



## Developing a holistic strategy for integrated waste management within municipal planning: Challenges, policies, solutions and perspectives for Hellenic municipalities in the zero-waste, low-cost direction

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### ABSTRACT

The present position paper addresses contemporary waste management options, weaknesses and opportunities faced by Hellenic local authorities. It focuses on state-of-the-art, tested as well as innovative, environmental management tools on a municipal scale and identifies a range of different collaboration schemes between local authorities and related service providers. Currently, a policy implementation gap is still experienced among Hellenic local authorities; it appears that administration at the local level is inadequate to manage and implement many of the general policies proposed; identify, collect, monitor and assess relevant data; and safeguard efficient and effective implementation of MSWM practices in the framework of integrated environmental management as well. This shortfall is partly due to the decentralisation of waste management issues to local authorities without a parallel substantial budgetary and capacity support, thus resulting in local activity remaining often disoriented and isolated from national strategies, therefore yielding significant planning and implementation problems and delays against pressing issues at hand as well as loss or poor use of available funds. This paper develops a systemic approach for MSWM at both the household and the non-household level, summarizes state-of-the-art available tools and compiles a set of guidelines for developing waste management master plans at the municipal level. It aims to provide a framework in the MSWM field for municipalities in Greece as well as other countries facing similar problems under often comparable socioeconomic settings.

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### 1. Introduction

Local authorities (LAs) of the first level, the municipalities and communities, have a key role to play in supporting changes towards sustainable development. They are responsible for infrastructure development, public procurement and waste management, as well as education, social welfare and physical planning. Due to their key supervising role in various systems at the local level, LAs maintain a key position in supporting sustainable development but the often segmented local approach to prob-

*Abbreviations:* CAMS, collective alternative management systems; EMAS, eco-management and audit scheme; EOL, end-of-life; EU, European Union; EWC, European waste catalogue; GIS, geographical information system; ISO, International Standards Organization; LA, local authority; MHHW, municipal household hazardous waste; MSW, municipal solid waste; PAYT, pay as you throw; PPP, polluter-pays-principle.

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lem solving is frequently proven to be inadequate when it comes to designing and implementing large-scale projects. Currently the focus of municipal solid waste (MSW) management from Hellenic LAs is still mainly on waste collection, often putting waste treatment or disposal at a second priority, a task which is currently undertaken by the newly formed second level LA. The present paper proposes a comprehensive framework for streamlining the role of LAs towards adoption of waste reduction targets, promotion of source separation and agreements/alliances with a vision to zero-waste LA. The role of the private sector in MSW management planning issues, drawing up a waste management strategy for consultation and implementation, will allow LAs to benefit from economies of scale and contemporary available tools.

### 2. Systemic approach

The waste management problem in the EU is characterized by increasing per capita production of waste materials, the need for

high levels of investment in physical infrastructure (incinerators, recycling facilities and landfills), institutional barriers, a wide range of stakeholders and a dynamic policy arena. The Waste Electrical and Electronic Equipment and Landfill Directives are two instruments aimed at reducing the amounts of biodegradable and elect(ron)ic waste being landfilled (Shmeleva and Powell, 2006). The waste stream itself varies in composition over time and space with seasonal and long-term changes in quantities of various materials, and the market for ‘recycled’ materials is characterized by uncertain demand and fluctuating prices. Strategic decision-making for waste is a complex problem in which the ideal solution looks very different depending on the analyst’s standpoint. From the LA point of view, the best solution would be to eliminate waste production and remove the need for any waste service provision in the first place, while from the waste industry view, maximizing the disaggregation of waste streams and ensuring available quantities of pre-sorted waste over time to ensure survival of the industry would be the desired pathway. However, little work to date has been carried out on the ways in which LAs are responding to the new agenda being set by the European Union (EU). A systematic examination of the main types of alliances formed around MSW management activities includes collection, transportation and disposal of MSW, as well as collection, trade, reuse and recycling of recyclables. The rationalization of MSW management in Greece requires the establishment of management schemes that ensure the safe and systemic collection, economically viable logistics and efficient/effective waste management services at all levels. LAs are a vital part of the integration mechanism of the national strategy for sustainable waste management (Hellenic Republic, 2000) that seeks to reduce the quantity of waste produced and make the best use of it. Waste management authorities have a vital role to play in moving towards the performance targets set by the EU waste strategy. Association and co-operation among them and private sector enterprises is essential in developing fully integrated solutions which minimize economic costs and maximize environmental benefits (Phillips et al., 1998; Read, 1999; Slater et al., 2006). While all cities desire low-cost, efficient and environmentally effective MSW management, it is generally acknowledged that developing economies are lagging behind their developed counterparts in this aspect. Common causes for the lack of waste minimization practices in developing econo-

mies are rapid urbanization, a relatively uneducated public on sustainable consumption practices, non-implementation of the polluter-pays-principle (PPP), monitoring and enforcement inefficiencies, as well as lack of corporate social responsibility and sustainable production. Limited financial resources in providing adequate waste infrastructure and inadequate institutional capacity in deterring defective behaviour are also parts of the problem (Agamuthu, 2003). Recycling is based today largely on the principle of extended producer responsibility (EPR), which has led to administrative structures, being authorized intermediaries between waste generation and the recycling industry (Masarutto, 2007). The Hellenic State has defined sufficiently the legislative and political framework for MSW management, in the frame of related EU legislative approaches. The 4R (reduce-reuse-recycle-recover) concept is well promoted by the “National Planning of SWM” (Hellenic Republic, 2000), constituted of two Joint Ministerial Decisions, legislated in 1997 and 2000, respectively. The objectives of this planning address national needs, demands and priorities regarding the minimization of MSW production, focusing among others at the establishment of contemporary and integrated programs and plants concerning both recycling and sanitary landfilling, promotion of source separation programs and the establishment of a communication strategy for the promotion of the 4R-concept. For implementing the MSW management options, LAs should also be capable of co-operating with several governmental or non-governmental schemes and systems of public and private sector (cf. Fig. 1).

It has already been noted (Baud et al., 2001) that, in order not to compromise the current potential for future actions, MSW management needs to work towards the following goals promoting sustainability:

- Waste collection (involving waste bins allocation and collection routing) optimisation using operations research tools and geographical information systems;
- Waste production minimization (involving customized design and implementation of fair charging systems);
- Material reuse and recycling promotion (as well as energy recovery);
- Monitoring of environmental performance in the context of offering incentives, generating motivation, invoking willingness, mobilizing participation and raising awareness, also through

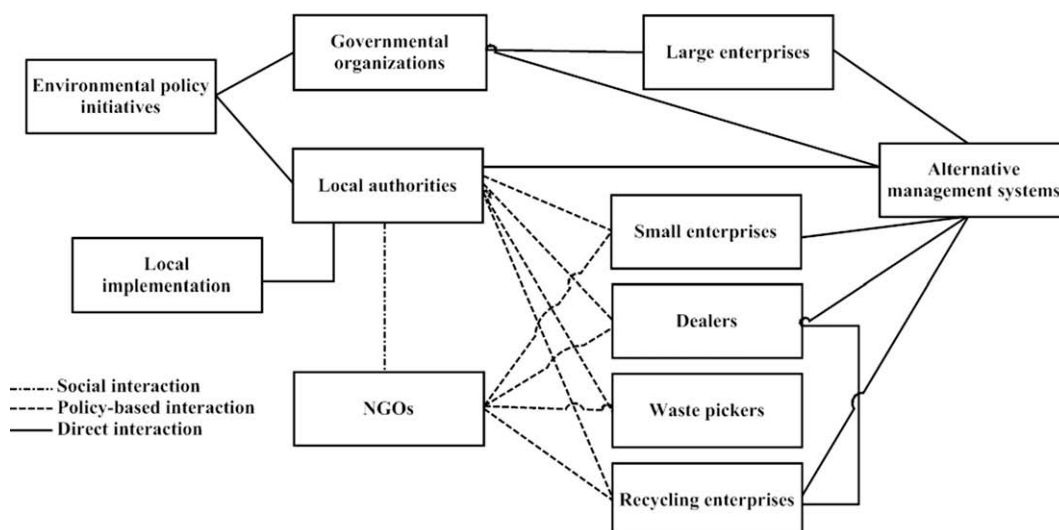


Fig. 1. Possible interactions and active co-operations in urban solid waste management, based partially on Baud et al. (2001).

back-tracking and either recognition and rewarding or penalising, aiming not merely at minimum legal compliance but going beyond at continuous improvement of environmental performance.

### 3. Environmental policy tools

LAs in Greece are key players in the local economy. As the government level closest to the citizen, they have an important influence on the environmental habits of the general public and can make a major contribution to the implementation of the principles of sustainable development at local level. Public authorities are moving towards improving their own environmental performance, not just for their own benefit, but also to set an example for the community. Several tools are available to LAs in order to achieve this goal of integrating a sustainable policy approach towards the environment. Some have already been adopted, whereas others are still untouched from an application stand point by LAs. These are discussed in the next section.

#### 3.1. Fair and efficient charging of waste management services

Many LAs finance their waste management services from general tax subsidies, not directly linking waste generation and the imposed collection, treatment and disposal costs to a charged fee. It is clear that fair and efficient charging of waste management services cannot be implemented without the integration of methods for exact estimation of the total MSWM costs. Recycling, innovative waste treatment methods and waste reduction actions include an overall investment and operational cost. Their successful implementation provides the methodological tool to reduce costs for the overall management of untreated waste and therefore prove to be economically viable. In such a financial consideration of the waste management problem, the external costs should also be taken into consideration in the basis of the PPP, which aims at the minimization/reduction of waste generation through fair charging of the invoked waste management services. The PPP is operationalised in MSWM via the pay-as-you-throw (PAYT) scheme, whereby charging of waste management services is proportional to the quantity of waste produced from each household. A recently recommended method for determining the price level of waste charges for PAYT in Greece is illustrated in Fig. 2. Each PAYT scheme is adjusted according to the waste collection method used or charging method selected. Dif-

ferent settings are used according to whether waste volume or weight is used and depending on the local economic, social and zoning conditions.

#### 3.2. Alternative waste management systems of either a collective or an individual character

The Hellenic legislative framework obliges producers, importers and retailers of several consumer commodities either to organize (individual), or to participate in (collective) alternative waste management systems in order for the set recycling targets to be achieved (Hellenic Republic, 2001). In Greece, 10 alternative waste management systems have been put into operation between 2001 and 2008 so far (cf. Fig. 3), while three more alternative management systems for construction and demolition waste (CDW), EOL-ships and printing paper are under implementation by mid-2008.

Each system provides the infrastructure and technical knowledge needed for operation with each LA, as well as funding to cover all additional costs of alternative management. The dual role of the LAs is imperative, as they both act as producers and managers of waste. As a consequence, LAs have the unique opportunity to formulate and implement new, often breakthrough policies towards sustainable environmental management, both by reducing their own waste production and by promoting policies that provide citizens with convenient tools to participate actively. In that sense, also the non-household waste producers within the LA administrative area constitute a crucial target group next to the households and their specific waste streams should be taken into account. Table 1 presents a partial list of such producers within a typical Hellenic municipality and indicates the associated generated waste streams and the respective suitable and available collective alternative management systems (CAMS). This compiled table is to be used as a roadmap (top-down approach) in each LA, together with field surveys (bottom-up approach) for determining a detailed inventory, followed by grouping for the purpose of determining possibilities for more waste diversion from the mixed waste stream. The introduction of EPR through these CAMS has been growing to an important complementary strategy next to individual industry motivation efforts. In this context, it must be acknowledged that the shifting of responsibility for achieving recycling targets to producers and retailers has already boosted recycling markets in many EU member countries (Salhofer and Isaac, 1999).

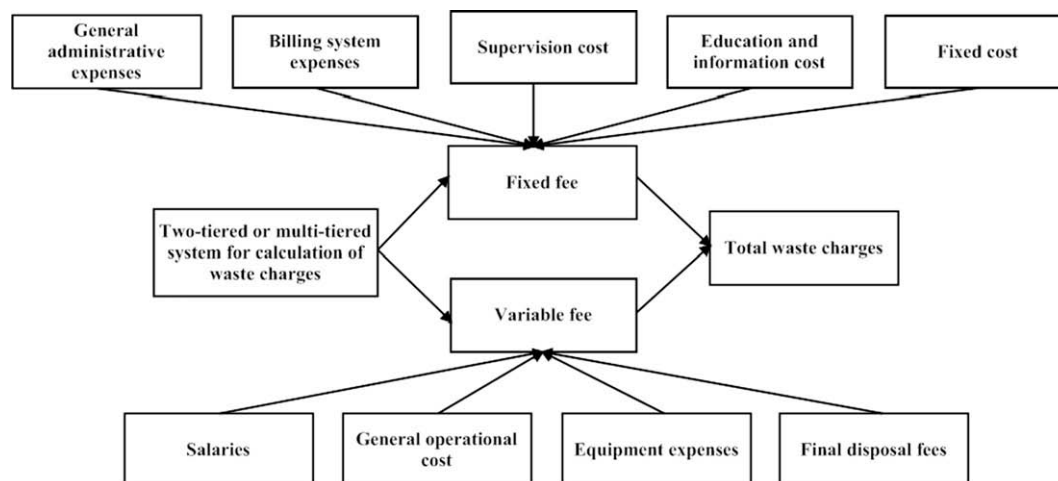
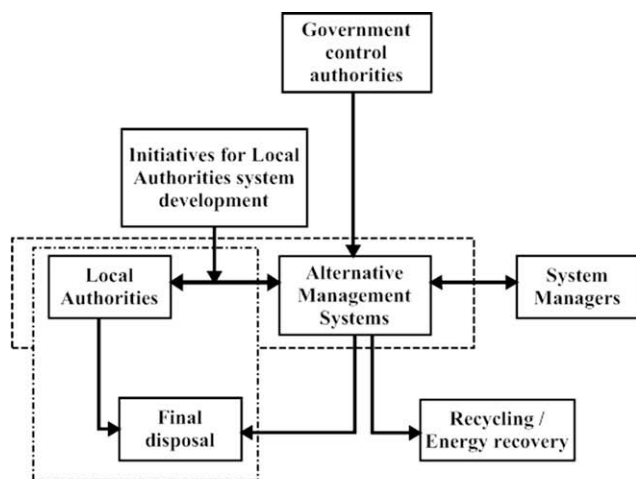


Fig. 2. Proposed method for determining the price level of waste charges for PAYT in Greece (Karagiannidis et al., 2005).



## Alternative Waste Management Systems:

1. EOL-Tires (1)
2. Waste Electrical and Electronic Equipment (1)
3. Consumer Packaging (2)
4. Construction and Demolition Wastes (1)
5. Portable batteries (1)
6. Accumulators (1)
7. Lubricants (1)
8. Lubricant packaging (1)
9. EOL-Vehicles (1)

**Fig. 3.** Proposed system model for the overview of LA's different systemic boundaries of MSW management in Greece. The available CAMS are listed. Initiatives (such as green fleets and used cooking oil management managing) towards sustainable eco-management are also included.

**Table 1**

Non-household municipal waste producers, their main respective produced waste streams, as well as respective alternative management schemes for a typical Hellenic LA.

	Waste streams												
	Paper	Plastic	Glass	Metals	Organic waste	Cooking oils	Mixed SW	Hazardous wastes <sup>b</sup>	Waste wood	Lubricants	Batteries	Tires	Accumulators
<i>Non-household municipal producers</i>													
Schools	x	x	x	x	x						x		
Hotels	x	x	x	x	x	x	x						
Construction sites	x	x		x				x	x				
Restaurants and food processing					x	X	x						
Open markets	x	x							x				
Shopping malls and middle-scale enterprises	x	x					x						
Car services	x							x		x		x	x
Health clinics							x	x					
Small-scale commercials <sup>a</sup>	x	x	x		x		x	x			x		
<i>Municipal buildings</i>													
City hall	x	x	x	x			x		x	x	x	x	x
Children care	x	x	x	x	x	x	x						
Senior citizens' care	x	x	x	X	x		x	x					
Consulting stations	x	x	x	X			x						
Depot (cars, etc.)	x	x	x	X	x				x	x	x		x
<i>Alternative management schemes</i>													
Packaging	x	x	x	X					X				
Portable Batteries											x		
Accumulators (Pb)													x
EOL-tires												x	
Lubricant packaging		x											
Construction and demolition wastes		x	x	X					x				
Lubricants	x									x			
Waste electric and Electronics													
EOL-vehicles													
N/A system (so far)					x	x		x					

<sup>a</sup> To be determined in detail (door-to-door) surveys.

<sup>b</sup> Including paints and stains (full or empty cans including aerosols, thinners, turpentine, varnishes, removers) as well as contaminated paint containers, solvents, pressure containers, all forms of hazardous material packaging, as well as pharmaceuticals, corrosive/poisonous cleaners (bleach, drain, toilet, oven cleaners); aerosol cans (full or partially full), caulking, cement powder, fire extinguishers, propane tanks or bottles, photo chemicals and glues, needles and syringes.

### 3.3. Green public procurement

As public procurement spending is worth about 16% of EU GDP, greening the public procurement rules at the EU and national levels could help substantially at reducing unsustainable production and consumption patterns (Euractiv, 2006). Green public procurement (GPP) is “the approach by which public authorities (including also local authorities) are encouraged to introduce and integrate environmental criteria into various stages of their procurement process, thus encouraging the further spread of environmental technologies and the development of environmentally sound products, by seeking and choosing outcomes and solutions that have the least possible impact on the environment throughout their whole life-cycle” (Bouwer et al., 2005). The main obstacles for the promotion of GPP among LAs are the perception of higher relative cost, lack of knowledge, management support and training of LA personnel.

### 3.4. Environmental benchmarking for local authorities

Environmental benchmarking for LAs is a structured approach to rigorously examining and comparing, from an environmental perspective, the processes supporting different LA activities (Bolli and Emtairah, 2001). The objective of environmental benchmarking is to identify and assess the abilities and attitudes that a LA must have to step up in operational and environmental performance simultaneously. It is considered to foster healthy competition among communities and lead to improvements. A schematic diagram of the process of environmental benchmarking implementation is provided in Fig. 4, while some of the specific attractions of environmental benchmarking are as follows:

Helping an LA to understand and develop its own processes affecting the local environment.

Promoting an active process of learning within the LA.

Breaking down the reluctance to change and helping employees and the administration become more receptive to new ideas.

Providing early warning for lagging costs and citizen satisfaction.

In general, LAs often do not know how well or how badly they are really performing and at what level they should set their goals. Therefore, choosing the right partners to benchmark against is considered crucial for finding ideas for improvement and drawing the right conclusions. Summarizing, environmental benchmarking of LAs is about finding out how top LAs achieve high performance in managing the environment or eco-efficiency, and about trying to adapt these superior practices to their own organizational structures.

### 3.5. Hazardous waste management plans

In 1994, the EU first introduced the European Waste Catalogue (EWC), which was upgraded in 2000 and amended in 2001, in order to include hazardous waste. In Greece, since March 2007, a Common Ministerial Decision has institutionalised the “National Planning for Hazardous Waste Management”. The annual production of municipal household hazardous waste (MHHW) is estimated to be 7000 t (0.6 kg/cap/yr) and is currently still mostly disposed along with municipal waste (Hellenic Republic, 2007). Despite the low concentration of MHHW in the overall annual municipal waste stream, which reaches 5 million t, its hazardous nature calls for its separate collection and management. LA initiatives can be proven decisive even for waste categories which present management particularities such as healthcare waste. Towards this category’s waste management, co-operation with public or private healthcare facilities can now also be achieved in the framework of public–private partnerships. In managing other categories of MHHW (like paints, chemical substances, gas canisters, etc.), collection and storage should be facilitated by the LA, in such a way that possible public reactions are minimized. Concluding, important means for sustaining the successful implementation of a MHHW management plan can be:

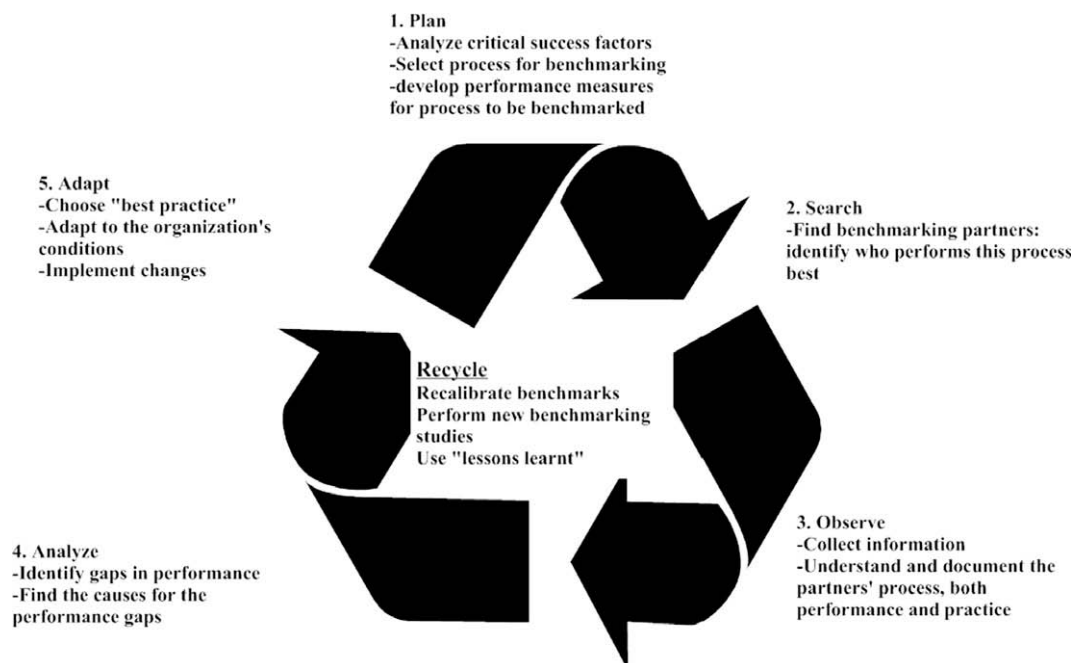


Fig. 4. The process of benchmarking in an LA (Bolli and Emtairah, 2001).



A help centre with suitably trained personnel to face daily questions regarding MHHW management in order to sustain and improve citizen and local industry participation.

A well-thought-out set of motives and incentives (also including financial subsidizing and positive public promotion) to local businesses, in order to encourage them to participate in the MHHW management plan via tax exemptions and vouchers.

Environmental certification (e.g., EMAS or ISO 14001, cf. also below) of the plan itself.

### 3.6. Green municipal fleets

While aiming to achieve a sustainable environmental policy in their areas, LAs in Greece should also focus their efforts on alternative fuels and alternatively propelled vehicles. In 2005 EU Directives regarding the promotion of the use of biofuels (2003/30/EC) and taxation incentives (2003/96/EC) were both included in the Hellenic legislative framework. The Hellenic market was already activated within 2005 and, by the end of 2006, 2% of all diesel consumed in the country was biodiesel. As a result, the first initiatives have been taken by some fleet operators in order to promote alternative fuels and alternatively propelled vehicles (Hellenic Republic, 2006). LAs could take initiatives in this area by two parallel actions: firstly by getting involved in the biofuel feedstock market of waste derived origin' and secondly by testing, and then adopting alternative fuels and vehicles in their own municipal fleets. A good example of the first direction refers to the collection of used cooking oils by restaurants within the area of the municipality, which then could be delivered to biodiesel production plants. Such programmes have been successfully organised by various municipali-

ties in many EU countries and their experiences could support new efforts. The second direction deals with the actual conversion of the existing (and future) type of municipal fleet to alternative propulsion ranging from biofuels to electric systems. The waste collection fleet is a very appealing part of the municipal fleet, both due to its relatively high gravity within the fleet, as well as the multiple messages coming out of it (e.g., a recycling truck running on biofuels would provide multiple environmental signals and synergies).

### 3.7. Environmental certification

The Eco-Management and Audit Scheme (EMAS) and the International Standards Organization (ISO) provide a structured framework for managing and improving the LA's own environmental performance (EC, 2001). There is an increasing number of LAs obtaining and pursuing such registration and certification from either body. The main reason for such a strategy is strategic, since if LAs obtain a more effective and structured organisation, it should enhance environmental improvements because there is then much more knowledge and control of individual strategies and actions within the organisation. Hence, environmental improvements are an indirect effect of organisational change and restructuring. Implementing an environmental certification is still a voluntary commitment and by signing onto this effort, LAs show a willingness to improve their overall environmental situation and send this message both internally and externally. As of January 2008, more than 140 LAs throughout the EU had been environmentally certified. In Greece, the municipality of Amarousio has been reported to have already implemented EMAS in selected services and athletic facilities.

## SWOT ANALYSIS

STRENGTHS	WEAKNESSES
Direct day-to-day contact with waste producers Charging leverage over municipal waste producers Status of authority Monitoring efficiency Awareness raising potential Increasing procurement capacities Availability over a range of vehicles and indirect influence of other fleets as well	Political influence at local level Priority conflict at local level Capacity gaps and shortfalls Urban LAs not caring about disposal sites they do not operate, but just mainly about collection Implementation of imposed policies (with enough tangible effects) Partial or no understanding of real own emissions and external costs
OPPORTUNITIES	THREATS
Funding schemes (national, EU, private sector) Outreach potential (sleeping giant) to civilians and hosted businesses Public Private Partnerships Clustering/grouping PAYT "mix" CAMS	Business as usual mentality Fines for non-compliance on waste and contaminated site management. PAYT failure leading to increased littering Urban: High cost of transfer Rural: High cost of disposal Improper recycling behavior Improper grey recycling Acidification Global Warming Fires Strikes Vandals Disinterested citizens

Fig. 5. SWOT analysis on Hellenic LAs adopting state-of-the-art SWM schemes.

**Table 2**

Development of a factor matrix that is needed for an LA to develop strategies that take into account the SWOT profile.

	Strengths	Weaknesses
Opportunities	S-O strategies	W-O strategies
Threats	S-T strategies	W-T strategies

### 3.8. Community oriented tools and campaigns

Possible examples include:

- Arranging long-term volunteer programmes, based on proper screening and training. Application areas include home composting, reuse events, support in education events, assisting with demonstration gardens, modelling proper recycling practices, and helping friends and relatives in setting waste diversion activities. Proper and appealing titles are recommended (e.g., Master Composter and Recycler).
- Setting up comprehensive user-friendly and convenient waste minimization and recycling programmes, including reuse and drop-off centres for old household goods, complementary to curbside and door-to-door recycling (which will remain the main focus, due to the densely populated Hellenic urban settings with a lack of open space).
- Providing clear, continuously available guidelines (written, web-based, hotline) for existing waste management activities (e.g., collection, recycling of various streams, separate collection of bulky wastes, etc.).
- Effectively design and apply community based social marketing aiming at behaviour and not attitude.

For initially integrating all the above tools and addressing their possible impacts to the MSWMS, a SWOT analysis of this system was initially performed, as illustrated in Fig. 5.

A local authority should not necessarily pursue the more lucrative opportunities. It may have a better chance at developing a competitive advantage by identifying best alternatives considering the strengths and upcoming opportunities of the LAs, while in some cases it can overcome a weakness in order to prepare itself to pursue a compelling opportunity. To develop strategies that take into account the SWOT profile, a matrix of these factors can be constructed as shown in Table 2 and explained below.

- S-O strategies pursue opportunities that are a good fit to the LA's strengths.
- W-O strategies overcome weaknesses to pursue opportunities.
- S-T strategies identify ways that the LA can use its strengths to reduce its vulnerability to external threats.
- W-T strategies establish a defensive plan to prevent the LA's weaknesses from making it highly susceptible to external threats.

## 4. Conclusions and recommendations

A major challenge in improving services in waste management for LAs in Greece is effective co-operation with the various stakeholders (e.g., citizens, NGOs, State Authorities, etc.). Initiatives to improve waste management services and the overall sustainability environmental policy chosen by LAs require participation of all involved parties; in order to be successful, all actions have to be credible, transparent, socially sustainable and, as far as possible,

convenient and practical to participants. Therefore, public relations strategies of LAs need to be adapted to specific target environments and offer the target groups real opportunities to act. In this context, a series of tools have been discussed in this paper for stirring up motivation and healthy competition in the field of sustainable urban waste management among and within LAs in Greece. Moreover, being responsible for and competent of fiscal measures related to transport and fuels, LAs could be a key actor in conversion to green fleets and further bridging the gap between waste management and sustainability in the transport sector, which has been gaining worldwide attractiveness recently in the form of waste derived biofuels. Consulting and training activities on sustainable waste management targeting local communities and specific target groups should become a priority in order to support related initiatives. Finally, financing such actions through competitive external projects is an option that should be further exploited by Hellenic LAs to a much larger extent, something that requires significant investments in human capital and resources. The tools presented in this paper have the prospective to find applicability in LAs not only in Greece but also in other transient economies where sustainable waste management practices are yet to meet a critical mass of success.

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