With the contribution of the LIFE financial instrument of the European Union
Total budget: €1,377,004,00
EU Contribution: 50%
The Project

**Project code:** LIFE12 ENV/G R/ 000427

**Project Title:** “Landfill mining pilot application for recovery of invaluable metals, materials, land and energy”

**Project Location:** Polygyros (Chalkidiki, GREECE)

**Beneficiaries:** ENVECO, HELECTOR, MoP, NTUA

**Start – End:** 01/07/2013 – 30/6/2016

**Budget:** €1,377,004,00 (50% EU contribution)
The Project

Landfill Mining

Preparatory Actions

Polygyros LFM Pilot Unit

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The Project

Landfill Mining

Generic definition:

“the extraction of resources from landfills”

Definition varies according to:

Who (issues of ownership & needs)
(public vs private bodies)

What (issues of technology & methods)
(in situ vs ex situ, direct vs indirect, materials vs other)

Where (issues of legislation)
(EU vs everywhere else)

Why (issues of motivation & efficiency)
(for profit or social benefit)
Procedure:

Waste mining: open-pit mining with mechanical means

Loading and transportation to the processing unit location

Processing of waste: separation of materials - sieving, hand-sorting, magnet, etc.

Results: recovery of materials, land, energy, etc.
History of LFM

- **First** Landfill Mining application: Israel, 1953
- **United States**: Many pilot studies and full-scale projects during 80’s-90’s
- Introduced in the **EU later**, with fewer full-scale applications in Germany, the Netherlands, Sweden, Finland.
- Some attempts in the **UK** were abandoned.
- **Asia**: Several studies on Landfill Mining owing to population issues, mainly in India and China.
- Currently raised interest in **Belgium** (Flanders): research, publications and the EURELCO consortium
The Project
Preliminary Actions

Action A1: Review of the international LFM experience
- International literature review (congresses, papers, studies)
- Waste legislation review (EU, greek)
- Stakeholder meetings with national and international experts (Belgium, Spain, Netherlands, UK)

Action A2: Permitting of LFM activity in Polygyros LF
- Description of current activity of the Polygyros Landfill
- Preliminary description of LFM activity
- Submission of permit dossier and contact with the authorities

Action A3: Baseline environmental & social conditions
- Data collection: field visits, meetings
- Reporting on the Baseline conditions
The Project

Investigation of the potential of LFM

Action B1: Landfill Inventory

- Covering Greece and selected EU territories: Cyprus, UK, Belgium (Flanders), Spain, the Netherlands, and others
- Construction of questionnaire (landfill characteristics)
- Communications with authorities responsible for waste management
- Additional data from national studies and the literature
- Data assessment and preparation (Database construction)
- Web-GIS creation and update: over than 23,000 sites

http://reclaim-gis.gr
Inception Phase – A1

Action A1

Action A2

Action A3

Actions D1-2

Actions E1-4
The Project

Preparation for the Polygyros LFM Pilot Unit

Action B2: Exploitation Plan Development
- Available technologies & methods
- Visits to Polygyros Landfill
- Identification of target areas (waste age & content)
- Mining scheme - resources & operation details
- Environmental Monitoring system proposal

Action B3: Design of waste treatment process
- Waste sampling missions (2)
- Waste treatment methods review
- Adaptation of the proposed methods to sampling findings
- Design of the Pilot Demonstration Unit: type of machinery to be used, calculation of productivity and procedure of processing.

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Sampling in Polygyros

Results

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Landfill Mining

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Sampling in Polygyros

Overview:
- 50% soil material (soil and rocks)
- High percentage of plastic and recyclable materials (bottles, cans, etc.)
- Very small percentage of metals
- Few glass items
- Many bulky items
The Project
Preparation for the Polygyros LFM Pilot Unit

Action B4: Sub-contracting procedures for Demonstration Unit
- Invitation for proposals and final contract for the supply and installation of the necessary equipment and machinery

Action B5: Pilot-scale Demonstration Unit installation
- Defining roles and responsibilities
- Preparation of the Unit location (landscaping and drainage system)
- Delivery and installation of the machinery and equipment
- Adjustments on the day-to-day activities
- Creation of a custom template to record production
- Installation of Environmental Monitoring equipment
The Project
Preparation for the Polygyros LFM Pilot Unit
MAY 2015
The Project
Polygyros LFM Pilot Unit Operations

**Action B6: Landfill Mining, waste processing and beneficiation tests**
- **45 days** (June – July 2015)
- Extraction of waste with **excavators** & transportation with **trucks** to the Unit location
- Regular **weighting** of inputs and outputs
- Waste fed to the Unit assembly using a **backhoe loader**
- A **Trommel sieve** separates smaller waste and soil from larger waste
- **Hand-sorting of waste**: Hard plastics, plastic bags, aluminum cans, glass, e-waste
- **Magnetic separation**
- Other features of the Unit: Washing Machine, Storage of waste
- Total mined & processed waste: about **1300m³ (580tn)**
- **Beneficiation tests**: ex situ (SMME/NTUA laboratory)
The Project

Summary of Polygyros Unit Results

- Soil: 4,944%
- Residue: 22,687%
- Iron scrap: 1,071%
- Plastic bags (FILM): 5,610%
- Plastic: 3,354%
- Glass: 2,289%
- Aluminum: 0.278%
- <70 to >10mm: 61,767%

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Conclusions
Action B7: Σχέδιο Αποκατάστασης Περιβάλλοντος
- Literature review (congresses, papers, studies)
- Selection of alternatives for the Polygyros Landfill after a complete Landfill Mining project
- Development of the RECLAIM-hab tool to ease the selection process of the best option (Multi-criteria analysis)
- Design of a 3D model of the chosen rehabilitation plan

Action B9: Financial and Socio-economic Analysis
- Development of a socioeconomic survey questionnaire
- Polygyros survey April-June 2015 (286 local residents)
- National telephone survey: April-July 2015 (392 Greek households)
- Socioeconomic analysis: positive findings for LFM in the case of using “own resources” (equipment & personnel).
Το Έργο
Σχέδιο Αποκατάστασης Περιβάλλοντος

Προκαταρκτικές Δράσεις

Μονάδα Πολυγύρου

Συμπεράσματα

Παράλληλες Δράσεις

Το Έργο
Εξόρυξη Αποβλήτων
The Project

Parallel Actions

**Action B8: National Action Plan**
- Opportunities, scope and feasibility for LFM in Greece
- Description and assessment of policy alternatives
- Description of Road Map for achieving goals
- Assessment of available means, objective setting, intermediate goals, prioritization, timeline, need for capacity building and proposed funding schemes for project implementation

**Action B10: Strategic Environmental Assessment Study**
- For the implementation of the NAP
- Establishing the context of the SEA
- Environmental Baseline assessment
- Consideration of Alternatives and Impact Assessment
- Mitigation measures proposal
## The Project

### Parallel Actions

<table>
<thead>
<tr>
<th>Environmental Indicators main categories</th>
<th>Social Indicators main categories</th>
</tr>
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<tbody>
<tr>
<td>Waste minimization</td>
<td>Economic</td>
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<tr>
<td>Material resources</td>
<td>Socioeconomic</td>
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<tr>
<td>Soil degradation</td>
<td>Social</td>
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<tr>
<td>Climate change</td>
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<td>Human health</td>
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<td>Land use</td>
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</tbody>
</table>
The Project

Communication Actions

Actions D1, D2 & D3

- Notice boards, posters, leaflets
- Press releases, newsletters, special edition newsletter
- Social Media accounts (LinkedIn, Facebook)
- Media communication (wide impact magazines, online newspapers and blogs, local TV channels, etc.)
- Project website development www.reclaim.gr
- Development of an official FORUM about Landfill Mining
- Polygyros Local Workshop (September 15th 2014)
- 1st National LFM Conference (September 16th 2014)
- Athens 2015 International Landfill Mining Conference (September 24th-25th, 2015)
- 2nd National LFM Conference (June 15th - 16th June 2016)
Conclusions

1. Landfill mining is still evolving (technology and process advances)

2. Need for standardisation; not only individual case applications

3. Implementation of a National Action Plan for the

4. Εφαρμογή του Εθνικού Σχεδίου Δράσης to strengthen the technical and legal framework

5. Involvement of the public sector will affect the Solid waste management at a National level

6. More LFM applications in larger-scale are needed and for longer period of time
Thank you very much!

Zoi Gaitanarou

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