



# Athens 2014

2ND INTERNATIONAL CONFERENCE  
on Sustainable Solid Waste Management



LIFE10 ENV/GR/605

## Study and assessment of segregated biowaste composting in Athens and Kifissia municipalities, Greece

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# ATHENS-BIOWASTE

## LIFE+ project

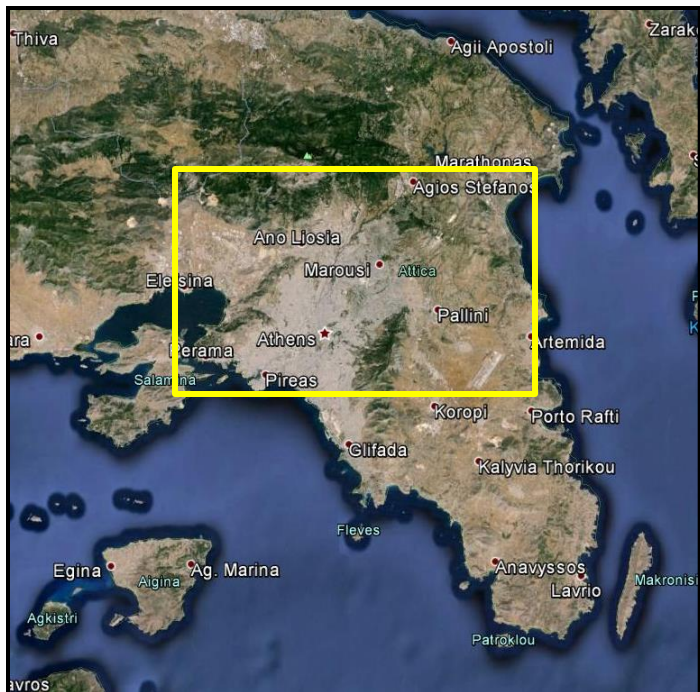


- **Project title and acronym:** «Integrated management of bio-waste in Greece – The case study of Athens, **ATHENS-BIOWASTE**»
- **PROJECT LOCATION:** Athens, Greece
- **BUDGET INFO:** 1,339,930.00 € (50% EC Co-funding)
- **DURATION: Start:** 01/09/11- **End:** 31/08/2014
- **PROJECT'S IMPLEMENTORS:**
  - **Coordinating Beneficiary:** National Technical University of Athens
  - **Associated Beneficiaries:**
    - Association of Communities and Municipalities in the Attica Region
    - EPTA – Environmental Engineers – Consultants
    - Municipality of Athens
    - Municipality of Kifissia



- ATHENS-BIOWASTE aims to establish and promote sustainable biowaste management in Greece using the municipalities of Athens and Kifissia as case study areas.
  - Separate collection systems in the Municipalities of Athens and Kifissia
  - Collection and composting of biowaste at the MBT facility of ESDKNA
  - Developing appropriate bio-waste management software tools (LCA-based & compost quality correlation model)
  - Drafting recommendations for the amendment of the current technical specifications included in Greek legislation
  - Raising environmental awareness and knowledge in citizens and other stakeholders regarding management of bio-waste

# Biowaste source separation pilot areas



## ATTICA REGION GREECE

## ATHENS & KIFISSIA MUNICIPALITIES





# Pilot areas selected in Kifissia Municipality



## NEA KIFISSIA

Population: **1189 inh**

Density: 38 inh/ha

## EKALI

Population: **1108 inh**

Density: 20 inh/ha

## KATO KHFISSIA

Population: **815 inh**

Density: 48 inh/ha

## KASTRI

Population: **409**

Density: 69 inh/ha

## 2<sup>nd</sup> expansion

## STROFILI

Population: **1500**

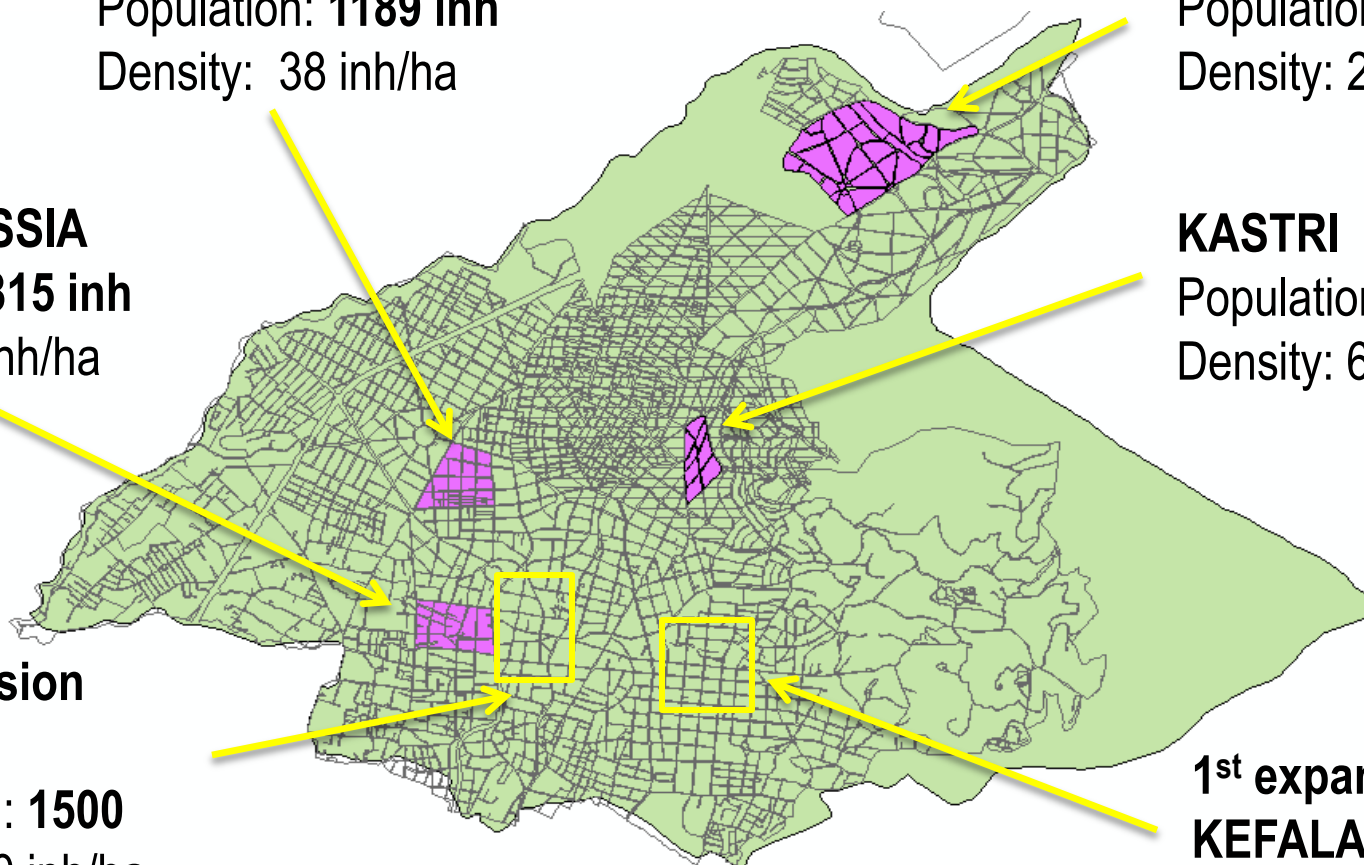
Density: 30 inh/ha

## 1<sup>st</sup> expansion

## KEFALARI

Population: **705**

Density: 41 inh/ha



# Kifissia Municipality Biowaste door to door collection system



120-360L bin for apartment blocks

Bin collection at common building area

10L bin per household  
(including biobags)



Bin collection outside the resident

35-50L for single-family detached residents

# Pilot areas selected in Athens Municipality



## 1<sup>st</sup> area KYPRIADOU

Population: **2.707 (including 2 Expansions)**

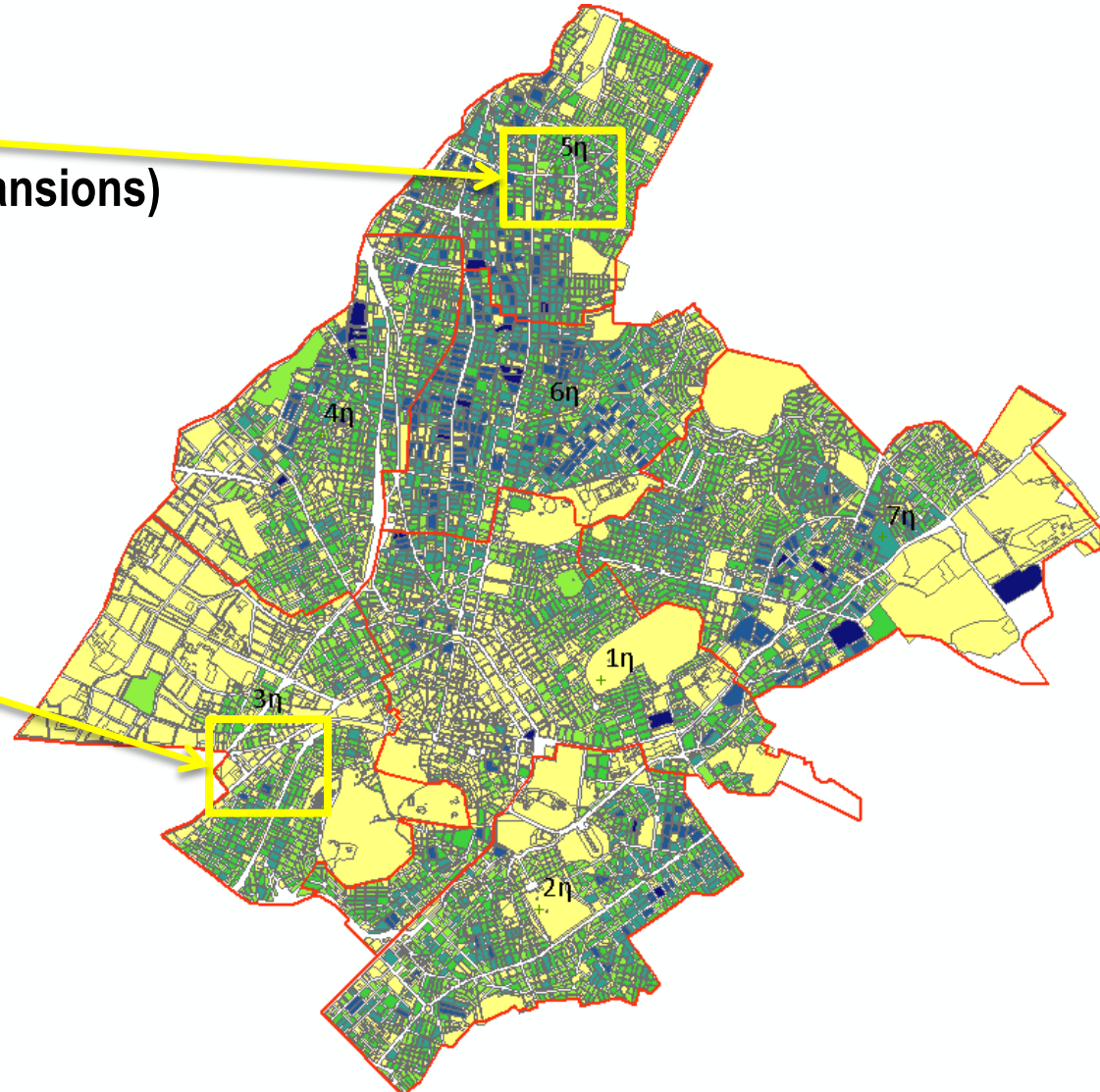
Density: 208 inh/ha

## 2<sup>nd</sup> area GAZI

Population: **1.447**

Density : 54 inh/ha

≈ 80 restaurant, bars etc



# Athens Municipality Biowaste kerbside collection system



10L bin per household  
(including biobags)

30-50L bin per bar  
restaurant etc.  
(including biobags)





# Further biowaste collection points in Athens Municipality



Armed Forces Officers Club  
(Restaurant - Food waste)



Agricultural University of Athens  
(Restaurant – Food waste)



Agricultural Floricultural Nurseries Cooperative of Attica  
(Green waste)

# Mechanical and Biological (Composting) Treatment plant in Attica Region – Treating mixed MSW operated by ESDKNA

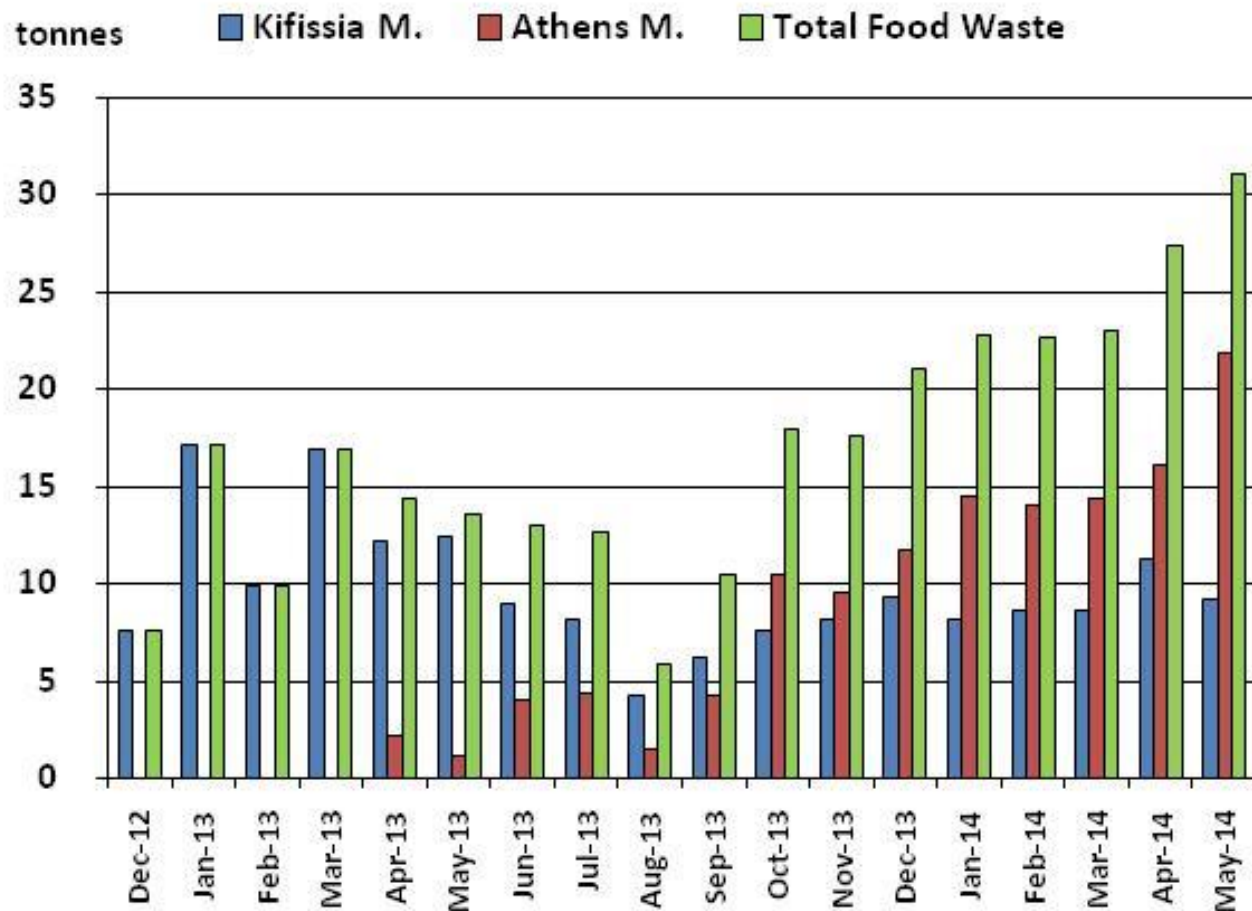


# Biowaste reception area at the MBT





# Monthly collected Food Waste at the MBT (11/2012 – 05/2014)

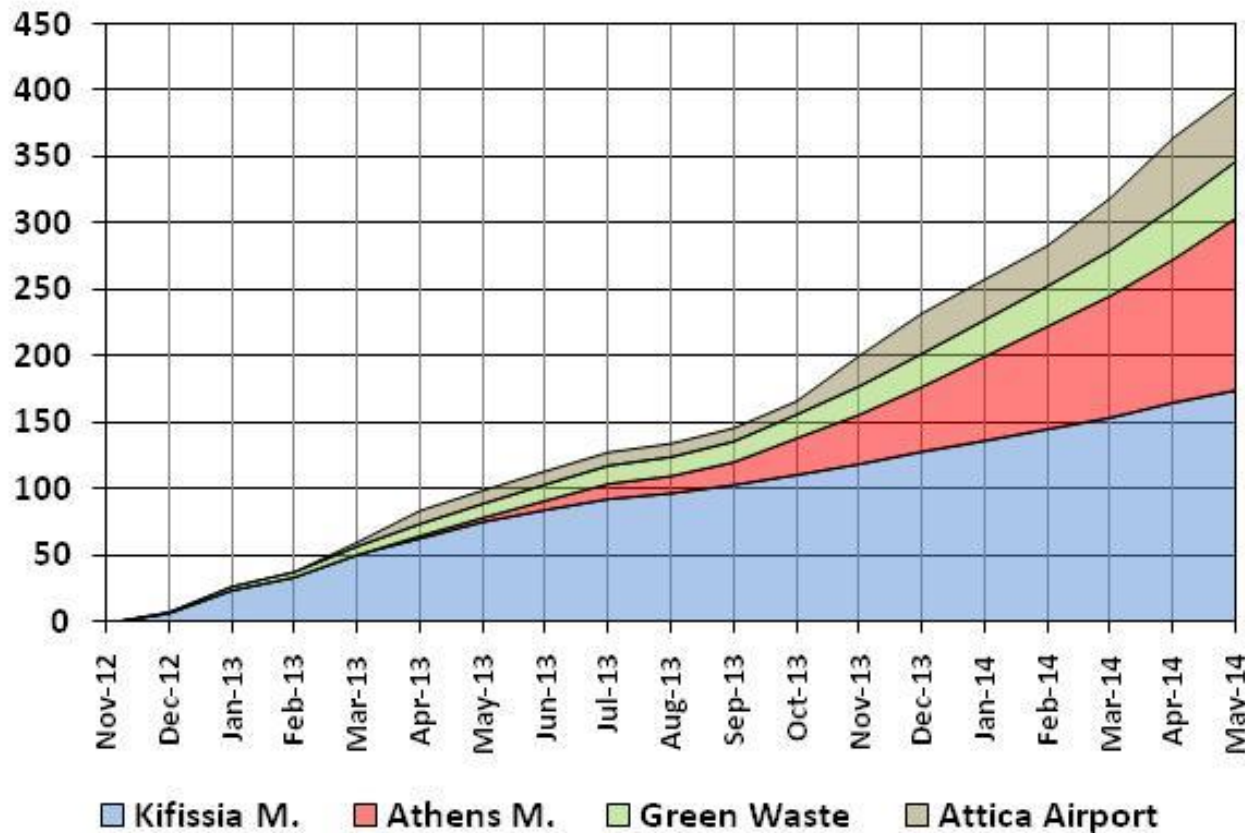




# Cumulative collected Food waste at the MBT (11/2012 – 05/2014)



tonnes

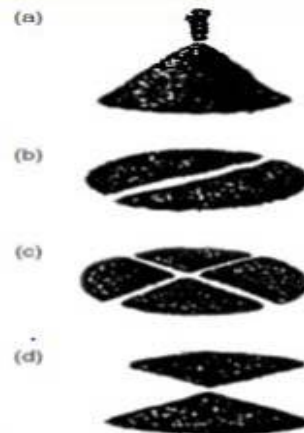


- Food Waste 305.0 tn
  - Athens: 130.1 tn
  - Kifissia: 175.0 tn
- Green Waste: 42.9 tn
- Airport Biowaste: 52.5 tn
- Total: 400 tn - May 2014

# Biowaste composition analysis



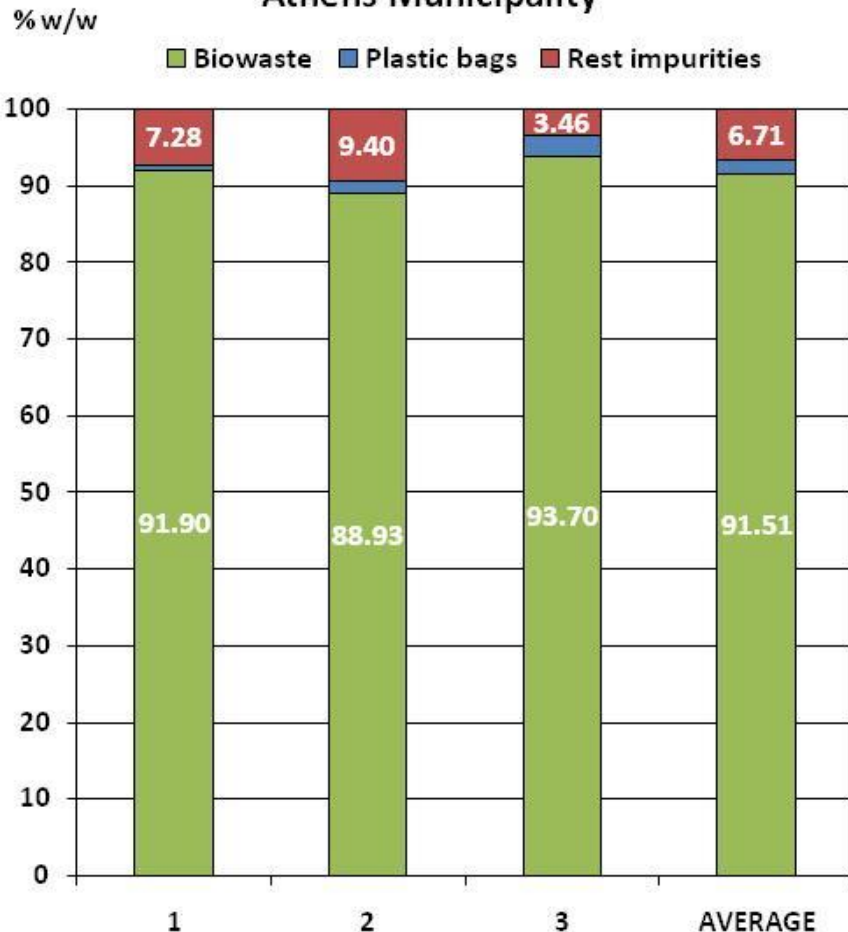
- Knowledge gap of compositional characteristics of food waste in Greece.
- Such information is of interest to a range of stakeholders such as national and local authorities, waste management companies, researchers and the public
- Coning and quartering procedure for selecting and sorting representative unprocessed waste samples in specific categories (i.e. Fruits, Vegetables, Meat etc.)



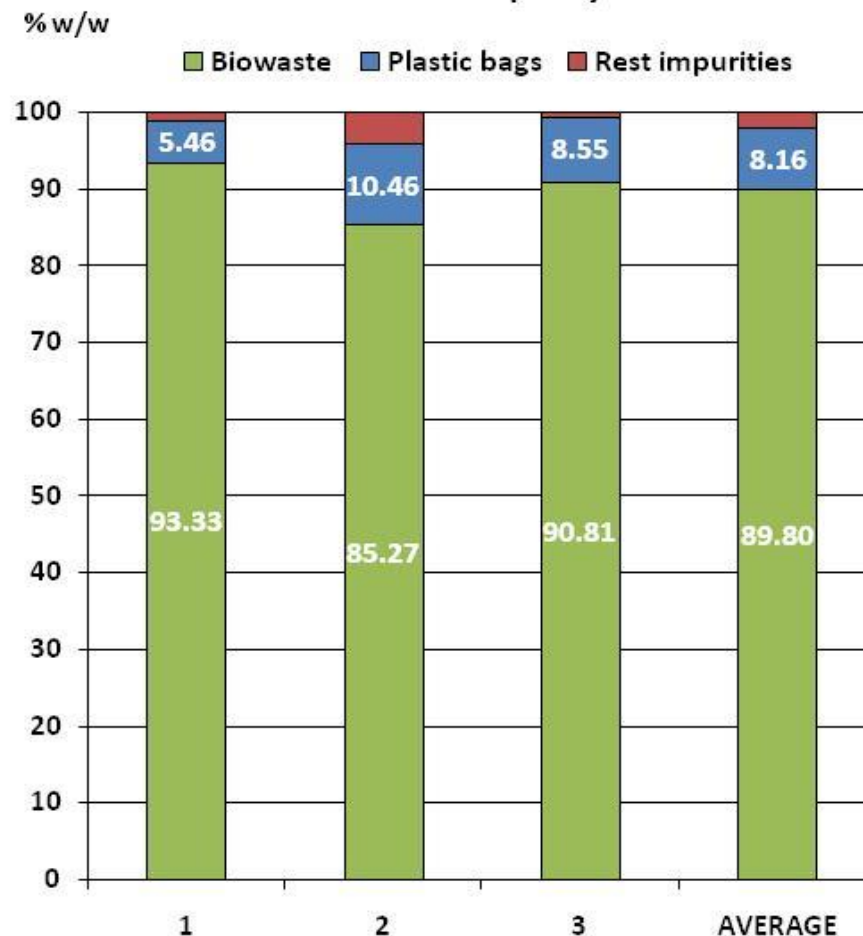
# Biowaste composition analysis in Athens & Kifissia Municipalities (1)



## Athens Municipality



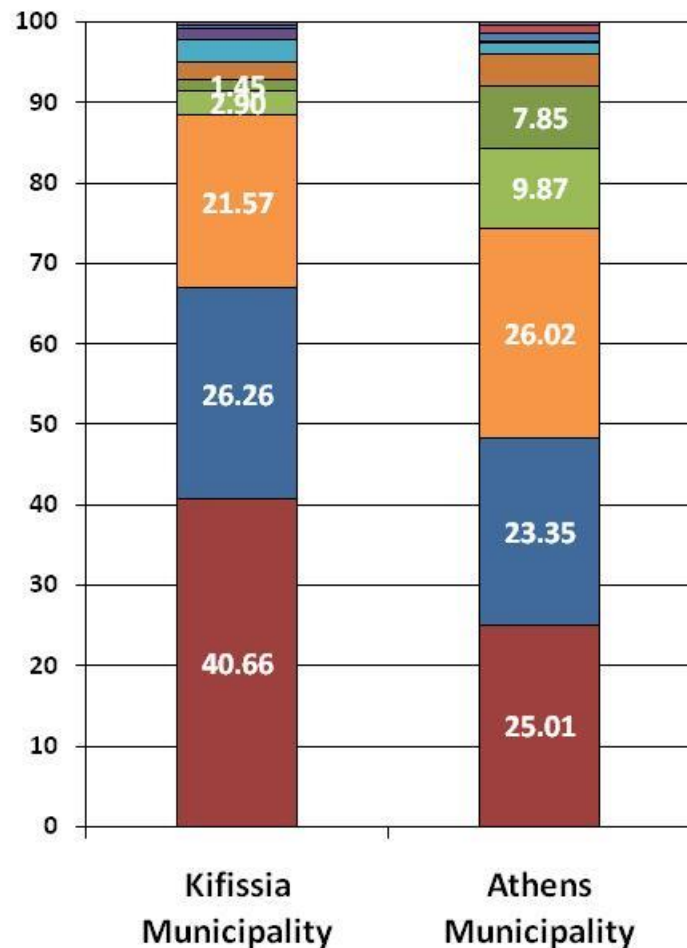
## Kifissia Municipality



# Biowaste composition analysis in Athens & Kifissia Municipalities (2)



% w/w



- Drinks (Coffee and tea bags)
- Cake, Desserts, Confectionery and Snacks
- Dairy and Eggs
- Pasta/Rice/Flour/Cereals
- Meals (homemade and preprepared)
- Garden Waste
- Meat and Fish
- Bread and Bakery
- Paper
- Rest biowaste
- Vegetables & Salads
- Fruits



# Biowaste physicochemical characteristics



Parameter	Units	Food Waste		Green Waste
		Kifissia Munic.	Athens Munic.	
pH (1/5)	-	5.09	5.31	6.2
Conductivity (1/5)	mS/cm	4.44	2.24	1.97
Water content	% f.m.	76.13	76.53	36.5
Density	g/cm <sup>3</sup> f.m.	0.53	0.54	0.19
Total Organic Carbon (TOC)	% d.m.	53.33	48.88	48.04
Organic Matter (LOI)	% d.m.	86.32	82.24	78.61
Total Nitrogen (TN)	% d.m.	1.88	1.61	1.01
TOC/TN ratio	-	28.77	34.11	52.48
Chromium (Cr)	mg/kg d.m.	0.84	0.84	NA
Copper(Cu)	mg/kg d.m.	13.69	8.47	NA
Nickel (Ni)	mg/kg d.m.	1.44	0.77	NA
Cadmium (Cd)	mg/kg d.m.	0.88	0.07	NA
Lead (Pb)	mg/kg d.m.	5.73	14.41	NA
Zinc (Zn)	mg/kg d.m.	23.89	179.70	NA

# Preparation of feedstock mixture (Food & Green waste)



- Determination of mixture of Food & Green waste
  - C/N ratio at about 30/1
  - Moisture content between 60 to 70%
- Food & Green waste quantities
  - For every 1 tn of Biowaste:
    - 880 kg Food waste
    - 120 kg Green waste (12% w/w additive)
  - For every 1 m<sup>3</sup> of Biowaste:
    - 0.67 m<sup>3</sup> Food waste
    - 0.33m<sup>3</sup> Green waste (33% v/v additive)

# Biowaste Mixing & Feeding Process



- Green waste size is reduced by using a shredding device
- Food & Green wastes are loaded manually to a conveyor system that transports them to the composting tunnel

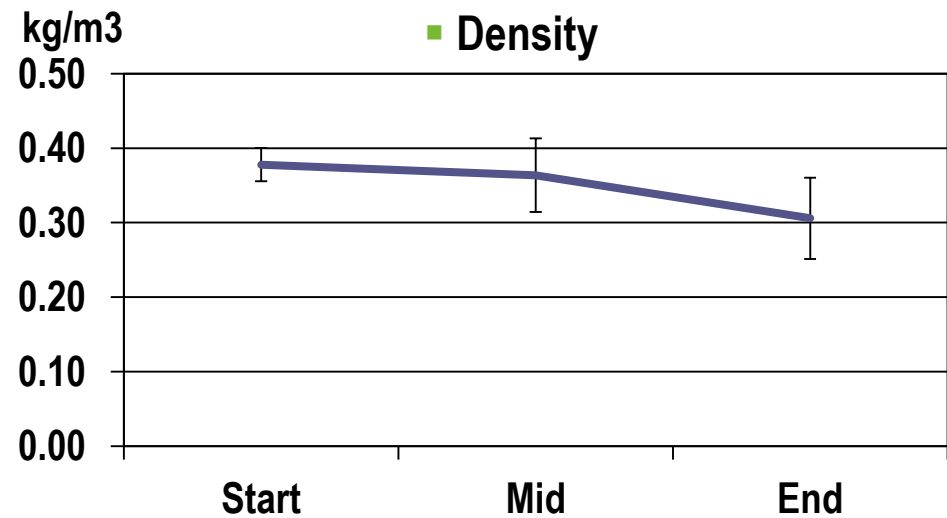
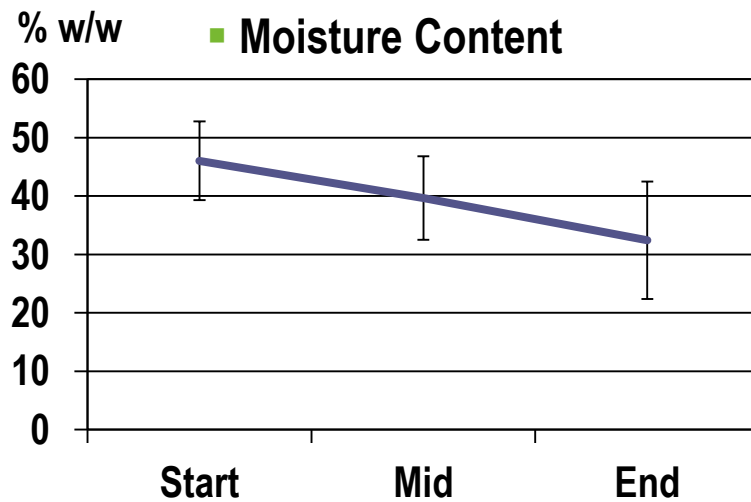
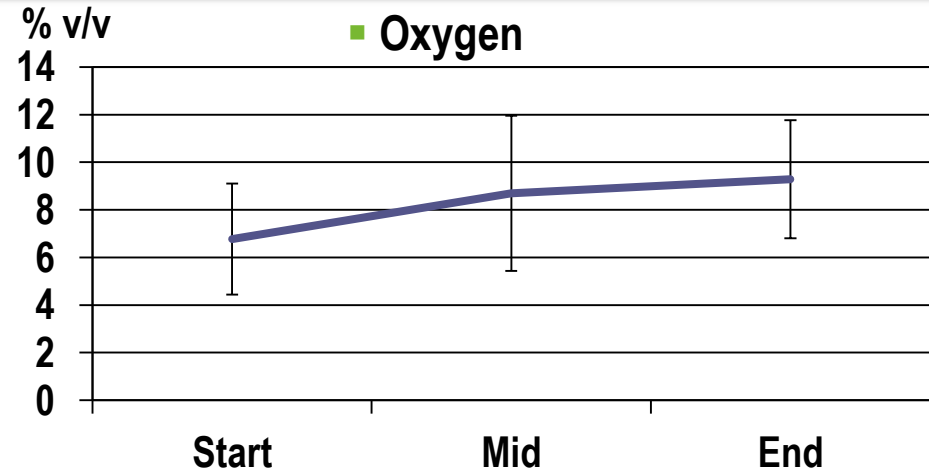
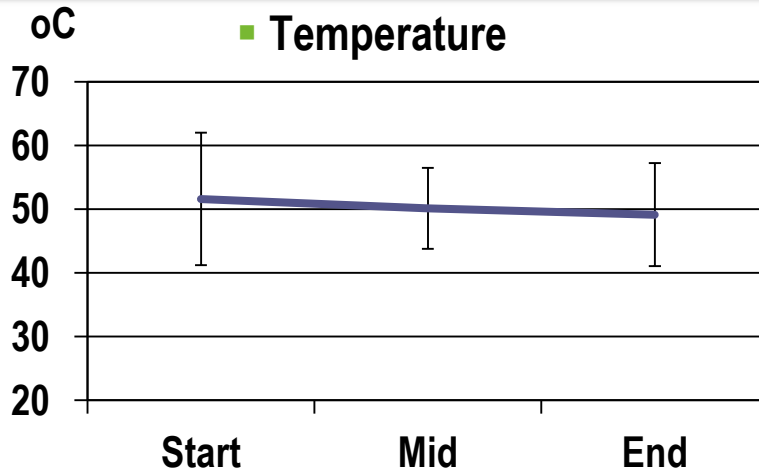




- Monitoring of biowaste composting process
  - Monitoring parameters
    - Temperature ( $^{\circ}\text{C}$ )
    - Moisture content (% w/w)
    - Oxygen content (% v/v)
  - Three measuring points along the composting tunnel
    - Start point
    - Mid point
    - End point



# Composting process monitoring



# Compost quality evaluation against EoWC

## Heavy metals



Compost source	Heavy metals concentration (mg/kg)						
	Cd	Cr <sub>tot</sub>	Cu	Hg	Ni	Pb	Zn
Source separated compost "ATHENS BOWASTE"	1.26	0.86	100.29	0.22	24.97	104.7	199.24
MBT mixed compost	0.94	33.02	214.36	1.08	47.63	182.90	433.81
End of Waste Criteria (EoWC)	1.5	100	200	1	50	120	600

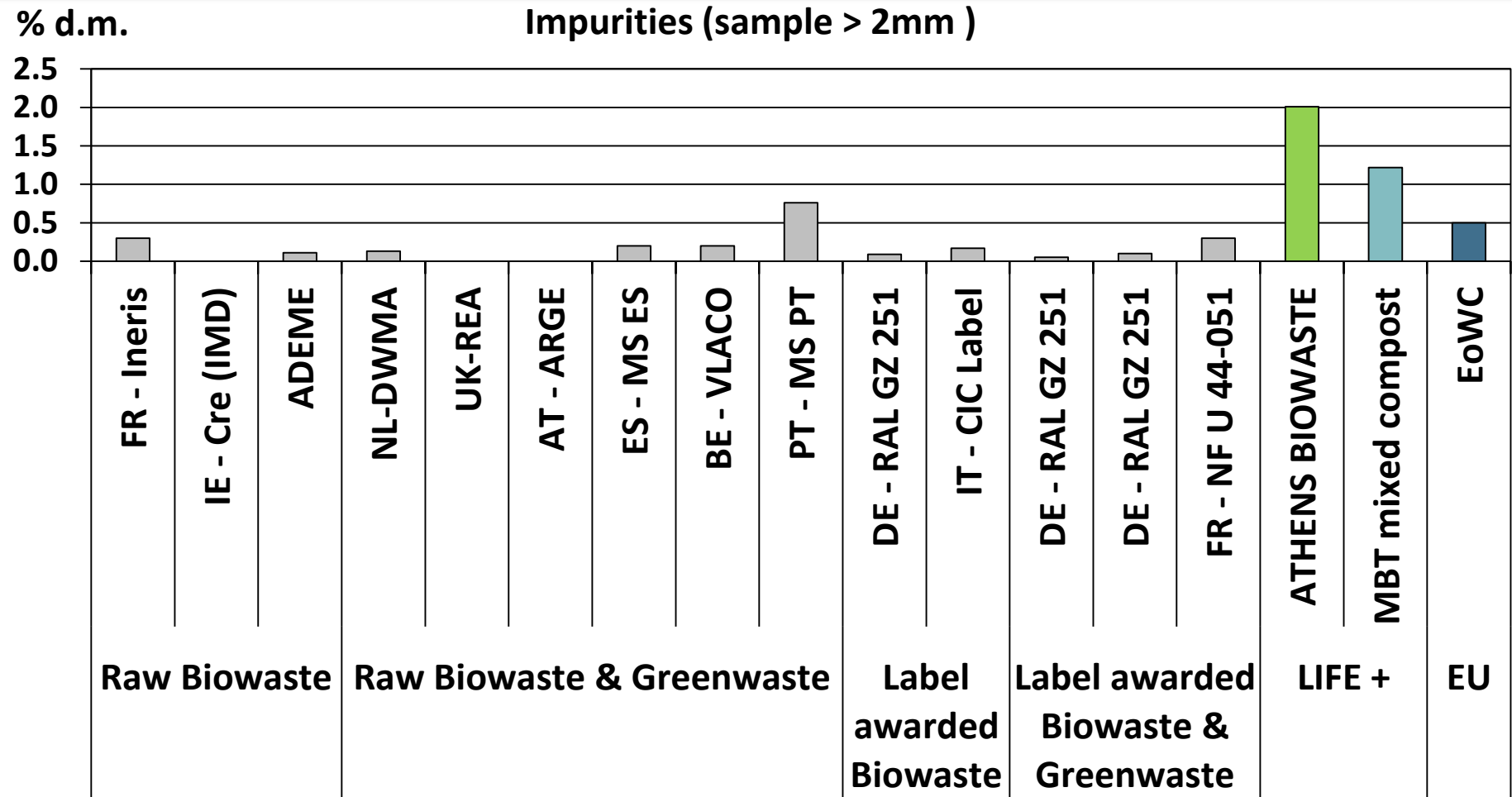
# Compost quality evaluation against EoWC

## Soil Improvement & Hygiene



Compost Quality Criteria	Parameter	EoWC	ECN	ATHENS BOWASTE
Soil improvement	Organic Matter	Min 15% d.m.		67.27±8.77 % d.m.
Hygiene (Pathogens)	Salmonella sp.	Absence in 25 g of fresh mass		0 (Absence)
	E.Coli	Max 1000 CFU per gr fresh mass	Δεν υπάρχει περιορισμός	30 CFU per gr fresh mass

# Compost quality evaluation against EoWC Impurities





# Compost quality evaluation against bibliographic references



Quality Criteria	Parameter	ATHENS BOWASTE	Bibliographic reference	
			Lower limits	Upper Limits
material properties	Moisture (% f.m.)	$31.39 \pm 12.30$	30 - 40	50 - 60
	pH	$7.87 \pm 0.60$	6.0 - 7.0	8.0 - 8.5
	Conductivity (mS/cm)	$3.06 \pm 1.88$	3.69 - 7.49	
	Density (g/cm <sup>3</sup> )	$0.33 \pm 0.08$	-	
fertilizing properties	TOC (% d.m.)	$40.33 \pm 4.89$	Related to Organic Matter content	
	TN (% d.m.)	$1.79 \pm 0.45$	0.7 - 1.8	2.0 - 4.5
	N <sub>opy</sub> (% d.m.)	$1.77 \pm 0.41$	> 80% του TN	
	TOC/TN	$22.70 \pm 5.16$	8.0 - 9.0	12.0 - 25.0



- The composting tunnel requires more feedstock to operate at its maximum capacity and to fully optimize the composting process
- Good quality source separated compost which satisfies most of biowaste EoWC
  - Heavy metals (lower than mixed compost which is currently produced at the MBT)
  - Pathogen free
  - Sufficient organic matter content
- The impurities level
  - is an issue of concern in areas where biowaste container system is used (i.e. Athens Municipality) and appropriate mechanical or manual sorting is required prior to composting.
  - not an issue in areas where door to door biowaste selection system is set up (i.e. Kifissia Municipality).

# Conclusions



- First implementation of biowaste source separation and composting scheme in Greece of such scale (targeting 10000 inhabitants in the pilot areas)
- The MBT facility can gradually receive source separated biowaste from municipalities in Attica region which
  - MBT potential capacity = 155,000 tn Biowaste per year
  - Covers 16.3% of Biowaste produced at regional level (Attica region)
  - Covers 5.8% of Biowaste produced at national level (Greece)

# Thank you for your attention!



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