

Development and implementation of a demonstration system on Integrated Solid Waste Management for Tinos in line with the Waste Framework Directive

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Abstract

The **ISWM-TINOS** project entitled “Development and implementation of a demonstration system on Integrated Solid Waste Management for Tinos in line with the Waste Framework Directive”, LIFE10 ENV/GR/000610, is a project co-funded by LIFE+ (Environment Policy & Governance 2008). The project is implemented in Tinos Island, Greece. The main objective of the project is the development and evaluation of an Integrated Solid Waste Management (ISWM) scheme for solid waste in Tinos in line with the Waste Framework Directive 2008/98/EC. The ISWM scheme will include the separate collection of recyclables (glass, metal, paper, plastic), as well as of biowaste (mainly kitchen waste) and the subsequent treatment of the collected biowaste with aerobic treatment (composting). The pilot scheme will be set for a sample of approximately 100 households located in Tinos Island. Furthermore, the anaerobic digestion of the biowaste will be investigated at the experimental hall of the University of Verona in Treviso (Italy) with “synthetic” biowaste. The present paper is mainly focused on the presentation of the project as well as on the results from the preparatory activities implemented in the framework of Action 1.

Keywords

Integrated Solid Waste Management, Waste Framework Directive, Recyclables, Biowaste, Composting

Overview of the ISWM-TINOS project

ISWM-TINOS is mainly focused on the promotion of the concept of Integrated Solid Waste Management by the development, the demonstration and the implementation of an ISWM System for approximately 100 households of Tinos Island (Greece) in line with the provisions of Directive 2008/98/EC.

The ISWM System will include: (a) the setting of a scheme for the separate collection of recyclables (glass, metal, paper, plastic) as well as of biowaste and (b) the aerobic treatment (composting) of the collected biowaste through a prototype unit which will be designed, constructed and finally set to Tinos Island. The setting of the system will be based on an Integrated Solid Waste Management Plan developed in the framework of the project and for the specific needs of the selected participating community of Tinos. Moreover, it is in the scope of the project to investigate the possibility of Anaerobic Digestion treatment of biowaste as an alternative of composting treatment. To this end, the anaerobic digestion of the biowaste will be investigated at the operating unit at the premises of the University of Verona in Italy using biowaste which shall acquire the same characteristics with biowaste generated and collected in the selected area of Tinos Island.

The Municipality of Tinos is the coordinating beneficiary and the Associated Beneficiaries are:

- 1) The National Technical University of Athens in Greece,
- 2) The University of Verona in Italy,
- 3) The Institute for Solid Fuels Technology and Applications of the Centre for Research and Technology Hellas.

The foreseen Actions for the implementation of the project are presented in Table 1. More information on the project can be found on the project’s web-page: <http://uest.ntua.gr/iswm-tinos/>.

Table 1: Actions of ISWM-TINOS project

Action	Name of the Action
1	Preparatory Activities
2	Planning and designing an ISWM system for the Municipality of Tinos
3	Development of the ISWM system in Tinos/ Setting of the scheme for the separation of MSW at source/ Construction & installation of the composting unit
4	Implementation of the ISWM system in the Municipality of Tinos
5	Overall evaluation of the ISWM system/ Suggestions for full-scale implementation
6	Dissemination Activities
7	Project management by TINOS
8	Monitoring and Evaluation
9	Networking with other projects
10	After-LIFE communication plan

Action 1 includes preparatory activities that will produce practical recommendations and information to be used during the implementation phase of the project. Such information is related to: (i) the identification of needs and review of existing systems concerning MSW management in Tinos, (ii) the examination, review and analysis of the Greek and EU waste management policies and legislative framework and (iii) the review on success stories of applied Integrated Solid Waste Management systems for municipal solid waste and on evaluation methodologies of such systems. In the framework of Action 2, the conduction of the ISWM plan for a preselected community as well as the design of a prototype composting unit are envisaged. The composting unit will be constructed and installed during the third action of the project. Action 3 also includes the setting of the scheme to the participating community i.e. the placing the placing of the collection bins for recyclables (plastic, paper, glass and metal) and for the collected biowaste. Once the ISWM system (setting of the separate collection system and construction and installation of the composting unit) has been successfully developed, Action 4 will take place. Action 4 includes the implementation of the ISWM system for a certain period of time in Tinos while in parallel the anaerobic degradation of a synthetic waste with similar characteristics will be studied in the experimental hall of Verona in Italy. Outcomes from Action 4 will be used for the overall evaluation of the ISWM system for the investigation of the possibility of full-scale implementation in the Island of Tinos (Action 5). Action 6 includes a variety of dissemination activities that shall take place in order to disseminate the project actions and results to all interested parties, stakeholders, target groups and the public. Action 7 is related to the Project Management while Action 8 to the Monitoring and Evaluation of the project. The Networking Action (Action 9) includes all the activities related to exchange of information with other relevant projects. Finally, an After-LIFE communication plan is foreseen as the last Action (Action 10) of the project.

Progress so far

Examination, review and analysis of the Greek and EU waste management policies and legislative framework

In the framework of Action 1, the examination, review and analysis of the Greek and European waste management legislative framework has taken place. In particular, the collected information has been categorised into three groups: (a) Framework Legislation on Solid Waste, (b) Legislation on Waste Management Operations and (c) Legislation on Packaging Waste and on Specific Waste Streams. The aforementioned categorization was applied for both European and Greek legislation in order to facilitate the assessment of convergence. The main findings of this work are summarized below.

Over the last 30 years, European waste management policy has been progressively established through a series of Environmental Action Plans (EAPs) and a framework of legislation, including Directives, Regulations and Decisions, aiming at eliminating negative environmental and health impacts and creating an energy and resource-efficient economy. The most direct form of European law is the Regulation which has binding legal force for every Member State, on a par with national laws. As a result, National Authorities are not obliged to take further action in order to incorporate European Regulations into national legislation. On the other hand, for the case of Directives, National Governments of Member States must take action in order to transpose the Directives into their national legislation. The same applies for European Decisions. Greece, as a Member State, is obliged to be in line with the European legislative framework. In Greece, the harmonization of European legislation is implemented through Laws, Presidential Decrees or Ministerial Decisions. The existing EU and Greek legislation as well as the relation between them are presented in Table 2.

Table 2: EU and Greek Legislation on solid waste - Convergence

Category	<u>European Legislation</u>		<u>Greek Legislation</u>		
	Date	Title	Date	Title	
Framework Waste Legislation	WFD	2008	2012	Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance)	Law 4042/2012 - Protection of the environment through criminal law - Transposition into national law of Directive 2008/99/EC – Framework for the production and the treatment of waste - Transposition into national law of Directive 2008/98/EC – Arrangement of issues related to the Ministry of Environment, Energy and Climate Change
	List of waste	2000	2003	Commission Decision 2000/532/EC of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Directive 91/689/EEC on hazardous waste as amended	JMD 50910/2727/2003 - Measures and terms for the management of solid waste. National and Regional Management Planning
			2012		Law 4042/2012 - Protection of the environment through criminal law - Transposition into national law of Directive 2008/99/EC – Framework for the production and the treatment of waste - Transposition into national law of Directive 2008/98/EC – Arrangement of issues related to the Ministry of Environment, Energy and Climate Change
Shipments of waste	2006	Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste as amended		Directly applicable	
Legislation on Waste Management Operations	Landfill	1999	2002	Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste as amended	JMD 29407/3508/2002 - Measures and terms for landfilling of waste
	Incineration	2000	2005	Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste	JMD 22912/1117/2005 - Measures and terms for the prevention and reduction of environmental pollution and the incineration of waste
	Port Reception facilities	2000	2009	Directive 2000/59/EC of the European Parliament and of the Council of 27 November 2000 on port reception facilities for ship-generated waste and cargo residues - Commission declaration as amended	JMD 8111.41/09/2009 - Measures and conditions for port reception facilities for waste generated by ships and cargo residues into compliance with the provisions under Directive 2007/71/EK.

Category		European Legislation		Greek Legislation	
		Date	Title	Date	Title
Legislation on Specific Streams	Sludge	1986	Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture	1991	JMD 80568/4225/1991 - Measures, terms and limitations for the use of sludge coming from household and domestic wastewater treatment in the agriculture
	Packaging Waste	1994	European Parliament and Council Directive 1994/62 of 20 December 1994 on packaging and packaging waste as amended	2001	Law 2939/2001 - Packaging and alternative management of packaging and other products - Establishment of the National Organization for Recycling of Packaging and other Products
				2007	JMD - 9268/469/2007 - Amending of the qualitative targets for recovery and recycling of packaging waste according to article 10 of Law 2939/01, as well as to other provisions of this Law, in accordance with Directive 2004/12/EC on packaging and packaging waste, of the Council of 11 February 2004
Legislation on Specific Streams	ELVs	2000	Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles as amended	2004	PD 116/2004 - Measures, terms and program for the alternative management of end of life vehicles, of spent spare parts and catalytic converters disabled in compliance with the provisions of Directive 2000/53/EC
				2012	JMD 15540/548/E103/2012 - Amend paragraph II of Article 18 of Presidential Decree 116/2004 (81/A) in compliance with the provisions of Directive 2004/37/EC amending Annex II to Directive 2000/35/EC of the European Parliament and Council on end-of-life
	WEEE	2002	Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment as amended	2004	PD 117/2004 - Measures, terms and program for the alternative management of waste electrical and electronic equipment, in compliance with the provisions of Directives 2002/95 "on the use of certain hazardous substances in electrical and electronic equipment" and 2002 / 96 "on waste electrical and electronic equipment"
	Batteries	2006	Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries & accumulators repealing Directive 91/157/EEC as amended	2010	JMD 41624/2057/E103/2010 -Measures, terms and program for the alternative management of spent batteries and accumulators in compliance with the Directives, 2006/66/EC and 2008/103/EC
	Waste oil	2008	Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives	2004	PD 82/2004 - Establishment of measures and procedures for the management of waste oils
Demolition	2008	Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives	2004	JMD 36259/1757/E103/2010 - Measures, terms and programs for alternative waste management from excavation, construction and demolition	

Based on the assessment of collected information, Greek legislation on solid waste is in line with the respective European. By the recently published of Law 4042/2012: *Protection of the environment through criminal law - Transposition into national law of Directive 2008/99/EC – Framework for the production and the treatment of waste - Transposition into national law of Directive 2008/98/EC – Arrangement of issues related to the Ministry of Environment, Energy and Climate Change (Official Gazette 24/A/13.2.2012)*, the Waste Framework Directive (2008/98/EC) has been transposed into national legislation. Consequently, European legislation under the three basic categories has been successfully incorporated into the national legislation [1].

Identification of needs and review of existing systems concerning municipal solid waste management in Tinos

In the framework of Action 1, the existing situation regarding solid waste management in Tinos and the identification of needs have been reviewed. The study was mainly focused on the collection and further assessment of data concerning produced quantities and current practices of treatment for Municipal Solid Waste (MSW) as well as for specific waste streams such as Waste of Electrical and Electronic Equipment (WEEE), spent portable batteries and accumulators, End of Life Vehicles (ELVs), used tires etc. The main findings of the implemented work are presented below.

Tinos is a Greek Island which belongs in the South Aegean Prefecture (SAP) and is one of the Cyclades islands, located in the Aegean Sea. According to the Kallikrates Program the Municipality of Tinos is divided into three Municipal Units (MU) i.e.: (1) the MU of Exomvourgo, (2) the MU of Panormos and (3) the MU of Tinos. The capital of the Island is the city of Tinos, while the historical capital is the Panormos village. Based on the temporary results of 2011 census of Greece, the permanent population of the island is 8,590 inhabitants.

The solid waste management of Tinos is covered by the Regional Solid Waste Management Plan (RSWMP) of SAP. The first RSWMP of SAP has been approved by the South Aegean Prefecture in June 2002 and it was mainly foreseen the integration of the RSWMP of Dodecanese and of the RSWMP of Cyclades into one RSWMP. In 2005, a study for the first revision of the approved plan was conducted. The approval of the first revision was issued in 24 April 2008 by the General Secretary of the Prefecture. In the end of 2008, a new study for the second revision of the RSWMP of SAP was conducted but the approval has not been issued yet. The approved RSWMP of SAP, foresaw the construction of a sanitary landfill for the safe disposal of MSW generated in Tinos while in the second revision, the source separation of MSW and the composting of the collected biowaste in a closed vessel were proposed.

Based on the latest available data, in 2008 the production of MSW from the permanent population of the island was estimated to be 4,314 tn/year while 402 tn/year of MSW were generated by seasonal population. Therefore, the contribution of the temporary population in the generation of MSW was approximately 9%, depicting seasonal variations in MSW generation between winter and summer period. During winter, the accessibility to the island is difficult due to the low frequency of ships and to the dependency on weather conditions while in the summer time the island is visited by a high number of tourists. Regarding waste management, the lack of appropriate waste treatment facilities in the island resulted in the operation of uncontrolled landfills. In December 2011, the contest concerning the study for the design of a sanitary landfill site which will cover the needs of the entire island for safe waste disposal was launched. Moreover, the Municipality of Tinos has proceeded to the closure of active uncontrolled landfills and to the gradually rehabilitation of inactive landfills. The construction and operation of the sanitary landfill in Tinos in conjunction with the closure and rehabilitation of uncontrolled landfills is expected to highly contribute to the protection of human health and the environment.

The collection and treatment of WEEE in Tinos is covered under contract of the Municipality of Tinos with an approved system for this reason. In order to collect WEEE, two collection points have been created; the first has been set to the MU of Tinos while the second is located to the MU of Exomvourgo. Moreover, 20 cardboard boxes for the collection of lamps have been placed throughout the island. In 2010, in total approximately 34.4 tn of WEEE were collected in Tinos. The collected quantities were shipped to appropriate treatment facilities. Regarding spent portable batteries, in 2011 the total collected amount was 0.80tn. In Tinos there is no collection point for ELVs and as a result the holder and/or owner shall deliver vehicles considered as waste to Siros, Paros or Attica. Based on official data in 2011, 56 ELVs were recycled for the case of Tinos. Finally, used tires are collected to 13 collection points in the island. In 2011, 40.4 tn of used tires were collected and sent for appropriate treatment in Tinos [2].

Development of the Integrated Solid Waste Management Plan for the Municipality of Tinos

In the framework of Action 2, prerequisite activities for the development of the Integrated Solid Waste Management System to a preselected community of approximately 100 households will be implemented. To this end, the conduction of an ISWM Plan for the treatment of MSW as well as the design of the prototype composting unit are envisaged. For the conduction of the plan the following steps have been followed.

- *Selection of the community participating in the ISWM System*

The selected community for the development of the ISWM System in Tinos Island is Pyrgos community. Pyrgos community is the only consistent and distinct community in Tinos Island that acquires a population of approximately 400 inhabitants. It has a homogeneous population and permanent population for all the months of the year. Moreover, the inhabitants have recent experience in managing local affairs and relevantly high participation rates and cooperation are generally anticipated.

- *Identification of the need for ISWM in the selected community*

The identification of the need for implementation of integrated solid waste management is based on the findings of the existing environmental policy in Greece and EU in regard to MSW management objectives and on the existing situation in the examined area (Pyrgos) in regard to MSW management.

- *Establishing quantitative objectives for the selected MSW streams in the area under examination*

- *Assessment of the capability of applying MSW source separation methods for the area under examination*

The investigation of the best available option for the deployment of a MSW source separation scheme in Pyrgos considered: (a) the MSW streams that need to be separately collected, (b) the characteristics and the effectiveness of each source separation method and (c) the characteristics of the selected community

- *Planning of the MSW source separation and treatment scheme*

For the planning of the source separation and treatment scheme for the selected community, the following were determined:

- i. The type, number and placement of bins/bags which are required for the effective and efficient source separation of MSW.
- ii. The conditions of the collection, transportation and temporal storage of source separated MSW considering the existing infrastructure, equipment (vehicles, routing, collection frequency etc) and public perception.
- iii. The site where the composting unit will be installed for the effective treatment of the separately collected biowaste.
- iv. The trading options of (a) the produced compost and (b) the separately collected dry recyclables namely paper, glass, plastic and metal.

- *Planning of the public awareness of the source separation scheme.*

Conclusions

ISWM-TINOS aims at the development and demonstration of an Integrated Solid Waste Management System for MSW at a selected community in Tinos Island. The selected community is Pyrgos Village which is located at the Municipal Unity of Panormos. The ISWM-System, which will be developed in Action 3, will include: (a) the separate collection of recyclables and of biowaste, based on the ISWM-Plan and (b) the aerobic treatment of biowaste in a closed composting unit. Based on the findings from the completion of Action 1, the appropriate legislative framework for the application of integrated waste treatment solution exists at national level. Moreover, the results from the capturing of the existing solid waste management situation in Tinos island highlighted that the development and application of a rational integrated system is imperative and of most importance in order to contribute to the effective and sustainable management of MSW. It is expected that the development and the demonstration of the ISWM-System will provide insight on how the ISWM system can be implemented in full-scale and simultaneously to reinforce its implementation in Tinos Island and in other Greek Islands that face solid waste management problems.

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