

# Carbon footprint calculation of the collection at source and treatment of biowaste

*Athena Bourka  
Chemical Engineer MSc, EPTA S.A.*

*G. Konstantzos, D. Malamis, C. Venetis,  
K. Moustakas, O. Skiadi, O. Bourka, M. Loizidou*





- A necessary decision-making tool for all Municipalities
- Helps a Municipality to:
  - design a separate collection system (equipment, collection frequency, etc.)
  - estimate investment and operational costs of biowaste separate collection
  - compare total biowaste management costs with existing ones treating mixed MSW
  - estimate carbon footprint of biowaste management and compare with existing ones treating mixed MSW

# Application of the Software

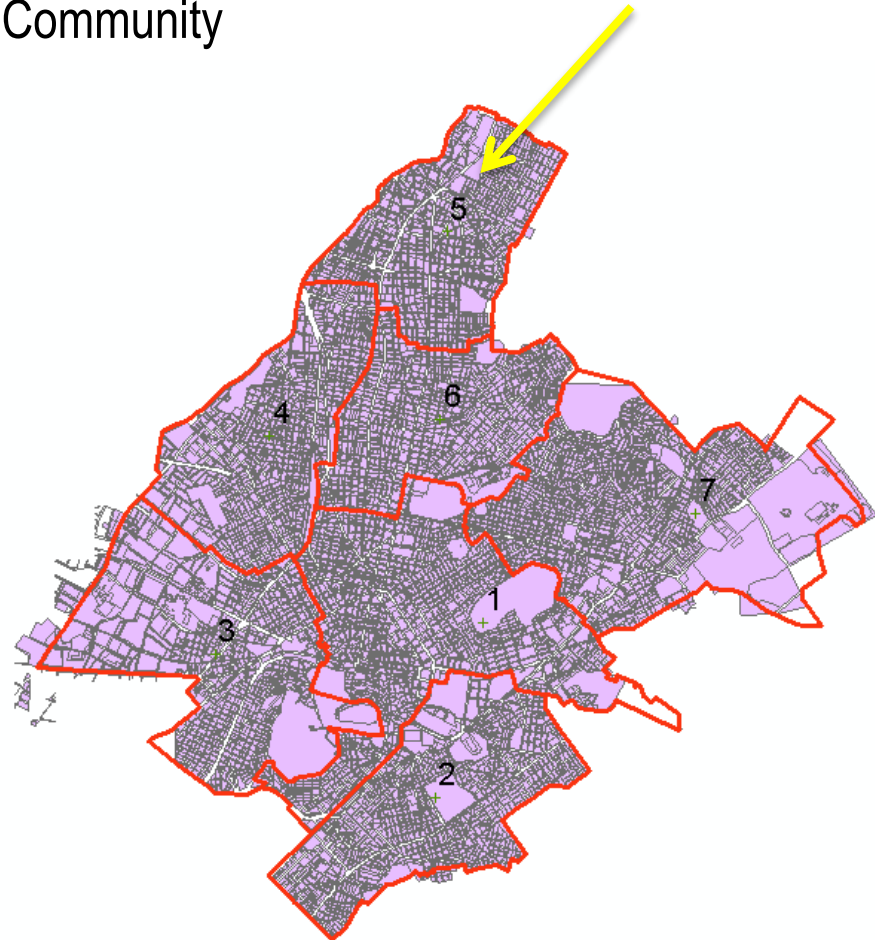
## Case study



### ■ City of Athens → 5<sup>th</sup> Municipal Community

- Probona
- Rizoupoli
- Ano Patissia
- Agios Eleftherios
- Patissia

### ■ 95.234 inhabitants



# BIOWASTE MODEL



ΕΜΕΠ



ΕΠΤΑ  
ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ




ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ



ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ

START

 [www.facebook.com/athensbiowaste](http://www.facebook.com/athensbiowaste)

# 1 MUNICIPALITY DATA AREA FOR SEPARATE COLLECTION

MUNICIPALITY DATA

WASTE  
MANAGEMENT

COLLECTION  
TRANSFER

## MUNICIPALITY DATA

1	Name of Authority	Municipality of Athens
2	Municipality	Δήμος Αθηναίων
3	Total Population (Municipality)	655.780,00
4	Area (km <sup>2</sup> )	39
5	Population Density (inh./ha)	168,30
6	No of inhabitants/household	2,50

## AREA WHERE SEPARATE COLLECTION WILL BE IMPLEMENTED

7	Separate Collectin will be implemented in the whole Municipality?	NO
		<i>for the whole Municipality</i> <i>for part of the Municipality</i>
8	Area Name	<b>5th Municipal Community</b>
9	Population	95.234
10	Households	38.094
11	Population Density (inh./ha)	168,30
12	<b>Building Characteristics</b>	<b>%</b>
	Detached houses <u>with</u> garden	5%
	Detached houses <u>with</u> garden or open car park ≤ 4 floors	20%
	High-rising buildings <u>with</u> garden or open car park > 4 floors	40%
	Buildings <u>without</u> garden or open car parks ≤ 4 floors	15%
	High-rising buildings <u>without</u> garden or open car park > 4 floors	20%
		100%
13	Tourist Activity	<b>without monthly peaks</b>
14	No. of large biowaste producers: Restaurants, Hotels, Supermarkets, Markets, Industries	150

BACK

NEXT

## 2 WASTE MANAGEMENT IN THE MUNICIPALITY

MUNICIPALITY DATA

WASTE  
MANAGEMENT

COLLECTION  
TRANSFER

### MSW GENERATION

WHOLE MUNICIPALITY

AREA FOR SEPARATE COLLECTION

1 MSW Generation Estimate (tn/year)

272.870,06

39.626,87

### WASTE MANAGEMENT

2 MSW Quantities to be separate collected and recycled (tn/year)

-

13.643,50

1.981,34

3 MSW Quantities landfilled (tn/year)

-

19.100,90

2.773,88

4 MSW Quantities to be treated as mixed waste (tn/year)

272.870,06

240.125,65

34.871,64

272.870,06

-

Type of facility

⇒ MBT (Composting | Recycling | Landfilling)

⇒ Landfilling (Biogas Recovery)

### BIOWASTE GENERATION

5 % Biowaste in MSW

44%

38%

-

6 Biowaste Generation Estimate (tn/year)

103.690,62

15.058,21

per inhabitant (kg/inh./day)

0,43

0,43

per household (tn/hh/day)

1,08

1,08

### BIOWASTE MANAGEMENT

7 Biowaste treatment technology

Composting in closed systems

BACK

NEXT

### 3 COLLECTION - TRANSFER

MUNICIPALITY DATA

WASTE  
MANAGEMENT

COLLECTION  
TRANSFER

#### MSW COLLECTION

1 MSW collection frequency

*winter or peak time*

3 collections/week	▲
4 collections/week	
5 collections/week	▼
6 collections/week	

*summer or peak period*

4 collections/week	▲
5 collections/week	
6 collections/week	▼
daily collection	

2 Routes per vehicle during winter or non peak period

1

3 Routes per vehicle during summer or peak period

1

4 Time from vehicle parking to the centre of the area in question (min)

25

#### MSW & BIOWASTE TRANSFER

5 Does the Municipality have a Waste Transfer Station?

NO

6 *If yes, distance from the area in question (km)*

7 *If yes, time from the area in question (min)*

8 Distance of the Biowaste treatment facility from the area in question (km)

20

9 Transfer time (min)

40

10 Waiting time in the facility (min)

20

11 How do you want to transfer separate collected biowaste?

**directly to the biowaste facility**

BACK

NEXT

# 4 BIOWASTE SEPARATE COLLECTION SYSTEM

## STEP 1 - BINS



### 1 Type of separate collection system

Software values	User values	Final values
KERBSIDE COLLECTION	<input type="text" value="DOOR-TO-DOOR"/> <input type="text" value="KERBSIDE COLLECTION"/>	<b>KERBSIDE COLLECTION</b>

### 2 Bins

- Kitchen caddies 10 lt (for households)
- Plastic bins 35-40 lt (exclusive external bins for households)
- Plastic bins 60 lt (kitchen bins for large producers)
- Plastic bins 120 lt
- Plastic bins 240 lt
- Plastic bins 360 lt
- Metal bins 660 lt
- Metal bins 1100 lt

38.094		<b>38.094</b>
0		<b>0</b>
75		<b>75</b>
0		<b>0</b>
1.562		<b>1.562</b>
419		<b>419</b>
0		<b>0</b>
0		<b>0</b>

### 3 Biodegradable Bags

- days for bags free-of-charge supply
- Biodegradable bags 10 lt
- Biodegradable bags 50 lt

90		<b>90</b>
3.428.424		<b>3.428.424</b>
6.750		<b>6.750</b>

BACK

NEXT



# 5 BIOWASTE SEPARATE COLLECTION SYSTEM

## STEP 2 - COLLECTION & TRANSFER SYSTEM



		Software values	User values
1	Summer or peak period months	0	
2	Biowaste collection frequency		
	<i>non peak period (number per week)</i>	5	2
	<i>peak period (number per week)</i>	5	2
3	Collection employees per vehicle (apart from driver)		
	<i>non peak period (number per week)</i>	1	1
	<i>peak period (number per week)</i>	2	1
4	Participation in the Separate Collection		
	Percentage of households-producers to receive bins	75%	
	Percentage of households-producers that have received bins and participate in separate collection	30%	
	Expected biowaste quantities to be collected (tn/year)	3.388,10	
	Percentage of the total biowaste in the area	22,5%	
	Percentage of the total biowaste in the Municipality	3,3%	

BACK

NEXT

# 6 BIOWASTE SEPARATE COLLECTION SYSTEM

## STEP 3 - VEHICLES



	NON PEAK PERIOD		PEAK PERIOD	
	Software values	User values	Software values	User values
1 Weekly quantities collected (tn/week)	70,59		70,59	
2 Collection Routes required per week	20,2		20,2	
<i>with collection frequency (number /week)</i>	2,0		2,0	
<i>with collection employees per vehicle</i>	1		1	
3 Vehicles required	3		3	
<i>capacity</i>	3		3	
<i>total vehicles</i>	3			

	CURRENT VEHICLES			
	Capacity (m3)	No. of Vehicles	Year of Construction	Fuel
4 Please, mention if the Municipality can provide existing vehicles for biowaste separate collection	6	1	2000	Diesel
	12	1	2005	Diesel
<i>Σύνολο</i>		2		

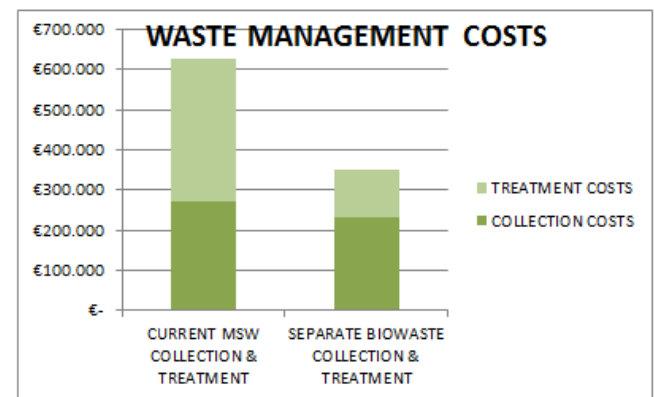
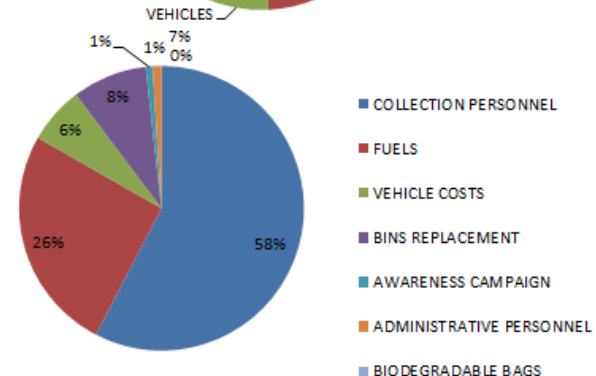
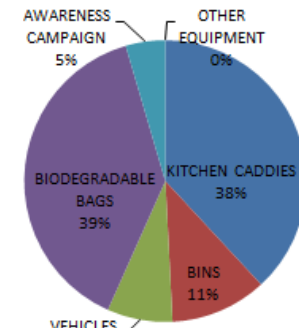
# 7 SEPARATE COLLECTION & MANAGEMENT COSTS



Investment Cost for Separate Collection		
1	KITCHEN CADDIES	304.748,80 €
2	BINS	88.466,00 €
3	VEHICLES	60.000,00 €
4	BIODEGRADABLE BAGS	310.211,91 €
5	AWARENESS CAMPAIGN	36.198,92 €
6	OTHER EQUIPMENT	- €
	<b>TOTAL</b>	<b>799.625,63 €</b>
	<i>per inhabitant</i>	8,40 €

Operational Cost (annual) for Separate Collection		
1	COLLECTION PERSONNEL	133.527,83 €
2	FUELS	59.419,36 €
3	VEHICLE COSTS	15.000,00 €
4	BINS REPLACEMENT	19.660,74 €
5	AWARENESS CAMPAIGN	1.809,95 €
6	ADMINISTRATIVE PERSONNEL	2.300,00 €
7	BIODEGRADABLE BAGS	- €
	<b>TOTAL</b>	<b>231.717,88 €</b>
	<i>per tonne</i>	68,39 €

Cost Benefit - Biowaste Management		
CURRENT MSW COLLECTION COST	271.047,77 €	
<i>Indicative collection cost for MSW per tonne</i>	80,00 €	80,00 €
CURRENT TREATMENT COST	355.750,20 €	
<i>Gate fee per tonne</i>	45,00 €	
<i>Landfill fee per tonne</i>	60,00 €	
<b>ΣΥΝΟΛΟ</b>	<b>626.797,98 €</b>	
NEW SEPARATE COLLECTION COST	231.717,88 €	
BIOWASTE TREATMENT COST	118.583,40 €	
<i>Gate fee for biowaste treatment per tonne</i>	35,00 €	
<b>TOTAL</b>	<b>350.301,28 €</b>	
COST - BENEFIT	-	276.496,70 € <b>BENEFIT</b>



BACK

NEXT

# 8 CARBON FOOTPRINT

\* only for the biowaste quantities to be collected

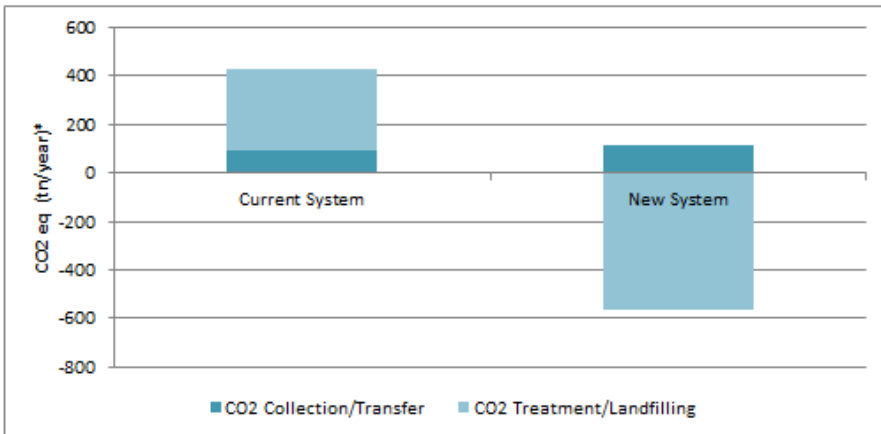
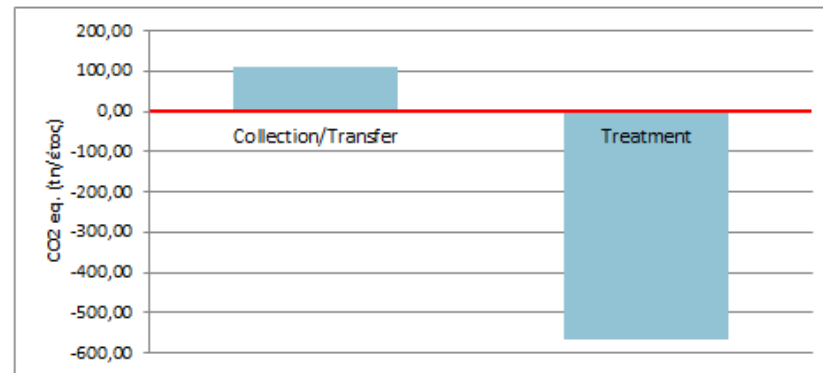
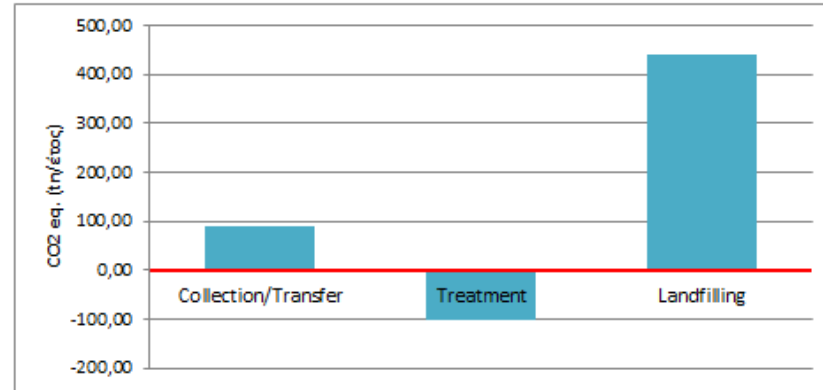


## CO2 eq Current Collection & Treatment System (tn/year)\*

1 Collection/Transfer	90,34
2 Treatment <i>MBT (Composting   Recycling   Landfilling)</i>	-99,73
3 Landfilling <i>Landfilling (Biogas Recovery)</i>	439,38
<b>TOTAL</b>	<b>430,00</b>

## CO2 eq new Collection & Treatment System (tn/year)\*

1 Collection/Treatmetn	112,09
2 Treatment <i>Composting in closed systems</i>	-565,81
<b>ΣΥΝΟΛΟ</b>	<b>-453,73</b>



BACK



THANK YOU FOR THE  
ATTENTION

*Athena Bourka*  
*Chemical Engineer MSc, EPTA S.A.*  
*aboutka@epta.gr*