



LIFE12 ENV/GR/000427 LIFE reclaim "Landfill mining pilot application for recovery of invaluable metals, materials, land and energy"

**TECHNICAL REPORT - ACTION C2
FOR THE POLYGYROS LANDFILL, IN THE MUNICIPALITY OF
POLYGYROS, CHALKIDIKI**

SUBJECT:

Baseline evaluation of the Project
by means of the
Socioeconomic performance indicators

STUDY : ENVECO S.A.



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of Polygyros



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1. Introduction

1.1. Report context and Objectives

This present report is the Deliverable of Action C2 of the Life reclaim Project “Landfill mining pilot application for recovery of invaluable metals, materials, land and energy”, which is being funded by the European Commission through Life+ 2012 vehicle, under the contract LIFE12 ENV/GR/000427.

The objective of this report is to examine the collected data and set the Baseline Evaluation of the LIFE reclaim project according to the Socioeconomic Monitoring Indicators which were identified at a previous stage. This evaluation serves as the basis for the project impact monitoring.

The Technical Report “Baseline environmental and social conditions report” of Action A3 will be used as an input of information about the baseline conditions of the area, along with any data gathered during this Action, via:

1. Assessment of related literature
2. Site visits in the wider area
3. Collection of primary data from relevant databases and organizations (census data, etc.)
4. Consultations with relevant authorities (land planning service, environmental services, the municipality, the regional authorities etc)
5. Final evaluation and reporting

The social information was collected for the Project Area and the wider region of Chalkidiki and Central Macedonia.

1.2. General information on Life+ reclaim

1.2.1. Project objectives

The Project aims at building a temporary pilot application on productive scale in order to mine parts of existing landfills, separate useful materials and produce marketable products, introducing innovative techniques from the mining industry, suggesting a new concept of waste valorization. It will also assess the viability of the proposed method as well as provide a scientific evaluation on the potential alternatives of the management of waste disposal sites. The basic objective is to introduce landfill mining (LFM) as a complementary approach of management of past landfill (controlled or uncontrolled) sites and create a useful tool for the recovery of:

- useful materials, especially ferrous and non-ferrous metals
- space, which equals to extra landfill capacity and lifetime in cases of expansion
- soil material, which has been disposed off along with the waste and which is a natural resource valuable to local ecosystems as well as to landfill industry itself

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- recyclable materials, like plastic and paper products, which can be either post-processed in a suitable recycling plant or burned in modern incinerators
 - land, in the case of old landfills, which will lead to a successful rehabilitation scheme with minimal environmental footprint which in turn, can be easily adapted to different waste compositions and site conditions.

At the same time the Project objectives include the familiarization of the public with the issue of post-disposal-processing of waste and with the potential of the procedure for metal recovery and site rehabilitation, resulting in a cleaner environment and rational waste management. The abovementioned objectives of material and/or energy recovery are widely known today in the waste processing industry and precede disposal, but have not been so far utilized in connection to (a) a wider program of waste post-disposal processing and (b) material beneficiation for valuable metals, by means of ore processing methods.

1.2.2. Actions and means

In order to establish LFM as a standard waste management procedure there are two basic tasks to be completed:

- LFM consolidation and application: Detailed elaboration on all technical aspects of LFM, from designing the waste mining operation to creating alternative final products (metal concentrates) that can be directly fed into metallurgical plants.
- Environmental and Social analysis: Detailed approach on the foreseeable socioeconomic impacts of adopting LFM practices.

More analytically, the Project includes the following Actions:

1. Preparation: International experience in LFM, Permitting of additional activities in Polygyros Landfill (PL), Baseline environmental and social conditions
2. Implementation: Landfill inventory, Exploitation plan, Design of production line, Sub-contracting procedures, Pilot-scale Demonstration Unit, MSW mining, operation and tests, Environment rehabilitation plan
3. Socioeconomics: EIA Study, Financial and socioeconomic analysis, Action Plan and Master Plan elaboration
4. Monitoring the environmental & socioeconomic impacts of project Actions
5. Dissemination Actions
6. Project management Actions
7. After-life communication plan

1.2.3. Expected results

According to existing literature, there is considerable experience in waste mining regarding energy and soil recovery, but not regarding non-ferrous metals, since the waste requires further processing which very few have attempted to undertake. It is expected that the Project will help consolidate knowledge, give practical experience in the field and contribute to the adaptation of an innovative production line under, various site conditions and waste compositions. Specifically, the Project is expected to bring the following results:

- Web GIS database for operational landfills and dump-sites in Greece combined with a Website during and after the duration of the Project, connected with the web-GIS database application
- Processing of waste for the production of different separation samples
- Two field environmental economics surveys on the acceptance of LFM
- Action plan on national level for LFM and Strategic Environmental Assessment on national level
- Socioeconomic analysis of LFM
- Publication of one bilingual book/album on LFM
- Dissemination of the experience and information gained, through conferences (2 national and 1 international) as well as through proper dissemination material

All results will be supported by respective Technical Reports (one of which is the present one), with documentation on the background, methodologies, alternatives examined and relevant results. In addition, a special report regarding the carbon footprint of the Project will be submitted in order to support the footprint minimization policy of the project.

1.3. **The Study Team**

This Report has been elaborated by the following Life reclaim collaborators:

- Spyros Papagrigoriou, Civil Engineer, Environmental Engineer, Dipl., MSc., MLitt
- Georgios Kotzageorgis, Biologist (University of Athens, Greece), Ph.D. in Ecology
- Yanis Katselis, Mineral Resources Engineer, Environmental Engineer MSc, Business Administration MBA
- George Tentis, Mining Engineer MEng (NTUA), MSc in Hydrology environmental management of water resources
- Nikolaos Mihas, Civil Engineer (AUTH), MSc in Environmental Engineering

- Ioannis Gavriil, Chemical Engineer (NTUA), MSc in Systems of Energy and Environmental Management (NTUA & University of Piraeus)
- Panagiota Mprousti, Environmental Scientist (University of Aegean), MSc in Water Resources Science and Technology (NTUA)

2. Socioeconomic indicators for the RECLAIM project

2.1. Proposed socioeconomic indicators

The socioeconomic indicators are summarized in the following Table 1. Each indicator is discussed in more detail below.

Table 1: Socioeconomic indicators used in RECLAIM project

Impact category	Socioeconomic Indicator	Unit
Economic	Revenues from recycled materials	Euros per ton of waste treated
Economic	Revenues (avoided costs) from energy savings	Euros per ton of waste treated
Economic	Value of green space saved	Euros per ton of waste treated
Economic	Value of CO ₂ savings	Euros per ton of waste treated
Economic	Investment cost	Euros per ton of waste treated
Economic	Operational cost	Euros per ton of waste treated
Economic	Financial Net Present Value	Euros
Economic	Financial Internal Rate of Return	Per cent
Socioeconomic	Economic Net Present Value	Euros
Socioeconomic	Economic Internal Rate of Return	Per cent
Social	Acceptance of landfill facilities	% of people
Social	Perception of the environmental impacts of landfills	% of people
Social	Perception of the state of the environment	% of people
Social	Willingness to support landfill mining	% of people
Socioeconomic	Direct employment generation	n. of workers
Socioeconomic	Indirect employment generation	n. of workers

- SE.I.1. Revenues from recycled materials: This economic indicator aims to monitor the potential revenues derived from the waste that will be excavated and treated during the RECLAIM project. It will be measured in Euros per ton of waste excavated and treated. And

will be calculated by multiplying the quantities of the materials recovered (i.e. glass, paper, ferrous metals, etc.) with the unit price of each type of material in the recycled market. This indicator will be connected with Environmental Indicators no. 3, 4, 5, 6, 7 and 8.

- SE.I.2. Revenues (avoided costs) from energy savings: This economic indicator is related to potential avoided costs from reduction in energy consumption of recycled materials in comparison to the use of new materials. It aims to monitor and assess potential energy savings in monetary terms from the materials that will be recycled during the RECLAIM project. It will be measured in Euros per ton of waste excavated and treated and will be calculated by multiplying the estimated energy savings with the cost of energy (e.g. Euros per kWh). The energy savings will be estimated by means of literature data. This indicator is based on Environmental Indicator no. 10.
- SE.I.3. Value of green space saved: The aim of this economic indicator is to monitor and monetize the benefits from the potential green space saved owing to the landfill mining process throughout the duration of RECLAIM project. The value of green space will be assessed by means of suitable environmental valuation approaches. The indicator will be measured in Euros per ton of waste excavated and treated. It will be estimated by multiplying potential land savings (e.g. in ha) per ton of waste excavated and treated by the value of green space (e.g. Euros per ha). The latter will be estimated by literature data using the Benefit Transfer method. This indicator is connected with the Environmental Indicators no. 17 and 18.
- SE.I.4. Value of CO₂ savings: The aim of this economic indicator is to monitor and assess in monetary terms the reduction in greenhouse gas of recycled materials compared to use of new materials that will be achieved during the RECLAIM project. The indicator will be measured in Euros per ton of waste excavated and treated. It will be calculated by multiplying the kg of CO₂ eq. provided by the Environmental Indicator no. 9 with the value of CO₂ provided by literature data.
- SE.I.5. Investment cost: The aim of this economic indicator is to assess the investment costs of landfill mining process (e.g. excavation and processing equipment). The indicator will be expressed in Euros per ton of waste excavated and treated and will be based on existing information and data gathered during the RECLAIM project from Tasks B6 and B9.
- SE.I.6. Operational cost: This aim of this economic indicator is to assess the operational costs of landfill mining process (e.g. energy costs, personnel costs, etc.). The indicator will be expressed in Euros per ton of waste excavated and treated and will be based on existing information and data gathered during the RECLAIM project from Tasks B6 and B9.
- SE.I.7. Financial Net Present Value: This economic indicator aims to assess landfill mining project's financial viability by measuring its financial net benefits. The indicator will be expressed in Euros. It will be estimated using the Discounted Cashflow method from the financial analysis of the landfill mining process through Task B9.
- SE.I.8. Financial Internal Rate of Return: This economic indicator aims to assess landfill mining project's financial attractiveness by measuring the returns internally generated by the

project. The indicator will be expressed in per cent. It will be estimated using the Discounted Cashflow method from the financial analysis of the landfill mining process through Task B9.

- SE.I.9. Economic Net Present Value: This socioeconomic indicator aims to assess landfill mining project's financial viability by measuring its socioeconomic net benefits. The indicator will be expressed in Euros. It will be estimated using the Discounted Cashflow method from the environmental and social cost-benefit analysis of the landfill mining process through Task B9.
- SE.I.10. Economic Internal Rate of Return: This socioeconomic indicator aims to assess landfill mining project's socioeconomic attractiveness by measuring the returns internally generated by the project. The indicator will be expressed in per cent. It will be estimated using the Discounted Cashflow method from the environmental and social cost-benefit analysis of the landfill mining process through Task B9.
- SE.I.11. Acceptance of landfill facilities: This social indicator aims at monitoring the acceptance of landfill sites in their current form. It will be examined by means of the local social survey that will be conducted in Task B9 and will be measured as the percentage of people that are willing to support landfill mining projects.
- SE.I.12. Perception of the environmental impacts of landfills: This social indicator aims at exploring the perception of people about the environmental impacts of landfill sites. It will be examined by means of the local social survey that will be conducted in Task B9 and will be measured in percentage terms (e.g. percentage of people considering that the environmental impacts are 'significant', 'minor', etc.).
- SE.I.13. Perception of the state of the environment: This social indicator aims at exploring the perception of people about the state of the environment. It will be examined by means of of the local social survey that will be conducted in Task B9 and will be measured in percentage terms (e.g. percentage of people stating the state of the environment is 'good', 'poor', etc.).
- SE.I.14. Willingness to support landfill mining: This social indicator aims at assessing the acceptance of landfill mining process. It will be examined by means of local and national social surveys that will be conducted in Task B9 and will be measured as the percentage of people that willing to support landfill mining projects.
- SE.I.15. Direct employment generation: This socioeconomic indicator aims at estimating the direct employment that will be generated by the landfill mining process. To this end, scientists and workers involved in Tasks B5 and B6 will be taken into consideration. If possible, this indicator will be expressed in person-months per m³ of waste excavated and treated during the RECLAIM project.
- SE.I.16. Indirect employment generation: This socioeconomic indicator aims at estimating the indirect employment that may be generated by the landfill mining process as a result of the direct employment. Data from SE.I. 15 will be used together with data from the processes that will take place in Tasks B5 and B6 to determine employment generated in

the businesses that supply goods and services. If possible, this indicator will be expressed in person-months per m³ of waste excavated and treated during the RECLAIM project.

If possible, the above-mentioned socioeconomic indicators no. 7, 8, 9 and 10 will be also expressed per m³ of waste excavated and treated during the RECLAIM project. The aim is to provide indicators for the assessment of landfill mining process, which will be coherent and compatible with waste management indicators in general and will be transferable to other landfill mining projects.

3. Evaluation of the Baseline Socioeconomic Impact for the RECLAIM project

Based on the collected data, a baseline analysis was carried out to estimate the aforementioned Indicators. However, due to the fact that the operation of the pilot demonstration unit has not started yet, most of these indicators are not applicable, or are estimated to be zero at the time.

The results of the evaluation are summarized in Table 2 of the next page.

Table 2: Baseline Socioeconomic Impact Evaluation for the RECLAIM project Environmental indicators

Impact category	Socioeconomic Indicator	Unit	Value	Comments
Economic	Revenues from recycled materials	Euros per ton of waste treated	0	The indicator is zero provided that no recycling activities take place in Polygyros Landfill
Economic	Revenues (avoided costs) from energy savings	Euros per ton of waste treated	0	The indicator is zero provided that no recycling activities take place in Polygyros Landfill
Economic	Value of green space saved	Euros per ton of waste treated	0	The indicator is zero provided that no landfill mining activities take place in Polygyros Landfill
Economic	Value of CO2 savings	Euros per ton of waste treated	0	The indicator is zero provided that no recycling activities take place in Polygyros Landfill
Economic	Investment cost	Euros per ton of waste treated	0	The indicator is zero provided that no landfill mining activities take place in Polygyros Landfill
Economic	Operational cost	Euros per ton of waste treated	0	The indicator is zero provided that no landfill mining activities take place in Polygyros Landfill
Economic	Financial Net Present Value	Euros	0	The indicator is zero provided that no landfill mining activities take place in Polygyros Landfill
Economic	Financial Internal Rate of Return	Per cent	0	The indicator is zero provided that no landfill mining activities take place in Polygyros Landfill
Socioeconomic	Economic Net Present Value	Euros	0	The indicator is zero provided that no landfill mining activities take place in Polygyros Landfill
Socioeconomic	Economic Internal Rate of Return	Per cent	0	The indicator is zero provided that no landfill mining activities take place in Polygyros Landfill
Social	Acceptance of landfill facilities	% of people	*	* The indicator will be determined by the social survey that will be conducted in the area (Action



				B.9)
Social	Perception of the environmental impacts of landfills	% of people	*	* The indicator will be determined by the social survey that will be conducted in the area (Action B.9)
Social	Perception of the state of the environment	% of people	*	* The indicator will be determined by the social survey that will be conducted in the area (Action B.9)
Social	Willingness to support landfill mining	% of people	*	* The indicator will be determined by the social survey that will be conducted in the area (Action B.9)
Socioeconomic	Direct employment generation	n. of workers	10	Current number of employees of the Polygyros Landfill
Socioeconomic	Indirect employment generation	n. of workers	38	Estimated by number of garbage trucks of the area, maintenance workers, etc.

