρίων για την βελτίωση του συστήματος κοστολόγησης των ελληνικών δήμων. Μεταξύ των βασικών αιτιών του παραπάνω φαινομένου είναι η περιορισμένη ελληνική βιβλιογραφία σε θέματα κοστολόγησης στη διαχείριση των αποβλήτων και την κείμενη νομοθεσία που λειτουργεί ως τροχοπέδη για την εφαρμογή του μοντέλου της Πλήρους Κοστολόγησης. Επιπλέον, η ποικιλία των συστημάτων διαχείρισης ΑΣΑ δημιουργεί επιπρόσθετες προκλήσεις δεδομένου ότι επηρεάζει τα ήδη πολύπλοκα συστήματα μεταφορών και διεργασιών διαχείρισης αποβλήτων, αυξάνοντας τη δυσκολία καταγραφής και αξιολόγησης της κοστολόγησής τους. Το σύστημα μεταφορών και οι διεργασίες διαχείρισης αποβλήτων αποτελούν μια περιοχή που παρέχει σημαντικά περιθώρια αφενός βελτιστοποίησης του συστήματος και αφετέρου δυναμικά σημαντικών μειώσεων στα κόστη των Δήμων και συνεπώς και στην χρέωση που μεταφέρεται στα νοικοκυριά.

Για την αξιολόγηση της υφιστάμενης κατάστασης όσον αφορά στην κοστολόγηση, πραγματοποιήθηκε εκτενής βιβλιογραφική έρευνα σε θέματα κείμενης νομοθεσίας και στις πτυχές της κοστολόγησης (π.χ. καθορισμός προϋπολογισμού σύμφωνα με τη νομοθεσία, απαιτούμενα έγγραφα για πραγματοποίηση λογιστικού ελέγχου).

Επιπροσθέτως της βιβλιογραφικής έρευνας πραγματοποιήθηκαν συναντήσεις με επτά (7) Δήμους της Περιφέρειας Αττικής, έξι εξ' αυτών στην Δυτική Αττική (Δήμος Περιστερίου, Δήμος Αιγάλεω, Δήμος Αγίας Βαρβάρας, Δήμος

Χαϊδαρίου, Δήμος Νίκαιας- Άγιος Ιωάννης Ρέντης, Δήμος Κορυδαλλού) και ο Δήμος Βάρης-Βούλας-Βουλιαγμένης. Στους Δήμους αυτούς διανεμήθηκαν ερωτηματολόγια για την αξιολόγηση της υπάρχουσας κατάστασης σχετικά με την κοστολόγηση. Το γενικό συμπέρασμα που προέκυψε από τις συναντήσεις και από τις απαντήσεις των ερωτηματολογίων είναι το γεγονός ότι οι Δήμοι βρίσκονται σε χαμηλό επίπεδο αναφορικά με τις διαδικασίες κοστολόγησης.

Η δημιουργία του εργαλείου Πλήρους Κοστολόγησης βασίζεται σε υπολογιστικό μοντέλο διαφοροποιώντας τα κόστη σύμφωνα με την τυπολογία εκάστοτε κόστους (π.χ. κόστος προσωπικού, κόστος υλικών, κόστη κεφαλαίου, γενικά κόστη κλπ. ), τμήματα κοστολόγησης (π.χ. κόστος τμήματος συλλογής αποβλήτων, τμήμα επεξεργασίας αποβλήτων, τμήμα διαχείρισης ΧΥΤΑ/Υ, εργαστήρια, διοίκηση κλπ.) και κοστολόγηση ανάλογα με το αντικείμενο διαχείρισης (π.χ. συλλογή αποβλήτων, χρήση Σταθμού Μεταφόρτωσης Αποβλήτων, Επεξεργασία αποβλήτων κλπ.).

Η προσέγγιση που παρέχεται από το εργαλείο με σταδιακή ανάλυση, συνάδει στον ακριβή καθορισμό του κόστους μέσω λιστών ελέγχου και εφαρμογή αναλυτικού προϋπολογισμού που συμπληρώνεται με αδιάσειστα στοιχεία. Ως παράδειγμα, παρουσιάζεται η εξαγωγή ενός πίνακα από το Εργαλείο Πλήρους Κοστολόγησης σχετικά με τον καθορισμό του κόστους συλλογής και μεταφοράς (βλ. κεφάλαιο 3.5.2. και 3.7.1.) Αναφορικά με την επεξεργασία/διάθεση ο καθορισμός της «τιμή χρέωσης εισόδου (gate fee)» και της «τιμής χρέωσης διάθεσης (tipping fee)» πραγματοποιείται με την χρήση ειδικών εργαλείων αξιολόγησης (ανάλυση κόστους-οφέλους ή ανάλυση του κύκλου ζωής με στόχο την κάλυψη των εξόδων, τα οποία στην Ελλάδα στις περισσότερες περιπτώσεις περιλαμβάνουν αποκλειστικά λειτουργία και συντήρηση) (βλ. κεφάλαιο 3.7.2.).

Η ιχνηλασιμότητα δυναμικής εξοικονόμησης κόστους μπορεί να καθοριστεί μέσω μιας ατέρμονης διαδικασίας παρακολούθησης και συγκριτικής αξιολόγησης του συστήματος.

Τα σημαντικότερα οφέλη της διαδικασίας της συγκριτικής αξιολόγησης είναι η αποτελεσματικότητα, η ποιότητα και η βιωσιμότητα στον τομέα της διαχείρισης αποβλήτων.

Καλές πρακτικές από ελληνικούς και ευρωπαϊκούς Δήμους υποδεικνύουν ότι η διαδικασία Πλήρους Κοστολόγησης είναι αποτελεσματική στην βελτιστοποίηση των πρακτικών διαχείρισης αποβλήτων και συγκεκριμένες βελτιώσεις είναι δυνατό να λάβουν χώρα. Οι κυριότερες προτάσεις πέραν της εφαρμογής της πλήρους κοστολόγησης συνηγορούν υπέρ ενός ξεκάθαρα διαμορφωμένου νομικού πλαισίου, ειδικότερα σε θέματα που αφορούν σε αρμοδιότητες φορέων και διαδικασίες υλοποίησης, ευαισθητοποίησης του κοινού και εκπαίδευσης του προσωπικού που θα τεθεί αρμόδιο.

Οι προτάσεις της παρούσας έκθεσης απευθύνονται σε εθνικό, περιφερειακό και τοπικό επίπεδο. Σε γενικές γραμμές συνιστάται η εφαρμογή του μοντέλου Πλήρους Κοστολόγησης για την διασφάλιση μιας αποτελεσματικής και αποδοτικής διαχείρισης στερεών αποβλήτων.

Σε εθνικό επίπεδο οι κυριότερες προτάσεις απευθύνονται στα αρμόδια υπουργεία και φορείς και περιλαμβάνουν:

- Θέσπιση στρατηγικού σχεδιασμού σχετικά με την Πλήρη Κοστολόγηση, που θα περιλαμβάνει μεταξύ άλλων μια κοινή μέθοδο υπολογισμού για όλα τα εμπλεκόμενα μέρη που απαιτούν πλήρη ανάκτηση κόστους, διαφάνεια του κόστους διαχείρισης αποβλήτων, αξιολόγηση κόστους (συγκρίσιμη με παρόμοια) σε εθνικό επίπεδο, δημοσίευση του κόστους διαχείρισης αποβλήτων και των αποτελεσμάτων της συγκριτικής αξιολόγησης σε εθνικό επίπεδο (βλέπε κεφάλαιο 4.2).
- Αξιολόγηση του στρατηγικού σχεδιασμού μέσω της απόκτησης των απαραίτητων δεδομένων κ.λπ.
- Καθιέρωση διαδικασίας συνεχούς

παρακολούθησης και συγκριτικής αξιολόγησης μέσω του μοντέλου Πλήρους Κοστολόγησης.

Σε τοπικό επίπεδο, επίπεδο Δήμων οι κυριότερες προτάσεις περιλαμβάνουν:

- Δημιουργία μιας αυτόνομης υπηρεσίας διαχείρισης αποβλήτων σε κάθε Δήμο που θα είναι υπεύθυνη για τη συλλογή των πληροφοριών που απαιτούνται για την συμπλήρωση του μοντέλου Πλήρους Κοστολόγησης, τη δημιουργία ενός συστήματος παρακολούθησης και την αξιολόγηση των παραμέτρων κόστους.
- Συλλογή των απαραίτητων δεδομένων σύμφωνα με το μοντέλο Πλήρους Κοστολόγησης (βλέπε κεφάλαιο 4.2.1)
- Εκπαίδευση του προσωπικού σχετικά με την εφαρμογή της Πλήρους Κοστολόγησης.
- Αύξηση της αποτελεσματικότητας σε θέματα διαχείρισης αποβλήτων μέσω της ανάλυσης των δεδομένων που προκύπτουν από το μοντέλο Πλήρους Κοστολόγησης.
- Δημοσίευση των αναλυτικών τοιχείων της Πλήρους Κοστολόγησης που αφορούν τη διαχείριση αποβλήτων.





# 1. Introduction

In Greece, waste management is mainly confined to the collection, transport and landfilling or dumping, with an effort during the last years to introduce mainly capital-intensive options of waste treatment. The lack of adequate collection and treatment of separated waste streams results in high costs, mostly operational, with an average of over 86%. This is expected to a large extent, as waste management is a labour-intensive service (K. E. Lasaridi, 2006).

Total cost is a crucial parameter when it comes to designing or redesigning MSW management systems. Often there is confusion concerning the unit costs to be included in the total cost calculations, and principally, according to the Greek legislation<sup>1</sup>, municipalities are urged to calculate general costs. These costs refer to all the services a municipality provides without being allocated to waste management. Pursuant to the current legislation framework, municipalities are obligated to

provide cost accounting figures in the form of an annual budget concerning all the provided services from their side and not broken down into specific areas of interest, such as waste management. The above legislation gap renders almost impossible the implementation of FCA at a municipal level.

## 1.1 OBJECTIVES OF THE STUDY

This study forms part of four areas of intervention to optimize municipal waste management in Greece. The fields of activities are embodied in 2 different tracks: technical and economic capacities, by creating synergies in two ways. This report focuses on the guideline for area 2 “Improvement of cost accounting in municipal waste management”, while its aim is to analyse the prevailing cost accounting of municipal solid waste in Greece and to develop a step-by-step guideline for Greek municipalities on how to set up and enhance their cost accounting for different contexts. The objectives of cost accounting in SWM are illustrated in the following figure:



Figure 1: Objectives of cost accounting scheme

<sup>1</sup> Decrees 3463/2006, 3536/2007, 3943/2011 (article 49, par. 5), 4038/2012 (article 2, par. 6)

## 1.2 THE CONCEPT OF COSTS

As a general term, waste management can be described as a system of interactive waste-related activities that include collection, transport, storage, sorting, treatment, recovery, and disposal operations. The components of the system operate according to environmental policies, regulatory frameworks, and the legal requirements of waste management activities which have to comply to European and national law.

At a functional level, solid waste management (SWM) consists of two major components: (a) waste collection and (b) waste treatment. On one hand, the municipal collection system deals with tactical and operational decisions, such as transport routes and waste-flow allocation. On the other hand, there is a regional waste management system that deals with strategic decisions in network design (e.g., investments for recovery facilities).

The cost of waste collection is typically reported in terms of a per-tonne cost for residual waste and for different materials. In some Greek municipalities, the cost breakdown is limited to summarised costs (monthly/annual fuel consumption, salaries, etc) regardless the provided service. For instance, the total cost of the personnel salaries includes administrative employees, drivers in general, not only in the waste management department. etc. Generally, there is no straightforward way of understanding the costs of collection systems other than in the local contexts, taking into account the parameters which influence the specific costs, such as area characteristics (density and type of housing), waste composition etc. Moreover several issues arise when the different components of the waste management system are in place. For example, one unpredictable factor in waste transportation in Athens, is the waiting time for the collection trucks to enter the treatment facilities, which varies from half an hour to four hours



depending on the traffic at the entrance. This is perhaps an explanation for — as much a consequence of — the variety of collection approaches that are adopted across countries/municipalities. The diversity of MSW management systems applied affects the complexity of logistics and processes, increases the difficulties to record and assess the involved full costs and thus, raises the question of which criteria to establish for upscaling, concerning the existence of separate collection facilities, the prevalence of kerbside/doorstep collection over bring schemes, the approaches to capturing different materials, etc. (Karagiannidis et al., 2008). There appears to be considerable scope for optimisation of system costs and potential for significant reductions in cost to municipalities and, hence, householders.

## 1.3 INTRODUCING FULL COST ACCOUNTING (FCA)

“FCA is a systematic approach for identifying, summing and reporting the actual costs of SWM. It takes into account past and future outlays, overhead (oversight and support service) costs, and operating costs” (EPA, 1997).

In July 1997, some states in the U.S.A. began to require local governments to use FCA to calculate the direct costs of waste management and report MSW costs to the public. Many municipalities and authorities found FCA concepts to be useful for managing solid waste.

In European countries, instead of detailed guidelines, there are regulations which describe in detail the prices of marketable services, the cost prices (fixed cost prices, target cost prices) under public contracts.<sup>2</sup>

FCA aims to:

- **Identify MSW management costs:** Often, municipalities cannot control MSW costs because they can get lost among expenditures, and thus, some costs may be overlooked.
- **Estimate the Peaks and Valleys in MSW Cash expenditures:** FCA offers techniques such as depreciation, amortization, and focusing on annual cash expenditures.
- **Make MSW costs transparent:** Transparency in cost allocations gives the ability to explain to the citizens exactly how much the service costs, in order to raise public awareness.
- **Evaluate the streams of MSW services:** With FCA, each element of the municipal solid waste system can be isolated and evaluated for promoting planning and decision-making.
- **Develop a stronger position in negotiating with vendors:** When considering the privatization of the MSW services, FCA is the tool to estimate future costs and negotiate with the representatives of the private sector.
- **Upscaling MSW applications and programs:** FCA also provides a standard template in cost accounting. The data from many

municipalities can be easily compared and used in “re-engineering” current situations and implemented in similar cases.

- **Adopt a business-like approach to MSW management:** The scope is to balance between quality and cost of service and finally organize and operate a sustainable system. The FCA can also identify opportunities for services and facilitate cost-saving efforts.

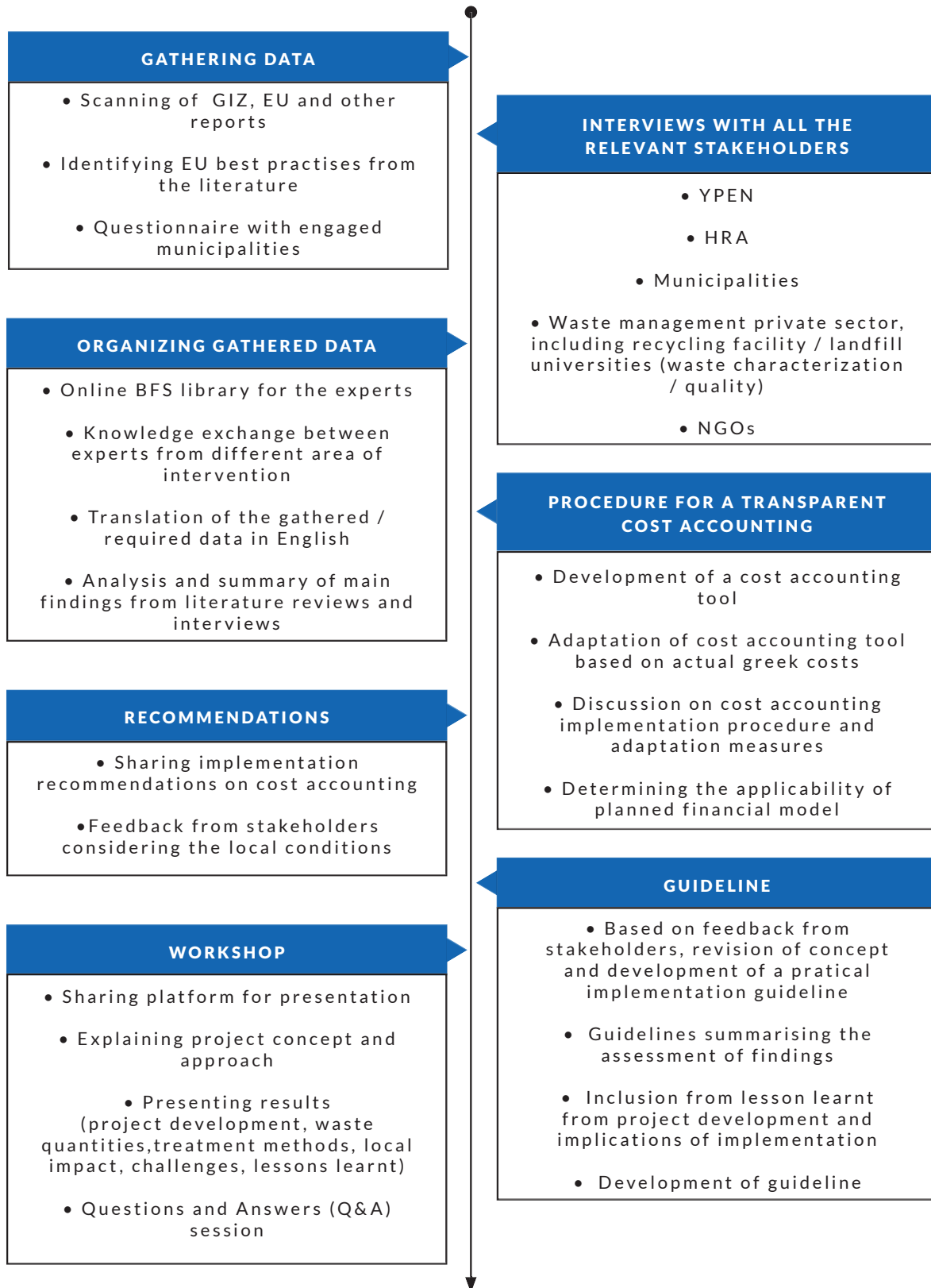
The FCA, in addition to up-front costs, operating costs, and back-end costs, the latter consisting of the “life cycle” costs of MSW activities, may include costs that are difficult to be measured. These costs, such as environmental costs and social costs, are often termed “externalities”. The FCA, moreover, is prodded to include contingent costs – future probabilistic costs, for instance – costs of remediating a future release of pollutants.



<sup>2</sup> In Germany, the Regulation PR No. 30/53 is referenced on pricing in public contracts.

# 2. Methodology and financial equations

The methodology is shown in Figure 2.



**Figure 2: Methodology for cost accounting of municipal waste management (BFS, 2019)**



The above-mentioned methodology is broken-down into the following actions:

### **Task break-down structure**

#### Gathering available data and reports with its evaluation for the cost accounting scheme

The first task is to get an overview of the stakeholders and the available data referring to cost accounting. Therefore, the following steps are carried out:

- Screening of various European Union (EU) studies/reports about MSW cost accounting; reports from Greek authorities (ministries, municipalities, Solid Waste Management Association (FoDSA), etc.).
- Identification of relevant stakeholders in waste management - different responsibilities of municipalities for household waste disposal; manufacturers or retailers for selected material flows, e.g. packaging material, waste management companies for collection, treatment and landfilling.
- Overview of existing cost data regarding waste collection, waste treatment and landfills (extent, quality) - differentiated into cost centres, e.g., costs of waste collection department, waste treatment department, landfill department, workshop, administration, etc. and types of costs, e.g., personnel costs, material costs, capital costs, overhead costs, etc..
- Overview of legal basis with regards to the accounting of waste management costs.
- Overview of current accounting

methodology for waste management costs to citizens and small and large businesses.

- Overview of gaps and needs for a full cost calculation system in Greece.

There are typically several challenges to gathering available data as a basis for determining and defining the next steps of FCA systems. Information about investment, operational, and maintenance costs is often not available in local authorities' accounting systems. Furthermore, accounting systems are often structured according to line items, such as staff payment, rent costs, fuel, and office expenses. Finally, there is very little information on services such as waste management or service components such as waste collection.

In order to gather the data from municipalities, a questionnaire was used which incorporated all types of costs or data requests linked to the delivery of waste management services. The filled-in questionnaires are illustrated in Annex 1.

#### Determining the applicable procedure that will result in a transparent cost accounting scheme

For a transparent cost accounting scheme, the following steps are carried out:

- Classification of costs (direct, indirect, and overhead costs).
- Definition of the necessary (available) cost parameters (centres, objects, and units).
- Determination of the functional areas to be considered (cost centres, costs of waste collection, waste treatment department, landfill, workshop, administration, etc., which are differentiated according to private companies and

municipalities if necessary), the types of costs to be included (such as personnel costs, material costs, capital costs, overhead costs, etc.), the distribution keys for the total costs to different types of costs units (such as residual waste, bio-waste, bulky waste, or recyclable materials), and possible subsidies for individual cost units (e.g., recyclable materials being cheaper than residual waste) or individual user groups (social compatibility).

- Project scheme identification and tracking.
- Evaluation of actual cost versus estimated cost.

For the FCA scheme, it is crucial to consider that there are different types of municipalities or municipality structures (e.g., on the mainland or the islands). Therefore, rules and formats for different local authority accounting systems might need to be adapted to track waste management costs effectively.

### Recommending the FCA scheme

In order to develop specific recommendations for FCA, the following steps will be taken:

- Compiling FCA data, including an inventory of physical assets and human resources and an organizational and financial records review.
- Development of a full cost calculation model (draft of a FCA scheme).
- Explaining the scheme's partial aspects / partial steps.
- Defining the transferability of the model to (all) Greek municipalities.

- Defining costs allocation (routine cash, capital, and future outlay, overhead costs).
- Reporting FCA results (tailoring the reporting to the audience, adjusting full cost to the revenues).

### Recommending the possible amendments of policy instruments in FCA

The above recommendations will be detailed and made more specific. Therefore, the following steps will be taken:

- Development of legal requirements for introducing a FCA system.
- Determination of cost responsibilities (e.g., municipalities, waste and manufacturers/traders for selected material flows, e.g., packaging materials), the scope of FCA, responsibilities for local implementation, control-instruments or control-bodies, and implementation periods.
- Discussion with Greek experts (policy/public waste management authority, etc.).
- Documentation of recommendations.



# 3. Guidelines for improvement in cost accounting

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## 3.1 GENERAL

The FCA methodology is a step-by-step process, which mainly aims in the identification of MSW management costs for local authorities. The method is designed to make costs transparent for the municipality employees and the citizens. The transparency makes the service costs easily explainable to the waste producers.

In FCA it is possible to evaluate the waste stream-specific costs concerning the provided services, documenting whether the current service is fully recovered and whether generates loss or profit. Moreover, the method is a decision-making tool by identifying opportunities for each service and cost reduction measures.

Finally, the method is used to identify costs that are usually not easily traceable - "hidden" costs - such as peaks and valleys in cash expenditures and techniques such as depreciation and amortization of investments.

## 3.2 FINDINGS ON THE COST ACCOUNTING FOR MSW IN GREECE

### 3.2.1 Legislation

The budget is a fundamental concept of public accounting that defines the annual financial program. The nature of the budget is of three-fold importance, namely:

- **Governmental accounting**, since the budget outlines

municipalities' future financial performance over a period of time by identifying the expected revenue and setting expenditures.

- The **economic-political concept**, since the budget is created to meet the needs of municipalities and achieve its objectives in a sustainable framework.
- **Fiscal**, in the sense that the budget is not a mere accounting statement of revenue and expenditure forecasts, but a significant operation consisting of planning and coordinating local government activities, formulating an investment policy, and auditing accounting accuracy, legality, and of cost-effectiveness.

The format of the municipal budget is determined by law 3462/2006 (article 155 par. 2) and a Joint Ministerial Decision (JMD) of the Ministry of Interior (YPES) and the Ministry of Finance (YO). It is followed by several amendments that provide guidelines on the breakdown of the budget. Moreover, the JMD, 4172 / 2013 par. 9 of article 77 of (replaced par. 4 of article 175 of L.3463 / 2006), stipulates that "By a JMD of the ministers of YPES and YO issued in July each year, following the opinion of the Central Union of Municipalities of Greece (KEDE), instructions are given for the preparation, implementation, and reform of the municipal budget (...)"

The law 4270/2014 (article 49) regulates the main principles of the budget: principle of annual duration, principle of unity (all municipalities cannot allocate their revenues and expenditures differently than it is indicated) and general content (all municipalities should provide information about all revenues



and expenditures.), principle of the budget breakdown, principle of honesty and precision, principle of publicity, and balance principle. According to article 27 of the law 4270/2014, an observatory agency is responsible for the evaluation of the budget plans, continuously monitoring the municipalities on a monthly basis, concerning their compliance with the financial rules and objectives. Moreover, the agency consults the YPES regarding the validity of the budget on the principle of unity and general content.

The municipalities are obliged to enter the data of the budget in an online database. The mandatory fields in the database, as regulated from the decrees 3463/2006, 3536/2007, 3943/2011 (article 49, par. 5), 4038/2012 (article 2, par. 6), are the following: revenues from exclusive rights and services, property income, mobile property income, revenues from fees, taxes, revenues from grants, irregular income, operation costs, capital investments, expenses from previous years, and reserved funds.

Finally, the law 4172/2013 (article 77) defines the stages and deadlines for the preparation of the budget.

In more detail, the first-level mandatory expenditures required in the database are the following:

- Consulting costs, compensation for attending meetings of city or community councils and committees, as well as travel expenses for local council chairmen
- personnel salaries, including standard travel expenses
- consumables for the protection of workers
- office stationary, expenditure on electricity or gas and water consumption, postal and telecommunications charges, all types of fuel and lubricants
- leases of immovable property used for municipal or community

services

- the costs of attestation and recovery
- the interest of the loans
- vehicles' insurance costs
- the annual fees to the waste management associations
- the costs of implementing inter-municipal cooperation and programme agreement between public authorities
- the grants of institutions and legal entities established by each municipality in respect of the amount stated in the constituent concerned
- expenditure on the enforcement of final judgments and on the settlement of outstanding debts, in accordance with their operative part
- fees levied by special laws
- welfare benefits' payment and the supply of materials and foodstuffs for the exercise of social protection and solidarity
- expenditure arising from the implementation of the two-year action plans of public benefit undertakings
- costs resulting from contracts for the execution of works, supplies, services, and studies

### 3.2.2 Budget Auditing Documentation and Responsibilities

The municipalities' budgets, even though they are a local issue, they are submitted for review and validation at the decentralised committee. The supporting documents required according to Circular 66115/45336 / 21-10-2014 are the following:

- the decision of the City Council and the Finance Committee, following the evidence of their publication,

which will bear the appointing authority

- Minutes of the Meeting (MoM) of the Municipal Consultative Committee and the Executive Committee
- the opinion of the Observatory of Financial Autonomy of the Municipalities and the instructions of the YPES
- the explanatory memorandum to the Financial Committee
- three (3) budget copies signed by the Municipal Board members (hardcopy) along with the internet submission
- statistical data signed by the statistical correspondent and the head of the financial service
- municipal board decisions regarding the imposition of taxes, fees, allowances and levies
- annual Technical Plan
- the decision of the Finance Committee and the Municipal Board on the preparation of the Integrated Framework of Action (IPD),
- payroll statements
- cash register statement of the amount of the cash balance with further distinction by the source of origin and destination
- confirmation of financial service that all compulsory expenditure has been recorded
- breakdown of interest on the loan instalments
- previous years debt lists,
- confirmation of the technical service for project registration and the source of its financing
- confirmation of balance of income and expenses
- detailed overview of ongoing expenditure and multi-annual commitments

### 3.3 CLASSIFICATION OF WASTE MANAGEMENT ACTIVITIES IN GREECE

Because of the diversity of the terrain in Greece, it is difficult to categorize the municipalities. Law 3852/2010 was amended with the insertion of "Article 2A Categories of Municipalities" after Article 2, with the recent Law 4555/2018 (Government Gazette 133 / A / 19-7-2018 (KLISTHENIS PROGRAM)). This article includes the categorisation of the municipalities into six basic groups, based on their population, particular geomorphological characteristics, the basic characteristics of economic activity within their boundaries, degree of urbanization, integration into larger metropolitan-type urban complexes, and their place in the administrative division of the municipality country:

- 1. Municipalities of metropolitan centres:** this category includes all the municipalities of the Central, Northern, Southern, and Western divisions of Athens and the Regional Unity of Piraeus of the Attica Region, as well as the municipalities of Thessaloniki, Ampelokipon - Menemeni, Kalamaria, Kordelio - Evosmos, Neapolis - Sykeon, Pavlou Mela, and Pylaias - "Chortiatis of the Regional Unity of Thessaloniki".
- 2. Large-sized mainland municipalities and municipalities prefectures:** this category includes all the mainland municipalities as well as the municipalities of the Region of Crete and the Regional Unity of Evia, with a population of more than 25,000 inhabitants, are included in this category, based on the permanent population data of the latest census of the Hellenic Statistical Authority, as well as the municipalities that constitute the capital prefectures, including island regions.
- 3. Medium-sized mainland municipalities:** 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 inhabitants, are included in this category, based on the permanent population data of the latest census of the Hellenic Statistical Authority.

**4. Small-sized mainland municipalities and small remote mountainous municipalities:** this category includes all mainland municipalities as well as the municipalities of the Crete Region with a population of fewer than 10,000 based on the permanent population data of the latest census of the Hellenic Statistical Authority.

**5. Large and medium-sized island**

**municipalities:** this category includes every island municipality with a population of over 3,500 inhabitants, based on permanent population data of the latest census of the Hellenic Statistical Authority.

**6. Small island municipalities:** this category includes all island municipalities with a population of up to 3,500, based on the latest census of the Greek Statistical Authority.

Concerning the different types of structures within this guideline for the cost accounting, seven categories can be defined (see Table 1)<sup>3</sup>, which serve the monitoring / benchmarking process described in 4.6.

**Table 1: Classification for cost accounting**

	CLASSIFICATION FOR COST ACCOUNTING
1	Municipalities of metropolitan centres with more than 100,000 inhabitants
2	Municipalities of metropolitan centres with less than 100,000 inhabitants
3	Large-sized mainland municipalities and municipalities prefectures
4	Medium-sized mainland municipalities
5	Small-sized mainland municipalities and small remote mountainous municipalities
6	Large and medium sized island municipalities
7	Small island municipalities

### 3.4 MEETINGS WITH MUNICIPALITIES

The meeting with six municipalities of Attika (municipality of Peristeri, municipality of Egaleo, municipality of Agia Varvara, municipality of Haidari, municipality of Nikea-Agios Ioannis-Rentis, municipality of Korydallos) confirmed the high costs of waste management. Most municipalities,

in order to cope with the expenses without jeopardizing the municipal services, are not able to invest in increasing the efficiency of waste management. The main findings of those meetings are the following:

- Information about investment and operational and maintenance costs not available in local authority

<sup>3</sup> Law 3852/2010 (article 2A) "Kleisthenis Law"

accounting systems.

- It is often structured according to line-items (such as staff payment, rent costs, fuel, and office expenses).
- Mostly no information according to service (such as waste management) or per service component (such as waste collection).
- • The absence of a tool or template that incorporates all types of costs that are linked to the delivery of waste management services.
- The absence of common rules and formats for local authorities' accounting systems.

The general conclusion from the meetings was that the data are unreliable and incomparable between different municipalities and/or departments from the same municipalities. The municipalities have to keep detailed daily records of expenses and weight sheets. The organizational levels of the different waste management services also vary, making the corresponding gathered data almost incomparable. Moreover, there is no long time-series with official records. The Digital Waste Registry was introduced in 2017. Another source for data may be the Local and Regional Waste Management Plans (RWMPs) or the National Waste Management Plan (NWMP) which are based on estimations, measurements and compositional analysis studies performed in certain regions and waste treatment facilities across the country. This may include the risk of having some general estimations of waste composition and generation rates which may not be representative for all Municipalities of one Region.

Furthermore, one of the main drawbacks of any waste management cost estimate at the local authority level in Greece is that the different waste management

services are not always precise. As a result, it is difficult to keep track of costs. For instance, many municipalities are not aware of how many of their personnel officially belong to the waste management service. This problem stems from many local authorities' practice of hiring people for the waste management services in order to cover various personnel needs. This means that many of these employees will eventually end up working in a different department within the local administration while being classified as employed in waste management (K. E. Lasaridi, 2006). Another consequence of inefficient waste management is the fact that usually, costs do not form a continuum. This practice supports the idea that landfill is the cheapest waste management option (Eunomia Research & Consulting, 2002). It is significant to mention that externalities are not taken into account in waste management cost breakdowns, and in the literature, there is almost nothing relating facility costs to the level of sustainability.

The six municipalities received a questionnaire about their waste management expenses and committed to fill it in and provide the data. Until today four of them have responded to the call and provided the required data regarding cost accounting (see Annex 1).

The attempt to develop cost accounting guideline in 2015 by HPC-PASECO Ltd. and YPEN was presented in three parts:

1. Analysis of data for the development of the guide
2. Guide for integrated costing of solid waste management
3. Proposals for institutional arrangements

The results of the data analysis for the development of the guide are illustrated in Table 2.

The municipalities did not implement the specific guidelines. The reasons,



according to the representatives of YPEN and the municipalities is mainly the fact that the guidelines cannot be considered user-friendly, too; the extended description of the costs and the two examples do not provide a step-by-step implementation of the process. Moreover, behavioural patterns, where many public servants

and members of the municipal boards are afraid to adopt new strategies and tools in waste management, were also observed.

All the above consist of the development of user-friendly guidelines, which support state-of-the-art technology.

**Table 2: Waste management cost allocation of 17 municipalities (HPC-PASECO, 2015)**

	ALEXANDROUPOLI	ALMIROS	VEROIA	ZAKYNTHOS	THASOS	KALAMATA	LIVADIA	KSILOKASTRO
Personnel costs	73.00%	17.70%	51.58%	64.22%	52.35%	48.43%	60.73%	75.92%
Collection-transport costs	0.00%	76.04%	1.21%	0.00%	16.78%	0.59%	19.64%	0.00%
Maintenance of bins	0.12%	0.00%	0.59%	0.00%	0.56%	0.85%	0.00%	0.00%
Vehicles and mechanical equipment repair/maintenance	5.29%	1.61%	0.00%	9.17%	7.49%	2.38%	8.50%	5.11%
Supply of equipment	0.42%	0.23%	0.00%	2.06%	1.12%	0.00%	0.00%	7.11%
Operating cost			14.06%	0.00%	0.00%	41.83%	0.00%	0.00%
Fuels cost	18.17%	3.04%	6.75%	13.76%	16.00%	4.92%	11.13%	8.38%
Public awareness expenses	0.00%	1.38%	0.00%	1.61%	0.00%	0.53%	0.00%	0.00%
Other expenses	3.00%		25.81%	9.17%	5.70%	0.47%	0.00%	3.48%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

	ORESTIADA	PAIONIA KILKIS	PATRA	PROSOTSANI	SANTORINI	SYROS	FARSALA	CHERSONISOS	CHIOS
Personnel costs	87.90%	56.54%	75.87%	81.45%	23.99%	54.64%	37.04%	23.18%	84.68%
Collection-transport costs	0.00%	19.71%	0.00%	1.80%	2.21%	10.10%	53.36%	0.00%	0.00%
Maintenance of bins	0.28%	0.49%	0.16%	0.10%	0.74%	0.11%	1.20%	0.00%	0.20%
Vehicles and mechanical equipment repair/maintenance	3.65%	10.99%	3.09%	4.57%	7.38%	5.65%	2.40%	0.00%	5.30%
Supply of equipment	0.00%	0.00%	0.89%	2.90%	2.21%	0.86%	1.20%	12.37%	0.00%
Operating cost	0.00%	0.00%	0.68%	0.00%	3.69%	10.15%	0.00%	64.45%	0.00%
Fuels cost	4.55%	10.80%	9.18%	9.18%	3.69%	5.18%	4.80%	0.00%	9.58%
Public awareness expenses	0.00%	0.00%	0.00%	0.00%	0.74%	0.00%	0.00%	0.00%	0.00%
Other expenses	3.62%	1.47%	10.13%	0.00%	55.35%	13.31%	0.00%	0.00%	0.24%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

### 3.5 BASICS / METHODOLOGICAL PROCEDURE FOR THE PREPARATION OF A FULL COST CALCULATION IN THE FIELD OF WASTE MANAGEMENT

#### 3.5.1 General description / requirements

The calculation model in which it is based the FCA tool should be differentiated into the following:

- types of costs (e.g., personnel costs, material costs, capital costs, overhead costs, etc.)
- cost centres (e.g., costs of waste collection department, waste treatment department, landfill department, workshop, administration, etc.)
- cost objects (e.g., waste collection, use of transfer station, waste treatment, maintenance of waste collection vehicles, etc.)

Once again, the FCA tool is based on a step-by-step and dynamic process; it should be frequently reviewed/evaluated, especially those important determinants which influence the economics of waste management.

#### 3.5.2 Collection and transport costs

Waste collection can generate up to more than 70% of the MSW system costs (GiulioGreco,2015). Eventhoughseparated waste collection implies additional costs, for which the sale of recycled waste often does not compensate, it represents a key cost driver, as the additional costs of separated waste collection are compensated by the reduction of expenses from other components of the waste management system. For instance, the reduction of costs for residual waste can be seen through the reduction of the





generation of the latter. Proper estimation and monitoring of waste collection costs are essential for defining the most cost-effective waste collection strategy by optimizing waste collection routes and increasing the efficiency of the waste collection process.

The first step is to recognize all of the types of costs related to waste collection and transportation. In order to avoid any costs omitted, developing a checklist of potential support services is necessary. The next step is to facilitate the breakdown of costs with concrete figures based on data from each case, in our case, e.g. the number of vehicles, employees.

### **Overhead costs**

Overhead costs are annual building costs, property taxes, utilities,

equipment supplies (gloves, suits, etc.) and administrative personnel costs. In addition, costs for public awareness campaigns are considered as overhead costs.

### **Costs of operating staff / administrative personnel**

The operating staff is usually estimated as two to three persons per collection vehicle, one driver and one or two loaders, street cleaning workers, workers at municipal recycling centres and workers in garage/workshop. The costs of the personnel include annual salary, annual payroll taxes, and insurance.

The administrative personnel consist of general management, leading administrative staff, administrative assistant staff, etc. (see Table 3).



**Table 3: Example (extract) “detailed personnel cost calculation”**

PERSONAL	DESIGNATION	WORKER			
		DRIVER	LOADER	MAINTENANCE WORKER	OTHER WORKER
Gross wage	[€/h]				
	[€/d]				
	[€/mon]	2,000	1,750	1,750	1,500
	[€/yr]				
Working time model	[-]				
Calendar days per year, including	365 [d/yr]				
<i>Weekend days (free)</i>	[d/yr]	104	104	104	104
<i>Vacation days</i>	[d/yr]	25	25	25	25
<i>Holidays (overall)</i>	[d/yr]	10	10	10	10
<i>Sick days (overall)</i>	[d/yr]	20	25	15	20
<i>Other absent days (overall)</i>	[d/yr]				
Attendance days per year	[d/yr]	206	201	211	206
Share reserve (entered)	[%]				
Share reserve (calculated)	[%]	27	30	24	27
Working time per day (net)	[h/d]	8.00	8.00	8.00	8.00
Workdays per week	[d/w]	5	5	5	5
Hours per week	[h/w]	40	40	40	40
Productive hours per year	[h/a]	1,648	1,608	1,688	1,648
Overtime hours per year	[h/a]				
Overtime compensation	[%]				
Paid working time (excl. overtime)	[h/yr]	2,088	2,088	2,088	2,088
<b>Gross yearly wage (excl. special payments)</b>	<b>[€/yr]</b>	<b>24,000</b>	<b>21,000</b>	<b>21,000</b>	<b>18,000</b>
+ Vacation/Christmas bonus	[€/yr]	2,500	2,500	2,500	2,500
+ other allowances	[€/yr]	0	0	0	0
<b>Yearly wage incl. special payments</b>	<b>[€/yr]</b>	<b>26,500</b>	<b>23,500</b>	<b>23,500</b>	<b>20,500</b>
Surcharge for non-wage labour costs etc,		0.0%	0.0%	0.0%	0.0%
Surcharge for non-wage labour costs etc,	[€/yr]	0	0	0	0
Subtotal II	[€/yr]	26,500	23,500	26,500	20,500
Value added tax		0,0%	0,0%	0,0%	0,0%
Value added tax	[€/yr]	0	0	0	0
<b>Total costs per employee and year</b>	<b>[€/pers/yr]</b>	<b>26,500</b>	<b>23,500</b>	<b>23,500</b>	<b>20,500</b>
<b>Personnel hourly rate</b>	<b>[€/h]</b>	<b>16.08</b>	<b>14.61</b>	<b>13.92</b>	<b>12.44</b>

## Vehicle costs

The vehicles, due to their variety, should be classified according to their characteristics:

- type (collection vehicles, transport vehicles)
- use (bio waste, residual waste, etc.)
- capacity (10 tonnes, 5 tonnes, etc.)
- special characteristics (rear loader, side loader, etc.)

The costs of investment in vehicle purchases are usually high. If the purchases are financed, interest should be included in operating costs. Vehicles should be depreciated over their remaining useful life. In common practice, the life span is approx. eight years. Regardless

of that, determining the useful life of a vehicle should rely on local experience, design specifications, and the vendor representative.

The remaining costs are related to operations and maintenance. The operating costs are (see Table 4):

- insurance
- road tax
- fuel consumption

On the other hand, maintenance costs include spare parts and components, labour, tools, and utensils for quick wear, energy and fluids, cleaning, hygiene and comfort, specialized works and other services (Vitor Sousa et. al., 2018).

**Table 4: Example (extract) “detailed vehicle cost calculation”**

		REAR LOADER 10 tn	REAR LOADER 6 tn	SMALL VEHICLE 1.5 tn
<b>Vehicle operating hour per year</b>	[h/yr]	2,080	2,080	2,080
Procurement value (chassis)		90,000 €	80,000 €	50,000 €
Procurement value (container)		40,000 €	30,000 €	
Vehicle procurement value (lifter)		20,000 €	20,000 €	
Vehicle procurement value (other)				
-----				
<b>Total investment per vehicle</b>		<b>150,000 €</b>	<b>130,000 €</b>	<b>50,000 €</b>
Recovery period		10 a	10 a	10 a
Recovery period		15,000 €/a	13,000 €/a	5,000 €/a
Recovery per year				
Inflation surcharge current assets		0 €/a	0 €/a	0 €/a
Weekend days (free) Interest rate		3%	3%	3%
Interest per year		2,250 €/a	1,950 €/a	750 €/a
<b>Cost of capital per annum</b>		<b>17,250 €/a</b>	<b>14,950 €/a</b>	<b>5,750 €/a</b>
Fuel consumption per operating hour		[l/h]		

		REAR LOADER 10 tn	REAR LOADER 6 tn	SMALL VEHICLE 1.5 tn
<b>alternative:</b>				
Kilometers traveled per annum Fuel consumption per 100 km Cost of fuel per year at a rate of	[km/yr]	19,500	17,550	15,795
	[l/(100 km)]	75	65	35
	1.15 €/l	16,819 €/a	13,119 €/a	6,357 €/a
		16,819 €/a	13,119 €/a	6,357 €/a
Insurance, tax, charge etc. or alternative global		1,000 €/a	1,000 €/a	1,000 €/a
Annual fixed charges for insurance, tax, charge etc.		1,000 €/a	1,000 €/a	1,000 €/a
5%	Service / repairs and maintenance (X % of PV per year)	7,500 €/a	6,500 €/a	6,500 €/a
5%	of fuel costs extra charge for oil and other lubricants	841 €/a	656 €/a	318 €/a
Tires		1,000 €/a	1,000 €/a	500 €/a
<b>Cost of operation per annum</b>		<b>27,160 €/a</b>	<b>22,275 €/a</b>	<b>10,675 €/a</b>
<b>Cost of capital and operation per annum</b>		<b>44,410 €/a</b>	<b>44,410 €/a</b>	<b>16,425 €/a</b>

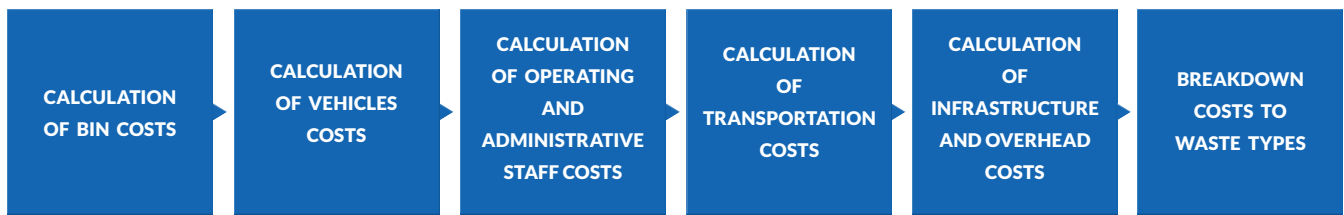
### Costs for containers (bins)

Due to the differences in the price of the bins according to their specifications (type, capacity, use), the cost analysis should be conducted estimating the cost of the bins per type, which entails investment and maintenance costs. The investment costs are the acquisition of the bins and depreciation over their lifespan, mainly according to design specifications and vendors' representatives. Maintenance includes parts and components, labour, tools, and utensils for quick wear, cleaning and hygiene (Vitor Sousa et. al., 2018). The extra hidden costs that should be taken into account are the costs for the delivery to the collection points/households.

### Costs for transfer station/ shipping

If a transfer station is available, the collection vehicles visit the transfer station facility and they are charged with a "gate fee". The gate fee covers the operation and maintenance expenses of the transfer station. In the case of island municipalities with no treatment or disposal facilities, the waste is shipped to adjacent islands with the appropriate facilities. The municipalities pay a shipping fee.

The calculation of accounting costs varies. A step-by-step process for calculating the collection and transportation costs is depicted in Figure 3:



**Figure 3: Step-by-step process for collection and transportation costs (INFA GmbH, 2019)**

The first step is to calculate the number of bins and their specific costs (€/unit and year), which is followed by calculating the number of vehicles and their specific costs (€/unit and year). The number and types of vehicles result in the calculation of the operating staff (amount and yearly specific costs) - how many drivers and loaders - and finally in the calculation of the yearly infrastructure and overhead costs. At this point, the components of the collection costs are calculated and only the optional transfer station costs / long distance transportation costs need to be added. The transportation costs in the case of small islands should take into account the shipping fees for transporting waste to facilities that are mainly located on other islands. Annex 2 shows a simplified example of a cost calculation matrix.

### 3.5.3 Treatment / disposal costs

Treatment and / or disposal facilities charge municipalities with a “gate fee” or “tipping fee” (price for treatment per tonnes). The “gate fee” of the facilities is calculated in advance, using assessment tools, such as cost-benefit analysis or life cycle analysis in order to cover their revenues, which in most cases in Greece include solely operation and maintenance costs.

The calculation of the name price is a result of a feasibility study of the facilities and the factors which affect the prices which are described in chapter 3.7.2.

## 3.6 MONITORING / BENCHMARKING

By comparing the costs of one period with the costs of other periods, by comparing the costs of one’s own organization with the costs of other organizations (intercompany comparison), or by comparing planned costs with actual costs, it is possible to identify cost savings (cost control). A substantial condition for such cost comparisons is the continuous monitoring of all provided services as well as in particular their relating costs. Only on the foundation of a substantiated data basis, an objective comparison with other companies/municipalities (benchmarking) is possible.

In order to implement the benchmarking process in Greece, all municipalities should be classified according the waste management activities (“Kleisthenis Law”).

### Germany - benchmarking

The German Association of Municipal Waste Management and City Cleaning (VKS), as part of the Association of Municipal Enterprises (VKU), is carrying out frequent benchmarking studies for cost aspects (also technical aspects). The carried-out benchmarking can be visualised and used for optimisation strategies (more than 70 municipalities participate). The data are processed and evaluated by third parties.

The main issues of benchmark are

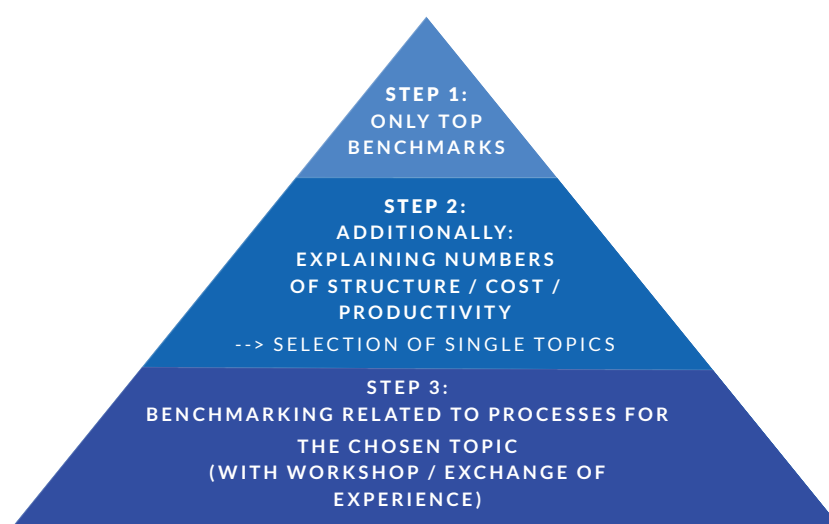
efficiency, quality, and sustainability in the field of waste management. The benefits are:

- external positioning (How is the own company compared to other companies?)
- internal positioning (How has the company developed its own (for repeated participation?)

- first exploratory company-specific strengths and weaknesses analysis
- the basis for strategic and operational decision-making

The subdivision of the analysis according to the size of the companies is substantial for the comparability of the results.

The process of benchmarking follows these steps (see Figure 4):



**Figure 4: The three-step model of the INFA / VKU comparison of benchmarks - waste management benchmarking model in Germany (INFA, 2019)**

Step 1: Current top benchmarks relevant for political decisions, as well as for controlling aspects, are provided regularly to the enterprises. Advantages of the comparison of benchmarks for the participating enterprises are:

- determination of the position
- record and evaluation of the enterprise's efficiency
- use as "virtual competition"
- the setting of an economical controlling authority
- support of the top management and staff motivation
- strategies of improvement of potentials

Step 2: More detailed analyses can be made in Step 2. Additionally, explaining identification numbers of structure, costs and productivity are presented.

Step 3: As required, extending data for selected topics can be raised, which will be analysed in small workshops.

## 3.7 DETERMINANTS OF WASTE MANAGEMENT COSTS IN GREECE

### 3.7.1 Determinants of collection and transportation costs

The knowledge of local and regional factors that affect effective solid waste



collection plays an important role in cost accounting. The process of calculating the costs of waste collection and transportation is described in chapter 3.5.2. The collections usually are done in an ad hoc manner that contributes to a huge solid waste collection cost, with the municipalities omitting appropriate planning of the needed financial and technical resources. The planning, which will be used as a framework for the cost calculation, will be part of the integrated disposal logistic planning. The result of the process is the calculation of the amount and type of vehicles needed in each area of interest. The factors which affect the logistic planning are the following:

- type of waste (mixed waste, recyclables, bio waste etc.)
- type of collection (bring system - door-to-door collection)
- area characteristics (size, density etc.) - density and type of housing
- frequency of waste collection (every day, every week)

On the other hand, the frequency of waste collection is influenced by the following parameters:

- the amount of waste
- the rate of waste generation
- the characteristics of the waste
- climate
- the availability of space within the premises
- the size and type of storage facilities (bins)
- the attitude of generators
- the resources that are available

Waste treatment and disposal facilities are located in remote areas away from urban zones where the activities of

waste production take place. The long back-and-forth distances constitute a significant portion of transportation costs and make it necessary to conduct studies (route planning) to optimize the routes, which includes considering the distance to the treatment plant or transfer station or harbour (in the case of an island).

The determinants of transport to a treatment plant are:

- location of the treatment facilities
- location of off takers

Since the transportation costs of the waste to a treatment plant relate mainly to the distance to the plant, a waste-transfer station might reduce the transportation costs.

The result of route planning will indicate the number and type (size and capacity) of the vehicles required and the necessary number of personnel.

The process of data collection regarding cost accounting is a dynamic one that should be frequently reviewed, especially the most important determinants that influence the economics of waste collection and transportation:

- frequency of waste collection
- collection routes, in case the collection points changed
- type and capacity of available vehicles
- distance to treatment/disposal plant (more alternatives should be evaluated regarding the economics, e.g., if it is more feasible to use a transfer station than to drive directly to the treatment plant)
- number of employees

An example of the breakdown of costs, as given in the cost calculation model, regarding bins/containers and personnel are illustrated in Table 5 and Table 6 respectively.

**Table 5: Extract from the cost calculation model - see annex for full model (INFA GmbH, 2019)**

DESCRIPTION	UNIT	AMOUNT FOR WASTE MANAGEMENT	UNIT PRICE PER YEAR	TOTAL COST PER YEAR	
			€/unit / yr	€/yr	
<b>1</b>	<b>Bins and containers</b>				
1.1	120 litres	bin	10,000	2.50	25,000.00
1.2	240 litres	bin	15,000	2.75	41,250.00
1.3	1.100 litres	container	4,000	35.00	140,000.00
1.4	---				0.00
alternative	flat bin / container costs	total costs	1		0.00
<b>subtotal 1</b>					<b>206,250.00</b>

**Table 6: Extract from the cost calculation model - see annex for full model (INFA GmbH, 2019)**

DESCRIPTION	UNIT	AMOUNT FOR WASTE MANAGEMENT	UNIT PRICE PER YEAR	TOTAL COST PER YEAR	
			€/unit / yr	€/yr	
<b>3</b>	<b>Personal costs</b>				
3.1	general management	Pers.	1	50,000.00	0.00
3.2	leading administrative staff	Pers.	3	40,000.00	0.00
3.3	administrative assistant staff	Pers.	10	30,000.00	0.00
3.4	secretariat	Pers.	2	25,000.00	25,000.00
3.5	driver	Pers.	18	25,000.00	41,250.00
3.6	loader	Pers.	36	20,000.00	140,000.00
3.7	maintenance worker	Pers.	2	17,500.00	0.00
3.8	other worker	Pers.	2	17,500.00	25,000.00
3.9	over time	Pers.	0.5	17,500.00	41,250.00
3.10	seasonal worker	Pers.	0.25	15,000.00	140,000.00
alternative	flat personal costs	total costs	1		0.00
<b>subtotal 3</b>					<b>1,772,500.00</b>

### 3.7.2 Determinants of treatment costs

The facilities are viewed as a system consisting of components or subsystems (Konstantinia Tsilemou, 2006). For various facility schemes (i.e., for various component arrangements) and facility sizes, it is feasible to evaluate the costs. The assessment of the treatment costs includes capital costs, operating costs, whole life costs and gate fee.

The parameters that affect the treatment costs are the following:

- Quantity of inflowing waste: specifically, the quantity of waste is measured by the capacity utilisation rate, defined as the ratio of actual inflow to design capacity flow. This rate drastically affects the operating costs and the capital recovery costs due to the infrastructure set-up cost (Konstantinia Tsilemou, 2006).
- Utilisation of the treatment plant: the operation conditions differentiate between facilities in working hours, number of lines, and crew size, all of which determines the personnel costs and affects the operating costs.
- Economy of scale: in general, a large plant will be more cost-effective than several smaller plants. Positive economies of scale are evident in both the capital and operating elements of large plants (Babtie, 2006).
- Composition of inflowing waste: the composition of the inflowing waste affects the facility costs, given that comingled waste treatment is time- and energy-consuming compared to segregated waste treatment.
- Applied technology: from waste minimization to final disposal, a

range of different treatment options are available, in order to deal with all types of solid waste materials in a flexible and market-oriented way, taking into consideration the specific targets and objectives set for each region. Each technology has different components, which have different needs related to workload, space, and energy.

- Location of the Facilities: transport and haulage costs are not taken into account. They are considered a part of the transportation costs.

### 3.7.3 Summarizing and breakdown of MSW costs

The objective of the guidelines is to focus on costs, which are, on the one hand, relatively easy to value in the marketplace and, on the other hand, include important data for decision-makers and planners, in order to include potential liability costs, such as social costs and environmental externalities.

Waste management is a dynamic multidimensional system, with many factors affecting both components of collection / transportation costs and treatment / disposal costs and improving it requires efforts to raise public awareness, increase funding and invest in infrastructure. By monitoring and reducing the costs with a well-built breakdown of costs (Table 4 - Table 7), SWM services can be improved.



**Table 7: Extract from the cost calculation model - see annex for full model (INFA GmbH, 2019)**

DESCRIPTION	COSTS PER YEAR	COSTS RELATED TO TYPE OF WASTE				
	€/yr	€/yr				
	TOTAL	RESIDUAL WASTE	BULKY WASTE	BIO WASTE	WASTE PAPER	OTHER VALUABLES
Subtotal 1	545,000.00	319,460.73	25,556.86	67,086.75	92,004.69	40,890.97
Subtotal 2	206,250.00	69,522.47	0.00	97,331.46	20,856.74	18,539.33
Subtotal 3	442,500.00	100,568.18	100,568.18	70,397.73	90,511.36	80,454.55
Subtotal 4	1,772,500.00	1,038,980.07	83,118.41	218,185.81	299,226.26	132,989.45
Subtotal 5	110,000.00	64,478.31	5,158.26	13,540.45	18,569.75	8,253.22
Subtotal 6	4,047,250.00	2,372,362.25	189,788.98	498,196.07	683,240.33	303,662.37
<b>Total costs</b>	<b>7,123,500.00</b>	<b>3,965,372.01</b>	<b>404,190.69</b>	<b>964,738.27</b>	<b>1,204,409.14</b>	<b>584,789.89</b>
	100%	56%	6%	14%	17%	8%

### 3.8 GOOD PRACTICES IN EU COUNTRIES

#### Overview of price laws in EU Member States

The EU Member States subject to harmonized EU public procurement law and public procurement pricing rules.

An implementation of the price rules of the EU public procurement directives has the objective, e.g. to check “abnormally low prices” or to set award criteria.

Most EU Member States have no more restrictive or normative requirements for public procurement. Regulations primarily have an internal administrative nature and are often related to specific area, e.g. defence procurement.

#### Germany - FCA and waste fees

In Germany, the municipalities are allowed to collect waste fees. With these fees, they allocate all costs for waste management to the citizens. The waste management fees in Germany are based on a FCA. For that FCA there exist some principles:

- the calculation must cover all costs, it's not allowed to exclude costs
- the calculation has to be carried out with economic principles
- the calculation has to include only costs of the waste management service and must be on an accrual base

Therefore, it is needed, that all municipalities are doing a detailed FCA for their waste management services. The costs, which are included in that FCA, are different for each municipality in Germany because the waste management service is often different. E.g. when a municipality has a recycling centre, they can include the cost in the cost accounting.

If the amount of the cost is not clear for a certain calculation period, the municipalities are allowed to do a cost forecast for the cost accounting. For example, when introducing new separate collection systems (e.g. separate biowaste collection), future mass flows and the resulting logistic and treatment costs can

only be forecast. The forecast has to be precise.

FCA is often separated into disposal logistic, waste treatment, waste consulting and other costs related to the waste management service e.g. disposal of illegal waste in parks or streets.

In Germany, waste management fees, and cost accounting have a legal frame based on national and regional laws and municipal degrees. There is no legal institution responsible for monitoring FCA. But all people have the right to apply for a review of the cost accounting and fees of the municipality at court.

#### **Portugal - Guideline: Cost calculation for water supply and waste management services from municipalities<sup>4</sup>**

In Portugal, municipalities have a guideline for cost accounting for water supply and waste management services. The main objectives of this guideline for the municipalities are:

- creating a cost accounting for every service
- classification of all costs to type of costs, cost units and cost centres
- assessment of all assets
- implementation of cost accounting by using simplified IT-solutions



- improving the billing

In the guideline, two examples for different FCA models are presented. The recommendations for improving the FCA in municipalities for water and waste management service were derived from these examples.

#### **Greece: Cost calculations of waste management**

In Greece, concrete guidelines for FCA, regarding the waste management sector, do not exist. However, many municipalities are using various methods to keep track of the waste management costs, with the example of the municipality Vari - Voula - Vouliagmeni to be indicative among others.

The current cost accounting system supports four different waste streams - residual, recyclable, bulky and green waste.

The cost accounting is separated into the following:

- personnel costs
- capital investments (facilities, vehicles, temporary storage equipment)
- maintenance and operation costs (facilities, vehicles, temporary storage equipment)
- public awareness campaigns

A GPS sensor is implemented in all vehicles, providing detailed data concerning the routes and the operation costs such as fuel consumption, insurance, taxes etc.

The municipality is preparing to implement a pilot programme in separate waste collection, in which they are planning to identify the total costs in even more detail. Not only per stream, but also per vehicle and per bin.

<sup>4</sup> Alexandra Gonçalves da Cunha, Cristina Landeiro Rodrigues: Apuramento de custos e proveitos dos serviços de águas e resíduos prestados por entidades gestoras em modelo de gestão direta



# 4. Recommendations for improvement of cost accounting

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## 4.1 GENERAL RECOMMENDATIONS

Local authorities are responsible for an effective and efficient management of the solid waste. The most crucial decision for the improvement of cost accounting is the application of FCA. By definition, FCA comprises two elements: identification of all costs (direct and indirect costs), associated with solid-waste management, allocation of all costs identified over the life cycle of the service provided (the appropriate benefitting periods).

Regional and local governments are the main practitioners of waste management. They undertake the waste management and associated reuse, recovery and recycling initiatives. The way in which regional and local governments relate to each other and to national governments varies from country to country. These relationships are critical to the successful development of a national strategy. The private sector is a major player in waste management, especially with regard to decisions about products and processes, which can be the determining factor in the amounts and kinds of waste generated. They also play a central role in delivering solutions to waste management problems and challenges, as suppliers of facilities and equipment and as service providers.

## 4.2 RECOMMENDATIONS ADDRESSED TO INVOLVED MINISTRIES/AUTHORITIES (NATIONAL LEVEL)

In addition to the European and national regulation, a number of other recommendations and mandates must be established in order to encourage action on waste management cost accounting. A strategic legal framework regarding the implementation of FCA should include:

- a calculation method common for all involved parties demanding full cost recovery
- transparency of the waste management costs and how these are communicated to the public with a separate full cost fee or a separate position in the municipal tax cost
- cost evaluation (comparable with similar) on a national level / benchmarking
- publication of waste management costs at a national level and benchmarking results
- regulation of responsibilities
- specific trainings of the public servants involved in the process of FCA (e.g. benchmarking)

Reference has been made to the importance of data and information and the challenge involved in its collection. The amount of data and information on waste management can increase in parallel with the development of the waste management system itself: as waste management improves, so should the

information base on which future decisions will rely. The data collection should be consistent in monthly and annual rate, providing each moment a detailed cost of waste management.

Assessment of the progress and success of the waste management strategy requires that progress towards the goals and targets for waste management is measured and assessed. This requires:

- information and data on each waste stream and on the system as a whole
- a process for evaluation of progress, including the identification of barriers to success and assessment of the success or failure of particular initiatives
- reporting of the results to governments and to stakeholders

A monitoring / benchmarking system should be established for the waste management parties to be able to compare policies, procedures, products and processes with others or to standard measurements. The outcome of the process includes among others:

- the identification of opportunities for improvement
- noting how targeted areas are performed better by peer companies
- the development of a performance improvement plan
- the review of results
- the identification of further improvement area

The results of the assessment should be available to the municipalities and the citizens, by being published in official media, the site of the ministry / authority responsible for the benchmarking (e.g. Management Organization Unit (MOU)).

## 4.3 RECOMMENDATION ADDRESSING THE MUNICIPALITIES

### 4.3.1 Recommendations for increasing efficiency in cost calculations

Local authorities handle differently solid waste, thus the approach described as a methodology fits all circumstances. Of high importance is an organizational review and reform within the municipalities' departments. As a first step an autonomous waste management department should be established and afterwards a second level differentiation can take place, with a breakdown based either on services (waste collection, road cleaners etc.) or waste stream (residual waste, recyclables etc.).

The waste management department should be responsible to:

- compile the information needed to report on FCA
- establish a monitoring system
- evaluate cost parameters.

The municipalities can conduct the above processes both by "activity" (e.g., collection, transfer station, transport, solid waste facility, sales) and by "path" (e.g., recycling, composting, waste-to-energy, land disposal). Irrespective of the differentiation in the full cost calculation, a large amount of basic data has to be collected in detail by the municipalities and processed in such a way that they can later be used for the cost model (see also chapter 4.5). The basic data should also be usable for the existing cost monitoring tool (online database - see chapter 4.2.1). Lastly, FCA is a dynamic process and should be frequently reviewed, focusing on the most important determinants which influence economics of waste management different components, waste collection, transportation, treatment,

disposal/ landfilling.

The employees of the waste management department and especially the ones who will be responsible for FCA are required to have full knowledge of the FCA methodology and tool. Specific training programmes should make the employees more efficient in their tasks. In order to make the training more efficient, a two-step process is recommended. First, the MOU to provide training programmes to the employees of the FODSA and in second step the FODSA employees should inform and train the municipalities on the FCA tool.

#### **4.3.2 Recommendations regarding increasing efficiency of waste management**

Integrated SWM (i.e. using a mix of waste management approaches) can minimise costs and maximise recovery and conservation of energy and materials. There is no single perfect SWM approach, therefore the use of FCA can communicate the costs of each approach. Understanding the full cost of each “path” is the first step in discussing where to shift the flows of MSW. Moreover, based on performance, targets achieved and cost figures, and through the benchmarking analysis, the municipalities can find out the sectors in which they perform poorly and exchange experience with other municipalities to achieve the optimisation of the waste management system. The benchmarking will be carried out according the classification-specific described in paragraph 4.3.

#### **4.3.3 Recommendations regarding information to the public**

Public awareness is a pivot point for efficient programme implementation on the waste management cost accounting. Specifically, the members of each municipality should be aware “how much waste management costs in their municipality”. The tax bill incorporated in the electricity bill combining municipalities’ services can

obscure what residents and businesses are paying for MSW management. Reporting the full costs of SWM and making the public aware of the fees in waste management, will have a direct impact on waste producers’ behaviour and can create incentives for reduction at source.

In order to inform the public on the cost accounting, the information / reports, it should be tailored to the public, according to the demographic characteristics of each municipality. It should be taken into account that different audiences are likely to have different interests and information need, thus different methods should be applied (e.g. publication on municipalities’ newspaper and website, electricity bill). Also, it is very important in the case of a PAYT system for each citizen/ household to have an easy access on the exact individual costs. Nevertheless, the main information provided should be the SWM costs, recycling costs per waste stream, how money are raised to cover the costs, how much money are saved by recycling. Last but not least, an explanation should be provided on the costs, especially if they are considered high.

### **4.4 RECOMMENDATIONS REGARDING RESPONSIBILITIES**

Legislation should clearly place the responsibilities among the different levels of government (local, regional and national). National governments, by definition have a leading role in developing, coordinating, implementing and reviewing any national waste management strategy. They will have the ultimate say in determining the overall national approach to waste management cost accounting at the highest level.

Government agencies with particular sectoral responsibilities (e.g. Observatory of financial autonomy of the Municipalities) will be important for policy coordination, coherency and integration, as well as potentially taking the lead in their sector.

The implementation of full cost calculation in the waste management department and the data supply by the municipalities should be mandatory. The database, where all the data are fed in, should be under the control of the ministry or ministries (YPES, YPEN) responsible for waste management cost accounting, serving a monitoring system and conducting an evaluation of cost parameters.

Last, the benchmarking analysis should be done by the ministry responsible for waste management or an association (similar to VKU in Germany) requiring voluntary participation for the municipalities.





# 5. Conclusions and the way forward

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“A budget is telling your money where to go instead of wondering where it went.” John C. Maxwell

This study examined the importance of cost accounting in SWM and providing guidelines for waste management improvement. There were four research objectives to be achieved:

- to study the current situation of cost accounting practices of SWM in Greek municipalities
- to analyse the legislative system and to recognise the gaps in the implementation of FCA
- to provide a step-by-step methodology concerning FCA
- to address recommendations in multi-level basis and establishing an understanding of the perception amongst local communities regarding FCA in SWM for enhancing efficiency and effectiveness

In summary, the research findings revealed that there are significant issues concerning the implementation of FCA in the waste management sector, due to the lack of proper guidelines with a step-by-step methodology, describing an adequate process. The insufficient reinforcement of regulation and laws concerning the application of cost account tools in waste management is identified as a barrier to municipalities, especially for those engaged in proper waste management cost accounting processes.

The FCA is identified as the backbone of sound cost accounting and should be implemented starting from primary level of waste management (i.e. municipalities). Considering the nature and components of waste generated by households and business places, and the requirements of the EU and national framework for resource efficiency and circular economy prioritising activities related to waste reduction, reuse, source separation, recycling and composting processes, management options should be integrated in a sustainable framework. Thus, the following Table 8 illustrates the key points for a successful implementation of FCA:





**Table 8: Key points for the way forward with FCA**

<b>LOCAL LEVEL - MUNICIPALITIES / FODSA</b>	
1)	Get full commitment of mayor and city council.
2)	Appoint cost accounting personnel in waste management Dpt..
3)	Train the cost accounting personnel in cost accounting issues and FCA tool.
4)	Establish a continuous data collection / maintenance for purpose of use in full cost calculation.
5)	Establish a full cost calculation system, e.g. FCA tool.
6)	Evaluate cost parameters for optimisation on base of specific performance and cost figures.
7)	Implement a monitoring system (for each department - min. for waste management department - better for single waste stream or waste / recyclables streams).
8)	Take part in exchange of experiences (benchmarking) among all waste management branches of municipalities in one region concerning "lessons learned" and the approaches to overcome difficulties - at least once a year.
9)	Increase public awareness by yearly publication of waste management costs.
<b>NATIONAL LEVEL - MINISTRIES / AUTHORITIES</b>	
10)	Reform the cost accounting data base according the FCA tool.
11)	Reform legislation in order to provide to the municipalities the liberty to provide incentives.
12)	Regulate responsibilities.
13)	Ensure / induce mandatory participation of FCA and data filling.
14)	Establish a monitor / benchmarking system (Mol).
15)	Train personnel in benchmarking processes.
16)	Conduct benchmarking by the ministry / authority (e.g. MOU) responsible for waste management.
17)	Evaluation of cost parameters by ministry / authority responsible for waste management.
18)	Publish benchmarking results.

Both the municipal and the national initiatives should advance parallel, in order for the system to be fully working in a 5-year horizon. The municipalities should gradually upgrade their level in cost accounting efficiency according the FCA tool, e.g. starting from filling general costs and reaching the detailed breakdown of costs, and at the same time involved

ministries and authorities should steer the process and orchestrate the combined efforts.

The implementation of a FCA system is not easy but it is worth it. In the long term, consistency will pay off and all the efforts will be rewarded. Stop wasting time!

## 6. References

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# 7. Annexes

## 7.1 ANNEX 1

### Municipality: Agia Varvara

#### 1. MSW generation data

CATEGORY	PARAMETER		VALUE
Demographic – Spatial characteristics	Population	Permanent (inh.)	26,550
		Seasonal (inh./yr)	-
	Population growth (%/yr)		-
	Total area (km <sup>2</sup> )		2.2 (km <sup>2</sup> )
	Total length of roads (km)		60 km
	Population Density (Inh./km <sup>2</sup> )		12,000 inh./km <sup>2</sup>
	Type of activities identified in the area to study (industrial/ residential/ commercial/ agricultural) <i>Please attach the land use map of your municipality</i>		Residential
Bio-waste sources	Households	Households (number)	9,849
		Households with garden (number)	-
		Average household size (Inh./household)	2.66 inh./household
		Single - family buildings (number)	-
		Multi - family buildings (number)	-
	Restaurants and collective catering	Restaurants etc. (number)	8
		Clients or Menus per year	10,000
	Schools	Kindergartens (number)	4
		Kindergartens (students/year)	250
		Primary education (number)	16 (9 kindergartens and 7 primary schools)
		Primary education (students/year)	1,543
		Secondary education (number)	5
		Secondary education (students/year)	1,016
		Higher education (number)	0
Higher education (students/year)	0		

CATEGORY	PARAMETER		VALUE
Bio-waste sources	Supermarkets	Number	5
	Open farm markets	Number / week	3 per week
	Hotels	Number of Hotels	0
		Beds	-
		% annual occupation	-
	Hospitals	Number of Hospitals	1
		Beds	-
	Other types of producers (Public services, stadiums, theatres, detention centres, etc.)	Number per type	-
		Capacity per type (e.g., number of employees, capacity, beds etc.)	-
	Urban gardens	Surface (m <sup>2</sup> )	Suburban 160,000 m <sup>2</sup> Urban 100,000 m <sup>2</sup>

## 2. Generation and composition of collected waste (year 2018)

CATEGORY	TONNES	%	TREATMENT METHOD			
			LANDFILLING RATE (%)	RECYCLING RATE (%)	RECYCLING RATE (%)	TREATMENT RATE (%)
Total waste quantity	10,553	100				
Mixed MSW	9,687	92	100			
Bio-waste						
Green waste	104	1				
Bulky waste						
Recyclable resources	762	7	49	51		
Wood waste						
Hazardous waste						
Textiles						
Electrical and electronic equipment						
Construction waste						

Note: Also 6.5 tonnes of glass and 6 tonnes of paper were collected.

### Existing collaborations with Extended Producer Responsibility (EPR) schemes:

1. Hellenic Recovery Recycling Corporation for the collection of packaging materials
2. Hellenic Recovery Recycling Corporation for the collection of glass
3. "AFIS SA" for the collection of old batteries
4. "Fotokiklosi S.A." for the collection of lamps
5. Recycling of electric appliances and lamps

### 3. Existing waste collection equipment

#### a) Temporary storage equipment

TYPE (BINS, BELLS ETC.)	CAPACITY (LITRES)	NUMBER	WASTE STREAM (MIXED MSW, RECYCLABLES ETC.)
Bins	770	700	Mixed MSW
Underground bins	3,000	6	Mixed MSW
Plastic Bins (blue)	770	600	Recyclables
Plastic Bins (blue)	1,100	15	Recyclables
Metal Bins (for glass)			Glass

Please attach a relevant map with the location of the temporary waste storage equipment in your municipality

#### b) Collection vehicles

No.	TYPE	CAPACITY (m <sup>3</sup> )	WASTE STREAM (MIXED MSW, RECYCLABLES ETC.)	YEAR OF SUPPLY
1	Garbage truck		Mixed MSW	1997
2	Garbage truck		Mixed MSW	1997
3	Garbage truck		Mixed MSW	1997
4	Garbage truck		Mixed MSW	2005
5	Garbage truck		Mixed MSW	2007
6	Garbage truck	16 m <sup>3</sup>	Recyclables	2006
7	Truck		Mixed MSW	1997
8	Small garbage press truck	7.5 m <sup>3</sup>		2005



#### 4. Breakdown of the latest budget for solid waste management (€)

##### a) Expenses

CATEGORY		(€)	%
Personnel expenses	Salary	807,065	51.33
Capital investment	Facilities (buildings, offices, workshops, etc.)		
	Transfer stations		
	Vehicles		
	Temporary storage equipment	21,600	1.38
	Treatment/Final disposal sites		
Maintenance and operation expenses	Facilities (buildings, offices, workshops, etc.)		
	Transfer stations		
	Vehicles	158,723	10.10
	Temporary storage equipment	3,987	0.25
	Treatment/Final disposal sites		
Public awareness expenses			
Other expenses	Contribution to ESDKNA, products of Individual Protection, Public Power Corporation (PPC) bookings and other providers on municipal taxes)	580,814	36.94
<b>TOTAL</b>		<b>1,572,189</b>	<b>100</b>

##### b) Cost recovery data

Total revenues via municipal taxes (€/y): **1,977,523**

% allocated to Solid Waste Management: **79.50%**

Other revenues e.g. sale of recyclables (€/yr): -

% of operational & maintenance cost coverage via total revenues: -

## 5. Performance Reports (January - December 2018)

CATEGORY	PARAMETER	VALUE
Collection Service	Average no. of trips per recyclables collection day	1
	Average no. of trips per collection day of other streams	4
	Average quantity of mixed MSW per collection day (tn/d)	40
	Average quantity of recyclables per collection day (tn/d)	5
	Average quantity of other waste streams per collection day (tn/d)	10
Transportation service	Average trips per day	6
	Average travel distance per trip (km)	100 km
	Average of actual collection time, in hours and daily average (hours)	4
	% collection vehicles availability	-
	Total fuel used for collection this month (litres)	-
Collection Crew	Total hours scheduled for collection workers (hours)	30 hours per week
	Actual hours spent by collection workers (hours)	20 hours per week
	Total number of collection workers	
	Total overtime (OT) hours (hours)	
Waste Treatment	Total waste collected (tn)	
	Landfilling rate (%)	
	Recycling rate (%)	
	Composting rate (%)	
	Treatment (MBT) rate (%)	
Collection Monitoring	Total number of complaints	
	Total number of complaints handled	540
SWM Costs	Total cost for fuel (€)	6,956
	Vehicle repair/ maintenance (€)	4,963
	Personnel costs in SWM sector (€)	69,868
	Consumables cost (€)	671
	Other overhead expenses: e.g. insurance, license etc. (€)	5,674
	SWM cost - tariff to EDSNA (€)	42,884
	Monthly budget allocation for SWM per cost category (€)	131,016

## 6. Detailed information on monthly operation and maintenance costs for SWM

(January - December 2018)

Year: 2018

ITEM	UNIT RATE	QUANTITY	COST (€/month)
Fuels			83,472
Waste oil			2,425
Tires			3,658
Vehicles repair / maintenance (other)			55,896
Other equipment repair / maintenance			0
Drivers			154,390
Workers			494,590
Other personnel (e.g. seasonal))			158,085
Staff equipment / Other consumables			36,972
Insurance			6,385
Circulation taxes			756
Depreciation			33,712
Third party / Private sector services			553,959
<b>TOTAL</b>			<b>1,584,300</b>

## Municipality: Egaleo

### 1. MSW generation data

CATEGORY	PARAMETER		VALUE
Demographic – Spatial characteristics	Population	Permanent (inh.)	69,496 (Census 2011)
		Seasonal (inh./yr)	30,000 (estimate)
	Population growth (%/yr)		-5.75% (2001-2011)
	Total area (km <sup>2</sup> )		6,450 (km <sup>2</sup> )
	Total length of roads (km)		150.40 km
	Population Density (inh./km <sup>2</sup> )		10,800 inh./km <sup>2</sup>
	Type of activities identified in the area to study (industrial/ residential/ commercial/ agricultural) <i>Please attach the land use map of your municipality</i>		97.8% “Residential”
Bio-waste sources	Households	Households (number)	12,000 (estimate)
		Households with garden (number)	750 (estimate)
		Average household size (Inh./household)	3.2 Inh./household
		Single - family buildings (number)	3,000 (estimate)
		Multi - family buildings (number)	9,000 (estimate)
	Restaurants and collective catering	Restaurants etc. (number)	1,000 (estimate)
		Clients or Menus per year	-
	Schools	Kindergartens (number)	9
		Kindergartens (students/year)	600
		Primary education (number)	24 kindergartens and 23 primary schools
		Primary education (students/year)	3,349 (estimate)
		Secondary education (number)	14 High schools + 4 Vocational High Schools + 1 Vocational Training Institute
		Secondary education (students/year)	4,656
		Higher education (number)	1
		Higher education (students/year)	28,000
	Supermarkets	Number	10
	Open farm markets	Number / week	5 per week

CATEGORY	PARAMETER		VALUE
Bio-waste sources	Hotels	Number of Hotels	-
		Beds	-
		% annual occupation	-
	Hospitals	Number of Hospitals	2 (private)
		Beds	100 (estimate)
	Other types of producers (Public services, stadiums, theatres, detention centres, etc.)	Number per type	5 Stadiums 2 Theatres 1 Police Department 2 Social Security Agency 1 Tax office
		Capacity per type (e.g., number of employees, capacity, beds etc.)	Stadiums → 8,000 Theatres → 300
	Urban gardens	Surface (m <sup>2</sup> )	650,000 m <sup>2</sup>

## 2. Generation and composition of collected waste (year 2018)

CATEGORY	TONNES	%	TREATMENT METHOD			
			LANDFILLING RATE (%)	RECYCLING RATE (%)	RECYCLING RATE (%)	TREATMENT RATE (%)
Total waste quantity	34,555	100%	x	x	x	x
Mixed MSW	27,910	100%	x	x	x	x
Bio-waste	0	100%	x	x	x	x
Green waste	764	100%	x	x	x	x
Bulky waste	0	100%	x	x	x	x
Recyclable resources	4,591	100%	x	x	x	x
Wood waste	0	100%	x	x	x	x
Hazardous waste	0	100%	x	x	x	x
Textiles	0	100%	x	x	x	x
Electrical and electronic equipment	8	100%	x	x	x	x
Construction waste	1,182	100%	x	x	x	x



## Existing collaborations with EPR schemes:

### Contracts with recycling companies

TYPE OF SERVICE	COMPANIES
<p style="text-align: center;"><u>ABANDONED CAR RECYCLING:</u></p> <ul style="list-style-type: none"> <li>→ 2015: 368 alerts - 80 cars -&gt; 4,395 €</li> <li>→ 2016: 235 alerts - 89 cars -&gt;10,430 €</li> <li>→ 2017: 495 alerts - 55 cars -&gt; 3,265 €</li> <li>→ 2018: 300 alerts - 97 cars -&gt;9,629 €</li> </ul>	ANAMET S.A
<p style="text-align: center;"><u>RECYCLING OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT:</u></p> <ul style="list-style-type: none"> <li>→ 2015: 2,270 kg x 0.08€/kg =181 €</li> <li>→ 2016: 3,110 kg x 0.08€/kg = 248 €</li> <li>→ 2017: 6,630 kg x 0.08€/kg = 530.40 €</li> <li>→ 2018: 7,100 kg x 0.055€/kg = 390.51 €</li> </ul>	ANAMET S.A
<p style="text-align: center;"><u>OLD IRONS:</u></p> <ul style="list-style-type: none"> <li>→ 2015: 8,490 kg x 0.172 €/kg = 1,460 €</li> <li>→ 2016: 1,650 kg x 0.172 €/kg = 283 €</li> <li>→ 2017: 6,580 kg x 0.172 €/kg = 1,131.76 €</li> <li>→ 2018: 7,970 kg x 0.15 €/kg = 1,195.50 €</li> <li>→ 28-3-19: 1,750 kg x 0.15 €/kg = 262.50 €</li> </ul>	LAVDARAS CHRISTOS S.A.
<p style="text-align: center;"><u>USED TIRES:</u></p> <ul style="list-style-type: none"> <li>→ 2015: 4,330 kg -&gt; 9.13 tn</li> <li>→ 2017: 10.06 tn, 2018: 3.27 tn, 1/2019: 45 vehicles + 20</li> </ul>	ECOELASTIKA S.A.
<p style="text-align: center;"><u>USED MINERAL OILS:</u></p> <ul style="list-style-type: none"> <li>→ 2014: 1,800 litres -&gt; 270 €</li> <li>→ 2015: 1,400 litres -&gt; 126 €</li> <li>→ 2016: 2,200 litres -&gt; 220 €</li> <li>→ 2017: 2,342 litres -&gt; 72 €</li> <li>→ 2018: 2,018 litres x 0.06 = 121.08 €</li> </ul>	CYTOP S.A.
<p style="text-align: center;"><u>LIGHTING LAMPS:</u></p> <ul style="list-style-type: none"> <li>→ 9° 2014 - 12° 2016 -&gt; 582 kg</li> <li>→ 2017: -&gt; 526 kg</li> <li>→ 2018: -&gt; 284 kg</li> </ul>	FOTOKIKLOSI S.A

<p style="text-align: center;"><u>PACKAGING RECYCLING:</u></p> <ul style="list-style-type: none"> <li>→ 2014: 649 tn</li> <li>→ 2015: 2,379 tn</li> <li>→ 2016: 2,600 tn</li> <li>→ 2017: 2,215 tn</li> <li>→ 2018: 2,526 tn</li> </ul>	<p style="text-align: center;">HELLENIC RECOVERY RECYCLING CORPORATION</p>
<p style="text-align: center;"><u>PACKAGING GLASS RECYCLING:</u></p> <p style="text-align: center;">There was 29 recycling points. Were placed 7 more bells in new locations.</p> <ul style="list-style-type: none"> <li>→ 2015: 23.4 tn</li> <li>→ 2016: 40.33 tn</li> <li>→ 2017: 38.30 tn</li> <li>→ 2018: 43.77 tn</li> <li>→</li> </ul>	<p style="text-align: center;">HELLENIC RECOVERY RECYCLING CORPORATION</p>
<p style="text-align: center;"><u>RECIPROCAL RECYCLING:</u></p> <ul style="list-style-type: none"> <li>→ 2014: 71,530 kg</li> <li>→ 2015: 75,829 kg</li> <li>→ 2016: 80,038 kg</li> <li>→ 2017: 69,100 kg (Total from 2014 to 2017: 296,497 kg)</li> <li>→ 2018: 120,000 kg (estimate)</li> <li>→</li> </ul>	<p style="text-align: center;">RECIPROCAL RECYCLING</p>
<p style="text-align: center;"><u>FRIED OILS:</u></p> <ul style="list-style-type: none"> <li>→ until January 2017 -&gt; 45 litres</li> <li>→ 2017: 170 litres</li> <li>→ 2018: 615 litres (municipality: 320 litres - Schools: 295 litres)</li> </ul>	<p style="text-align: center;">OIL 4 LIFE</p>
<p style="text-align: center;"><u>BATTERIES:</u></p> <ul style="list-style-type: none"> <li>→ 9/2014 – 12/2016: 370 kg (and 750 kg from Schools)</li> <li>→ 2017: 123 kg</li> <li>→ 2018: 551 kg</li> </ul>	<p style="text-align: center;">AFIS S.A.</p>
<p style="text-align: center;"><u>GREEN WASTE:</u></p> <ul style="list-style-type: none"> <li>→ 2014: 9.30 tn</li> <li>→ 2015: 203.94 tn</li> <li>→ 2016: 154.61 tn</li> <li>→ 2017: 430.73 tn</li> <li>→ 2018: 763.76 tn</li> <li>→</li> </ul>	<p style="text-align: center;">EMA - GREEN</p>
<p style="text-align: center;"><u>CONSTRUCTION &amp; DEMOLITION EXCAVATION WASTE:</u></p> <ul style="list-style-type: none"> <li>→ 2018: 1,182.60 tn</li> </ul>	<p style="text-align: center;">PAVLAKIS KONSTANTINOS</p>
<p style="text-align: center;"><u>PAPER:</u></p> <ul style="list-style-type: none"> <li>→ 2018: 10,520 kg</li> </ul>	<p style="text-align: center;">EDSNA</p>

Notes:

1. Quantities of 2018 are in line with EWR
2. The Amount of Returns for 2018 is estimated:

- Total recycling 4,762,628 kg
- Total mixed waste 33,899,508 kg
- 14.05% recyclable to total mixed waste

## 5. Existing waste collection equipment

### a) Temporary storage equipment

TYPE (BINS, BELLS ETC.)	CAPACITY (LITRES)	NUMBER	WASTE STREAM (MIXED MSW, RECYCLABLES ETC.)
Bins	1,100	1,500	Mixed MSW
Underground bins	3,000	8	Mixed MSW
Plastic Bins (blue)	1,100	835	Recyclables
Bells	2,500	15	Glass
Bins of Paper	1,100	25	Paper
Container for Electronic Devices	33,000	1	Electronic Devices

### b) Collection vehicles

No.	TYPE	CAPACITY (m <sup>3</sup> )	WASTE STREAM (MIXED MSW, RECYCLABLES ETC.)	YEAR OF SUPPLY
1	Garbage truck x10	16 m <sup>3</sup>	Mixed MSW	Average age 13.25
2	Garbage truck x4	20 m <sup>3</sup>	Mixed MSW	Average age 16.25
3	Garbage truck x2	4 m <sup>3</sup>	Mixed MSW	Average age 10
4	Garbage truck x4	16 m <sup>3</sup>	Recyclables	Average age 9.25
5	Triaxle truck x4	14,5 m <sup>3</sup>	Construction Waste + Green waste	Average age 17.5
6	Bi-axle truck x4	10 m <sup>3</sup>	Construction Waste + Green Waste	Average age 17.8

## 6. Breakdown of the latest budget for solid waste management (€)

### a) Expenses

CATEGORY		(€)	%
Personnel expenses	Salary	3,913,689.17 €	
Capital investment	Facilities (buildings, offices, workshops, etc.)	93,738.53 €	
	Transfer stations	x	
	Vehicles	x	
	Temporary storage equipment	x	
	Treatment/Final disposal sites	x	
Maintenance and operation expenses	Facilities (buildings, offices, workshops, etc.)	445,845.56	
	Transfer stations	x	
	Vehicles	x	
	Temporary storage equipment	x	
	Treatment/Final disposal sites	x	
Public awareness expenses			
Other expenses		2,146,079.41	
<b>TOTAL</b>		<b>6,599,352.67 €</b>	<b>100</b>

### b) Cost recovery data

Total revenues via municipal taxes (€/yr): **7,287,849.10**

% allocated to Solid Waste Management: **100%**

Other revenues e.g. sale of recyclables (€/yr): **0**

% of operational & maintenance cost coverage via total revenues: **no information**

## 7. Performance Reports (January - December 2018)

Month: (prices are almost constant per month)

CATEGORY	PARAMETER	VALUE
Collection Service	Collection frequency of mixed MSW	Everyday
	Collection frequency of recyclables	Everyday
	Collection frequency of other streams (e.g. green waste)	Everyday
	Average no. of trips per mixed MSW collection day	10
	Average no. of trips per recyclables collection day	3
	Average no. of trips per collection day of other streams	1
	Average quantity of mixed MSW per collection day (tn/d)	2,325
	Average quantity of recyclables per collection day (tn/d)	391
	Average quantity of other waste streams per collection day (tn/d)	169
Transportation service	Average trips per day	14
	Average travel distance per trip (km)	20
	Average of actual collection time, in hours and daily average (hours)	4
	% collection vehicles availability	90%
	Total fuel used for collection this month (l)	18,500
Collection Crew	Total hours scheduled for collection workers (hours)	6
	Actual hours spent by collection workers (hours)	4
	Total number of collection workers	45
	Total overtime (OT) (hours)	0
Waste Treatment	Total waste collected (tn)	-
	Landfilling rate (%)	100%
	Recycling rate (%)	
	Composting rate (%)	
	Treatment (MBT) rate (%)	
Collection Monitoring	Total number of complaints	69,868
	Total number of complaints handled	40 per month

CATEGORY	PARAMETER	VALUE
SWM Costs	Total cost for fuel (€)	-
	Vehicle repair / maintenance (€)	
	Personnel costs in SWM sector (€)	
	Consumables cost (€)	
	Other overhead expenses: e.g. insurance, license etc. (€)	
	SWM cost - tariff to EDSNA (€)	
	Monthly budget allocation for SWM per cost category (€)	

## 8. Detailed information on monthly operation and maintenance costs for SWM

(January - December 2018)

Year: (prices are almost constant per month)

ITEM	UNIT RATE	QUANTITY	COST (€/month)
Fuels	1.3 €/l	18,500 l	24,050
Waste oil			
Tires			2,500
Vehicles repair / maintenance (other)			20,000
Other equipment repair / maintenance			7,500
Drivers		16	12,800
Workers		32	22,400
Other personnel (e.g. seasonal))	x	x	x
Staff equipment / Other consumables			650
Insurance			2,500
Circulation taxes			700
Depreciation			x
Third party / Private sector services			1,000
<b>TOTAL</b>			<b>94,100</b>



## Municipality: Haidari

### 1. MSW generation data

CATEGORY	PARAMETER		VALUE
Demographic – Spatial characteristics	Population	Permanent (inh.)	46,897
		Seasonal (inh./yr)	-
	Population growth (%/yr)		-0.329%/yr
	Total area (km <sup>2</sup> )		226.55 (km <sup>2</sup> )
	Total length of roads (km)		-
	Population Density (inh./km <sup>2</sup> )		207 inh./km <sup>2</sup>
	Type of activities identified in the area to study (industrial/ residential/ commercial/ agricultural) <i>Please attach the land use map of your municipality</i>		Residential (Pure and General)  Industrial (Skaramagkas area)
Bio-waste sources	Households	Households (number)	17,278
		Households with garden (number)	-
		Average household size (Inh./household)	3 Inh./household
		Single - family buildings (number)	2,413
		Multi - family buildings (number)	19,233
	Restaurants and collective catering	Restaurants etc. (number)	545
		Clients or Menus per year	-
	Schools	Kindergartens (number)	8
		Kindergartens (students/year)	540
		Primary education (number)	32 (Public Schools) 3 (Private Schools)
		Primary education (students/year)	3,984
		Secondary education (number)	13 (Public Schools) 2 (Private Schools)
		Secondary education (students/year)	2,699
		Higher education (number)	-
		Higher education (students/year)	-
	Supermarkets	Number	12
	Open farm markets	Number / week	5 per week

CATEGORY	PARAMETER		VALUE
Bio-waste sources	Hotels	Number of Hotels	12 (most of them are semi-permanent hotels)
		Beds	664
		% annual occupation	-
	Hospitals	Number of Hospitals	3
		Beds	1,430
	Other types of producers (Public services, stadiums, theatres, detention centres, etc.)	Number per type	3 Military Camps 2 Cinemas 2 Theatres 1 Post office 8 Banks 3 Stadiums 1 Town hall 1 Police Department 1 Citizens Service Centre 1 Unified Social Security Fund 1 Day Hosting Centre "ERISMA" 1 Roof of Culture 3 Elderly Protection Centre 1 Orphanage 1 Nursing Home
		Capacity per type (e.g., number of employees, capacity, beds etc.)	-
	Urban gardens	Surface (m <sup>2</sup> )	16,160,000 m <sup>2</sup>

## 2. Generation and composition of collected waste (year 2018)

CATEGORY	TONNES	%	TREATMENT METHOD			
			LANDFILLING RATE (%)	RECYCLING RATE (%)	RECYCLING RATE (%)	TREATMENT RATE (%)
Total waste quantity	20,757.11					
Mixed MSW	18,397.31					
Bio-waste						
Green waste	562.66					
Bulky waste						
Recyclable resources	1,797.14					
Wood waste						
Hazardous waste						
Textiles						
Electrical and electronic equipment						
Construction waste						

### Existing collaborations with EPR schemes:

- There is an agreement from the 07/05/2019 for the implementation of the “Integrated Alternative Management Program for Used Clothes and Footwear” with the company “RECYCOM”. 30 bins (1,200-litre capacity) have been delivered and installed and the company collects them once a week (every Friday).
- Operation of the program of The Hellenic Recovery Recycling Corporation for the packaging waste recycling system (blue bins) as well as the glass collection for recycling (blue bells).
- There is a contract with the company “KOURTOGLOY NEOFITOS LTD” with an approved end-of-life vehicle (ELV) recycling system for the withdrawal of abandoned vehicles.

### 3. Existing waste collection equipment

#### a) Temporary storage equipment

TYPE (BINS, BELLS ETC.)	CAPACITY (LITRES)	NUMBER	WASTE STREAM (MIXED MSW, RECYCLABLES ETC.)
Bins	1.3 (m <sup>3</sup> ) / 1,300 litres	9	Glass
Bins (Blue)	1,100 litres	715	Recyclables
Bins	1,100 litres	1,600	Mixed MSW
Bins (clothes and footwear collection)	about 1,200 litres	30	Used Clothes and Footwear

#### b) Collection vehicles

No.	TYPE	CAPACITY (m <sup>3</sup> )	WASTE STREAM (MIXED MSW, RECYCLABLES ETC.)	YEAR OF SUPPLY
1	Garbage truck	16 m <sup>3</sup>	Mixed MSW	2018
2	Garbage truck	16 m <sup>3</sup>	Mixed MSW	2018
3	Garbage truck	16 m <sup>3</sup>	Mixed MSW	2018
4	Garbage truck	16 m <sup>3</sup>	Mixed MSW	2018
5	Garbage truck	12 m <sup>3</sup>	Mixed MSW	1993
6	Garbage truck	10 m <sup>3</sup>	Mixed MSW	1997
7	Garbage truck	12 m <sup>3</sup>	Mixed MSW	1997
8	Garbage truck	6 m <sup>3</sup>	Mixed MSW	1997
9	Triaxle truck	10 m <sup>3</sup>	Recyclables	2006
10	Garbage truck	10 m <sup>3</sup>	Recyclables	2006
11	Open truck	16 m <sup>3</sup>	Green Waste / Construction waste	2016
12	Open truck	10 m <sup>3</sup>	Green Waste / Construction waste	2017
13	Open truck	16 m <sup>3</sup>	Green Waste / Construction waste	2019

#### 4. Breakdown of the latest budget for solid waste management (€)

##### a) Expenses

CATEGORY		(€)	%
Personnel expenses	Salary	2,417,113.93	63.887
Capital investment	Facilities (buildings, offices, workshops, etc.)	1,610.14	0.042
	Transfer stations	0	0
	Vehicles	0	0
	Temporary storage equipment	6,806.36	0.179
	Treatment/Final disposal sites	0	
Maintenance and operation expenses	Facilities (buildings, offices, workshops, etc.)	69,688.56	1.841
	Transfer stations	0	0
	Vehicles	306,778.33	8.108
	Temporary storage equipment	12,105.91	0.319
	Treatment/Final disposal sites	969,312.80 [(Transfer Station, MBT, Landfill)]	
Public awareness expenses		0	0
Other expenses		0	0
<b>TOTAL</b>		<b>3,783,416.03</b>	<b>100</b>

##### b) Cost recovery data

Total revenues via municipal taxes (€/y): **5,165,945.24**

% allocated to Solid Waste Management: **73.24% (RELATED TO TOTAL REVENUE)**

Other revenues e.g. sale of recyclables (€/y): **0**

% of operational & maintenance cost coverage via total revenues: **100%**

## 6. Monthly Performance Reports (January - December 2018)

→ THE FOLLOWING TABLE IS REPEATED FOR ALL NEXT MONTHS OF THE 2018 WITH THE ONLY DIFFERENCE IN THE AMOUNT OF FUEL (litres) AND COST OF FUEL AS SEEN IN TABLE 6 WHICH LISTS THE QUANTITIES AND THE COST OF FUEL PER MONTH.

Month: JANUARY 2018

CATEGORY	PARAMETER	VALUE
Collection Service	Collection frequency of mixed MSW	5 days/week and 4 trips at the weekend
	Collection frequency of recyclables	Every 3 days
	Collection frequency of other streams (e.g. green waste)	Everyday
	Average no. of trips per mixed MSW collection day	7
	Average no. of trips per recyclables collection day	2
	Average no. of trips per collection day of other streams	6
	Average quantity of mixed MSW per collection day (tn/d)	60
	Average quantity of recyclables per collection day (tn/d)	8
	Average quantity of other waste streams per collection day (tn/d)	15
Transportation service	Average trips per day	15
	Average travel distance per trip (km)	80
	Average of actual collection time, in hours and daily average (hours)	4
	% collection vehicles availability	80
	Total fuel used for collection this month (l)	12,256
Collection Crew	Total hours scheduled for collection workers (hours)	32.5 per week
	Actual hours spent by collection workers (hours)	25 per week
	Total number of collection workers	38
	Total overtime (OT) (hours)	650 (average hours per month)
Waste Treatment	Total waste collected (tn)	1,400
	Landfilling rate (%)	90
	Recycling rate (%)	10
	Composting rate (%)	10
	Treatment (MBT) rate (%)	-
Collection Monitoring	Total number of complaints	10 per day
	Total number of complaints handled	10 per day



CATEGORY	PARAMETER	VALUE
SWM Costs	Total cost for fuel (€)	16,368
	Vehicle repair / maintenance (€)	5,200.44 (average per month)
	Personnel costs in SWM sector (€)	201.426,16 (average per month for the whole personnel)
	Consumables cost (€)	1,593.28 (average per month for the whole personnel)
	Other overhead expenses: e.g. insurance, license etc. (€)	2,754.18 (average per month)
	SWM cost – tariff to EDSNA (€)	80,776.06 (average per month)
	Monthly budget allocation for SWM per cost category (€)	

## 7. Detailed information on monthly operation and maintenance costs for SWM

(January - December 2018)

ALL INFORMATION REFER TO ANNUAL BASIS FOR 2018 EXCEPT THE COST FOR FUEL, WHICH IS LISTED IN THE NEXT TABLE IN MONTHLY BASIS.

Year: 2018

ITEM	UNIT RATE	QUANTITY	COST (€/month)
Fuels	-	-	-
Waste oil			28,764.82
Tires			0
Vehicles repair / maintenance (other)			60,694.39
Other equipment repair / maintenance			1,710.94
Drivers		12	260,440.32
Workers		22	331,320.00
Other personnel (e.g. seasonal))			
Staff equipment / Other consumables			19,119.37
Insurance			25,016.41
Circulation taxes			8,033.76
Depreciation			-
Third party / Private sector services			1,736
<b>TOTAL</b>			

MONTH	ITEM	UNIT RATE	QUANTITY	COST (€/month)
January	Fuels	-	12,256	16,368
February	Fuels		10,848	14,496
March	Fuels		15,180	21,215
April	Fuels		11,982	15,519
May	Fuels		11,480	16,620
June	Fuels		11,975	17,600
July	Fuels		12,109	17,734
August	Fuels		11,252	16,459
September	Fuels		10,660	15,585
October	Fuels		15,140	21,872
November	Fuels		13,656	20,164
December	Fuels		14,048	19,715

## 7.2 ANNEX 2 EXAMPLE OF “FCA -TOOL WASTE MANAGEMENT”

GUIDELINE TO USE THE FULL COST CALCULATION MODEL		
General		You can enter values in yellow coloured fields
		You can enter values in orange coloured fields
		You can enter names in coloured fields.
		Light green coloured fields are linked to other calculated field or choose settings from a drop-down
		Grey fields can not be adjusted. The values will be calculated, or the text is fixed.
Table “Full cost accounting”	<b>Within this table the following costs can be shown and be added to the total costs for waste management service:</b>	
	<b>type of costs</b>	<b>No.</b>
	- bins and containers - trucks and vehicles - personal costs - infrastructure / facilities area - third-party charges - other costed.	1 2 3 4 5 6
	<b>The amount of costs can be entered in the table as:</b> - detailed calculated costs - alternative / flat costs - percentage costs	
	<i>calculation of detailed cost</i> (see tables “Veh_costs_detailed_calc”; “Pers_costs_detailed_calc”, “Facilities_costs_detailed_calc”	<i>No. of cost:</i>
	If there is a detailed calculation of cost, you can enter these costs: - cleft “description” enter the different type of e. g. vehicle or personal - cleft “amount for waste management”: enter the amount of e. g. vehicle of staff - cleft “unit price per year”: enter the detailed calculated price for one unit	1, 2, 3, 4, 6
	<i>flat costs</i>	<i>No. of cost:</i>
	If there only exist flat cost per year e. g. for vehicle costs or personal cost, this line can be used. - cleft “unit price per year”: enter the detailed calculated price for one unit	1, 2, 3, 4, 6
	<i>percentage of costs</i>	<i>No. of cost:</i>
	If there exist total costs but there is only a percentage of the costs that are related for waste management service this line can be used. -cleft “total costs per year” enter the total costs - cleft “Percentage of use in waste management sector” enter the percentage for waste management	5

## GUIDELINE TO USE THE FULL COST CALCULATION MODEL

<b>Table "Full cost accounting"</b>	<p><b>At "third party charges" all costs can be named and entered that are related to third parties.</b></p> <p><b>At "other costs" all other costs for waste management can be named and entered that can not be assigned to one of the named type of costs.</b></p> <p><b>With the cleft "reference to" you can choose the reference with that are the calculated costs can be divided to the different type of waste (see table "Basic-data_percentage" for base settings)</b></p>
<b>Table "Full cost accounting"</b>	<p>If there are detailed costs for containers / bins and the different type of containers / bins this table can be used by calculate a detailed unit price per year.</p> <p>Therefore all the different costs that exists for a type of container / bin can be entered in the table.</p> <p>The calculated unit price per year can be used for the calculation of the total container / bin costs per year (see table "Full cost accounting", costs "Bins and containers"; "calculation of detailed costs").</p>
<b>Table "2_Veh_costs_detailed_calc"</b>	<p>If there are detailed costs for vehicle and different type of vehicles this table can be used by calculate a detailed unit price per year.</p> <p>Therefore all the different costs that exists for a type of vehicle can be entered in the table.</p> <p>The calculated unit price per year can be used for the calculation of the total vehicle costs per year (see table "Full cost accounting", costs "trucks and vehicles"; "calculation of detailed costs").</p> <p><u>Attention:</u> The number of reserve vehicles should be entered either in the data sheet "Full cost accounting" as an absolute number or in the data sheet "2_Veh_costs_detailed_calc" as a % rate.</p>
<b>Table "3_Pers_costs_detailed_calc"</b>	<p>If there are detailed costs for personal and the different type of personal this table can be used by calculate a detailed unit price per year.</p> <p>Therefore all the different costs that exists for a type of personal can be entered in the table.</p> <p>The calculated unit price per year can be used for the calculation of the total personal costs per year (see table "Full cost accounting", costs "personal costs"; "calculation of detailed costs").</p> <p><u>Attention:</u> The number of reserve employees should be entered either in the data sheet "Full cost accounting" as an absolute number or in the data sheet "3_Pers_costs_detailed_calc" as a %-rate.</p>
<b>Table "4_Infrastru_costs_detailed_calc"</b>	<p>If there are detailed costs for facilities this table can be used by calculate a detailed unit price per year.</p> <p>Therefore all the different costs that exists for a facility can be entered in the table.</p>
<b>Table "Basic-data_percentage"</b>	<p><b>With this table it's possible to make a rough division of the total amount of waste to different type of waste, to split the calculated costs to that different type of waste.</b></p> <p>That can be done by enter different data (you can enter just one of these data or plenty of the data):</p> <ul style="list-style-type: none"> <li>- inhabitants</li> <li>- waste amount</li> <li>- no. of bins</li> <li>- no. of emptying bins</li> <li>- no. of households</li> <li>- m<sup>2</sup> apartment space</li> </ul> <p>It's not necessary to enter in this table data. This table is a support. If there are no data entered, the cost calculation still works, there is only no division of the costs to the different type of waste.</p>

DESCRIPTION	UNIT	AMOUNT FOR WASTE MANAGEMENT	UNIT PRICE PER YEAR	TOTAL COSTS PER YEAR	
			€/unit / yr	€/yr	
<b>1</b>	<b>Bins and containers</b>				
1.1	120 litres	bin	10,000	2.50	25,000.00
1.2	240 litres	bin	15,000	2.75	41,250.00
1.3	1.100 litres	container	4,000	35.00	140,000.00
1.4	---				0.00
alternative	flat bin / container costs	total costs	1		0.00
<b>subtotal 1</b>					<b>206,250.00</b>

DESCRIPTION	UNIT	AMOUNT FOR WASTE MANAGEMENT	UNIT PRICE PER YEAR	TOTAL COSTS PER YEAR	
			€/unit / yr	€/yr	
<b>2</b>	<b>Trucks and vehicles</b>				
2.1	Rear-loader 10 tn	vehicle	10	40,000.00	400,000.00
2.2	Rear-loader 6 tn	vehicle	3	35,000.00	105,000.00
2.3	small vehicle 1.5 tn	vehicle	2	20,000.00	40,000.00
2.4	---				0.00
alternative	flat vehicle costs	total costs	1		0.00
<b>subtotal 2</b>					<b>545.000,00</b>

DESCRIPTION	UNIT	AMOUNT FOR WASTE MANAGEMENT	UNIT PRICE PER YEAR	TOTAL COSTS PER YEAR	
			€/unit / yr	€/yr	
<b>3</b>	<b>Personal costs</b>				
3.1	general management	Personal	1	50,000.00	400,000.00
3.2	leading administrative staff	Personal	3	40,000.00	105,000.00
3.3	administrative assistant staff	Personal	10	30,000.00	40,000.00
3.4	secretariat	Personal	2	25,000.00	0.00
3.5	driver	Personal	18	25,000.00	0.00
3.6	loader	Personal	36	20,000.00	0.00
3.7	maintenance worker	Personal	2	17,500.00	0.00
3.8	other worker	Personal	2	17,500.00	0.00
3.9	over time	Personal	0.5	17,500.00	0.00
3.10	seasonal worker	Personal	0.25	15,000.00	0.00
alternative	flat personal costs	total costs	1		0.00
<b>subtotal 3</b>					<b>1,772,500,00</b>

DESCRIPTION	UNIT	AMOUNT FOR WASTE MANAGEMENT	UNIT PRICE PER YEAR	TOTAL COSTS PER YEAR
			€/unit / yr	€/yr
<b>4</b>	<b>Third-party charges</b>			
4.1	collection costs	tn/yr	3,200	192,000.00
4.2	transfer (station) costs	tn/yr	42,650	426,500.00
4.3	treatment "residual waste"	tn/yr	25,000	3,125,000.00
4.4	treatment "bio waste"	tn/yr	5,250	393,750.00
4.5	treatment "waste paper"	tn/yr	7,200	-360,000.00
4.6	treatment "other valuables"	tn/yr	3,200	-80,000.00
4.7	treatment "bulky waste"	tn/yr	2,000	250,000.00
4.8	---			0.00
4.9	---			0.00
4.10	---			0.00
alternative	flat others	total costs	1	100,000.00
<b>subtotal 4</b>				<b>4,047,250.00</b>

DESCRIPTION	TOTAL COSTS PER YEAR	PERCENTAGE OF USE IN WASTE MANAGEMENT SECTOR	COSTS PER YEAR FOR WASTE MANAGEMENT SECTOR
	€/yr		€/yr
<b>5</b>	<b>Infrastructure / facilities area</b>		
5.1	land purchase	125,000	50,000.00
5.2	property development costs	25,000	15,000.00
5.3	road construction, yard area, parking lot	50,000	25,000.00
5.4	office building	125,000	87,500.00
5.5	vehicle hall / workshop	100,000	50,000.00
5.6	bin / container storage	10,000	10,000.00
5.7	transfer station	40,000	40,000.00
5.8	weighbridge	15,000	15,000.00
5.9	---		0.00
5.10	---		0.00
5.11	flat energy costs	100,000.00	70,000.00
5.12	flat machinery and equipment	100,000.00	80,000.00
alternative	flat infrastructure / facilities costs for waste management		0.00
<b>subtotal 5</b>			<b>4,047,250.00</b>



DESCRIPTION	UNIT	AMOUNT FOR WASTE MANAGEMENT	UNIT PRICE PER YEAR	TOTAL COSTS PER YEAR	
			€/unit / yr	€/yr	
<b>6</b>	<b>Other costs</b>				
6.1	Interest on credits	-	1	10,000.00	10,000.00
6.2	---	-			0.00
6.3	---	-			0.00
6.4	---	-			0.00
6.5	---	-			0.00
alternative	flat others	total costs	1	100,000.00	100,000.00
<b>subtotal 6</b>					<b>110,000.00</b>

FULL COST ACCOUNTING: "WASTE MANAGEMENT"		TOTAL COSTS PER YEAR
		(€/yr)
Subtotal 1	Trucks and vehicles	545,000.00
Subtotal 2	Bins and containers	206,250.00
Subtotal 3	Infrastructure / facilities area	442,500.00
Subtotal 4	Personal costs	1,772,500.00
Subtotal 5	Other costs	110,000.00
Subtotal 6	Third-party charges	4,047,250.00
<b>TOTAL</b>		<b>7,123,500.00</b>

SUMMARY	TOTAL COSTS PER YEAR
number of inhabitants/users	100,000 inh.
household size	28,571 household
amount of waste	42,650 tn/yr
amount of waste per inhabitant and year	427 kg/inh./a
amount of waste per household and year	1,493 kg/household/a
<b>total costs per year</b>	
	7,123,500 €/yr
<b>total costs per inhabitant and year</b>	
	71 €/inh./yr
<b>total costs per household and year</b>	
	249 €/household/a
<b>total costs per m<sup>2</sup> apartment space and year</b>	
	2.85 €/m <sup>2</sup> /a
<b>total costs per tonnes</b>	
	167 €/tn

INHABITANTS / USER	UNIT	RESIDUAL WASTE	BULKY WASTE	BIO WASTE	WASTE PAPER	OTHER VALUABLES	TOTAL
number of inhabitants/users	inh.	100,000	100,000	70,000	90,000	80,000	<b>440,000</b>
percentage		23%	23%	16%	20%	18%	100%

WASTE AMOUNT PER YEAR	UNIT	RESIDUAL WASTE	BULKY WASTE	BIO WASTE	WASTE PAPER	OTHER VALUABLES	TOTAL
amount of waste	tn/yr	25,000	2,000	5,250	7,200	3,200	<b>42,650</b>
percentage		59%	5%	12%	17%	8%	100%

BINS	UNIT	RESIDUAL WASTE	BULKY WASTE	BIO WASTE	WASTE PAPER	OTHER VALUABLES	TOTAL
number of bins or container	bin o. cont.	10,000	0	14,000	9,000	8,000	<b>41,000</b>
percentage		24%	0%	34%	22%	20%	100%

BIN EMPTYING	UNIT	RESIDUAL WASTE	BULKY WASTE	BIO WASTE	WASTE PAPER	OTHER VALUABLES	TOTAL
emptied bins per year	empt./yr	1,560,000	0	2,184,000	468,000	416,000	<b>4,628,000</b>
percentage		34%	0%	47%	10%	9%	100%

HOUSEHOLDS	UNIT	RESIDUAL WASTE	BULKY WASTE	BIO WASTE	WASTE PAPER	OTHER VALUABLES
household size	inh./household.	3,5	3,5	3,5	3,5	3,5
households	household.	28,571	28,571	20,000	25,714	22,857

M <sup>2</sup> APARTMENT SPACE	UNIT	RESIDUAL WASTE	BULKY WASTE	BIO WASTE	WASTE PAPER	OTHER VALUABLES
m <sup>2</sup> space per inhabitant	m <sup>2</sup> /inh.	25	25	25	25	25
m <sup>2</sup> apartment space	m <sup>2</sup>	2,500,000	2,500,000	1,750,000	2,250,000	2,000,000

DESCRIPTION	COSTS PER YEAR	COSTS RELATED TO TYPE OF WASTE				
	(€/yr)	(€/yr)				
	TOTAL	RESIDUAL WASTE	BULKY WASTE	BIO WASTE	WASTE PAPER	OTHER VALUABLES
Subtotal 1	545,000.00	319,460.73	25,556.86	67,086.75	92,004.69	40,890.97
Subtotal 2	206,250.00	69,522.47	0.00	97,331.46	20,856.74	18,539.33
Subtotal 3	442,500.00	100,568.18	100,568.18	70,397.73	90,511.36	80,454.55
Subtotal 4	1,772,500.00	1,038,980.07	83,118.41	218,185.81	299,226.26	132,989.45
Subtotal 5	110,000.00	64,478.31	5,158.26	13,540.45	18,569.75	8,253.22
Subtotal 6	4,047,250.00	2,372,362.25	189,788.98	498,196.07	683,240.33	303,662.37
<b>Total costs</b>	<b>7,123,500.00</b>	<b>3,965,372.01</b>	<b>404,190.69</b>	<b>964,738.27</b>	<b>1,204,409.14</b>	<b>584,789.89</b>
	100%	56%	6%	14%	17%	8%