



RAWFILL WP T1
Enhanced Landfill Inventory Framework
Deliverable 1.2
Existing LFM initiatives -draft version

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Remark: final version of this document will be published at the end of the RAWFILL project when additional information regarding landfill mining experiences will be available

Interreg North – Ouest Europe (NWE) VB 2014 - 2020

Project: NWE377 RAWFILL

Title: Supporting a new circular economy for RAW materials recovered by landFILLs

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ACRONYMS AND DEFINITIONS

COCOON: “Consortium for a Coherent European Landfill Management Strategy”, an INTERREG Europe-funded project, whose objective is to develop, integrate and improve relevant policy instruments, while increasing subsidies through operational programs for landfill mining projects,
<https://www.interregeurope.eu/cocoon/>

DST: “Decision Support Tool”, a tool that will rank landfills regarding landfill mining opportunities. The ranking is based on information following ELIF structure. It will operate at 2 levels: “Selection” (a first level of quick screening to identify landfills with a priori interesting potential but which need further historical investigations and geophysical survey) and “Ranking” (a prioritization tool to rank pre-selected and fully investigated landfills of economic interest for raw material recovery purposes).

ELFM: “Enhanced Landfill Mining”, the safe exploration, conditioning, excavation and integrated valorisation of (historic, present and/or future) landfilled waste streams as both materials (Waste-to-Material, WtM) and energy (Waste-to-Energy, WtE), using innovative transformation technologies and respecting the most stringent social and ecological criteria).

ELIF : “Enhanced Landfill Inventory Framework”, a landfill inventory structure that is focused on information regarding resources that can be extracted from a landfill (materials, energy carriers and land). The ELIF is used to describe landfills not only in terms of environmental and risk issues, but focuses on the quality and the quantity of dormant materials lying on them, in order to supply relevant data for stakeholders involved in ELM projects.

LFM: “Landfill Mining”, the safe exploration, conditioning, excavation and integrated valorisation of (historic, present and/or future) landfilled waste streams as both materials (Waste-to-Material, W2M) and energy (Waste-to-Energy, W2E), without specification of technologies.

RAWFILL: “Supporting a new circular economy for RAW materials recovered from landfills”, an INTERREG North-West Europe-funded landfill mining project, launched in March 2017, www.nweurope.eu/rawfill

RECLAIM: “Landfill mining pilot application for recovery of invaluable metals, materials, land and energy”, project funded by the European Commission through Life+ 2012 vehicle, contract LIFE12 ENV/GR/000427



SMART GROUND: “SMART data collection and inteGration platform to enhance availability and accessibility of data and information in the eU territory on secondary raw materials”, an H2020-funded project aiming at improving the availability and accessibility of data and information on SRM (Secondary Raw Materials) in the EU territory, while creating collaborations and synergies among the different stakeholders involved in the SRM value chain, www.smart-ground.eu

PRESENTATION OF RAWFILL

RAWFILL (“Supporting a new circular economy for RAW materials recovered from landfills”) is an INTERREG EU-funded landfill mining project, gathering partners and associated partners of North-West Europe regions and supported by EURELCO. RAWFILL was launched in March 2017 and will end in March 2020.

The ultimate goal of RAWFILL is to allow North West Europe public & private landfills owners & managers to implement profitable resource-recovery driven landfill mining and enhanced landfill mining projects, hereunder named LFM or ELFM according to the context.

RAWFILL develops a cost-effective standard framework for creating landfill inventories (ELIF) based on existing experiences, an innovative landfill characterization methodology by geophysical imaging and guided sampling and an associated Decision Support Tool (DST) to allow smart ELFM project prioritization. The whole concept will be demonstrated in 2 pilot sites in Flanders (Meerhout) and France (Les Champs Jouault). Additional geophysics calibration operations will take place on a few other landfills where specific information is available.

More information about RAWFILL and its progress reports can be found at the project site: www.nweurope.eu/rawfill

The ELIF will be used to describe landfills not only in terms of environmental and risk issues, but will focus on the quality and the quantity of dormant materials lying on them, in order to supply relevant data for stakeholders involved in ELFM projects.

The ELIF is the basis for the DST ranking tool and so a prerequisite to assess feasibility, business plan & business cases for launching profitable projects.

The DST is a ranking tool that will allow ELFM projects prioritization based on a set of suitable physical, chemical, environmental, technical and social information. It will integrate the multiple aspects involved in ELFM projects, i.e. economic, technical, environmental & social factors in order to compare and classify landfills regarding their ELFM interest.

PRESENTATION OF WP T1 “ENHANCED INVENTORY FRAMEWORK”

One main challenge for stakeholders involved in ELFM operations is to evaluate the project profitability risk based on quantity and quality of dormant resources that can be excavated and recovered from a particular landfill site. Related reliable decision elements are missing in most of the landfill inventories we have reviewed, covering NWE region. The most advanced inventories describe landfills in terms of environmental and risk issues, but give no way to evaluate, even roughly, their dormant resources potential. In most cases, even the volume of waste remain unknown and only a very general information is given about waste type (which is very often a mixture of domestic, industrial and construction wastes).

A T.1.1 analyses current situation in NWE countries by collecting structures of public & private available LFs databases/inventories. Supported by the WP Leader, each partner collects data from its region, while the WP leader uses the EURELCO network to gather additional information.

A short review of landfill mining experiences, presented hereunder (WP T1 – Activity A T.1.2) and focused on the methodology applied to evaluate the landfill resources potential, shows that, in the studied cases, no specific particular attention was given to the precise evaluation of resources. Other important factors lead to the decision of mining the landfill, as solving an environmental issue, recovering valuable land or performing feasibility tests. This situation is expected to change as far as the ELFM market will grow and, within North-West Europe, because some mineral resources will request more attention. For sure, in a high density populated area, the economic value of the land that can be reclaimed trough an ELFM project will remain a key decision factor.

A T.1.2 performs a benchmark analysis of the existing LFM initiatives (+/- 20 in Europe), including legal, technical & economic issues, focusing on how the raw material content of the LFs was estimated, the accuracy of the evaluation and its economic impact in the (positive or negative) results.

Regarding existing information, the level of accuracy of some data is sometimes difficult to estimate, for example the indicated surface of the landfill which is mixed with the total surface of the site, the volume of waste which can be just a draft estimation based on a mean height, the type of waste which remain generic in uncontrolled landfills, etc. . As this precision is very important for launching a LFM feasibility study, our ELIF should specify for each DST-relevant field an accuracy



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estimation that will be taken into account for the ranking. The simplest one will be a classification as “poor/average/good/unknown”.

Analysis of A T.1.1 and A T.1.2 will lead to establish a list of suitable fields for our ELIF, which is part of the 3rd activity of the Work Package that will be presented in 2018:

A T.1.4 supplies the enhanced ELIF, i.e. a database structure taking into account LFs resources, under the form of 1) a list of fields (“indicators”) and 2) a spreadsheet (“tool”). Only the first deliverable “indicators” is presented here.

A T.1.2 Benchmark analysis of existing LFM initiatives

Partners involved

Lead Partner

- Atrasol sprl

Partners involved

- BAV
- NERC
- SAS Les Champs Jouault
- SPAQuE
- OVAM
- ULiège

Landfill mining experiences

- Depollution by mechanical sorting of the Beaucens Landfill, Conseil Départemental 64, France
- Landfill Mining in Denmark, DGE Group
- Skarup Landfill Mining in Skanderborg, Denmark
- LFM project in France, Opale Environnement
- LFM pilot projects, North-Brabant, The Netherlands (3 LFM experiences)
- Landfill Mining Projects in Denmark, René M. Rosendal,, Danish Waste Solutions ApS (5 projects)
- Landfill Mining & Reclamation at Sandford Farm, Reading, UK, Duncan Scott (VertaseFLI)

Other documents of interest

- COCOON, questionnaire on landfills, landfills management and (enhanced) landfill mining in the EU, March 2017

- Characterization of fine fractions from LFM: a review of previous LFM investigations, Hernandez, Höllen & Pompberger, Proceedings Sardinia 2017 / Sixteenth International Waste Management and Landfill Symposium
- Landfill reclamation, effect on waste age, Gary A. Foster, Lancaster County, MSW assessment of landfills
- Caractérisation de l'évolution de l'état de biodégradation des massifs de déchets non dangereux en post-exploitation : application de méthodes géophysiques, Thèse ANRT, IRSTEA, site des Champs Jouault
- Landfill Mining: An Option to Trigger Resources?, Prof. Dr.-Ing. Peter Quicker, RWTH Aachen University –Unit of Technology of Fuels, 8th CEWEP W2E congress, 2016, Rotterdam
- BAT (Best Available Techniques) Reference Document, Waste Treatment Industries, August 2006, European Commission
- BAT (Best Available Techniques) Reference Document, Waste Incineration, August 2006, European Commission
- Improved Landfill Mining, Biotechnology Advances. Volume15, Issue 2, 1997
- BENVITEC-IBH, Rehabilitation by LFM of 2 landfills in Alicante, Spain, prefeasibility assessment, March 2006

Analysis of existing experiences

This short review of landfill mining experiences, still in progress, focuses on the methodology applied to evaluate the landfill resources potential. It shows that, in most of the studied cases, no specific particular attention was given to the precise evaluation of resources. Other important factors lead to the decision of mining the landfill, as solving an environmental issue, recovering valuable land or performing feasibility tests.

Confidentiality is quite high in that particular domain, and many of the results have not been published. So, we will not give a detailed review of experiences that, in many cases, do not supply a lot of information.

The following questions were asked:

- Type of ELFM project: R&D/pilot size/real size
- Dates
- Main difficulties encountered (legal/technical/economic)
- How was the content of raw materials evaluated?
- What was the feedback of this evaluation?
- Recommendations for future projects?

The table hereunder summarizes the results for the 14 cases studies

Feature	Amount
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R&D/business model development	5
Pilot size	5
Real size	4
Historical study performed	13
Sampling on site	13
Geophysics performed	3
Detailed composition known	13

Among the problems encountered:

- presence of asbestos,
- bad estimation of volume due to soil irregularities and unexpected buried masses of wastes,
- bad estimation of composition based on simplified historical studies,
- low value for materials (excepted metals, but they count for 1 or 2 % inside domestic waste landfills).
- in all cases, the % of “fine” materials that cannot be valorised is high, more than 40%. (“Fine” materials are not precisely determined, as they are sometimes described as “soils”, but we can assume that this fraction size distribution is between 0 and 30 to 50 mm. Very often, it increases with the age of the wastes.)

Real cases were performed to solve environmental urgent problems and recover volume for further landfilling or reclaiming land, which is also the purpose of some pilot and R&D cases.

Geophysics is sometimes performed, through Georadar and EM- electromagnetic prospection, with not so good precision, probably due to insufficient calibration and lack of cross-overs between several methods.

First conclusions

Until now, not much focus has been put on the evaluation of the lying resources that can be found in landfills where ELFM works, pilot or real scale, have been performed.

One explanation is that the decision of mining these landfills was taken regarding other parameters, as solving an important environmental issue or reclaiming valuable land. The valorisation on the waste was more seen as a “by-product” of the whole ELFM process.

As the benefits of the recovery were expected to be very limited, not much efforts have been made to evaluate the content of resources prior to performing the works.

Evaluations were of limited precision, regarding waste volume or geophysics.

This situation is expected to change as far as the ELM market will grow and, within North-West Europe, because some mineral resources (let's think of Aluminium for instance) will request more attention. So, the RAWFILL methodology will really become necessary in order to select profitable projects.

For sure, in a high density populated area as NWE, the economic value of the land that can be reclaimed through an ELM project will remain a key decision factor.

As far as geophysical imaging is concerned, the use of a lot of different methods on the same landfill promoted by RAWFILL seems to be a pre-requisite for a precise evaluation of the landfill geometry and the waste composition.

ANNEX: Questionnaire 2 « LFM Initiatives »

**WORKPACKAGE WP T1
ENHANCED LANDFILL INVENTORY FRAMEWORK (ELIF)
REQUEST FOR INFORMATION – LANDFILL MINING
EXPERIENCES**

1. Introduction

RAWFILL (“Supporting a new circular economy for RAW materials recovered from landfills”) is a new EU-funded landfill mining project gathering partners and associated partners of EU NWE regions and supported by EURELCO.

The ultimate goal of RAWFILL is to allow NWE public & private landfills owners & managers to implement profitable resource-recovery driven landfill mining projects.

RAWFILL develops a cost-effective standard landfill inventory framework (ELIF) based on existing inventories and experiences, an innovative landfill characterization methodology by geophysical imaging and guided sampling and an associated Decision Support Tool (DST) to allow smart LFM project prioritization. The whole concept will be demonstrated in 2 pilot sites in Flanders and France.

ELIF will be used to describe landfills not only in terms of environmental & risk issues, but will focus on available dormant materials, so that it will be possible to economically evaluate later the resource-recovery potential of each landfill. ELIF is the basis for our DST ranking tool and so a prerequisite to assess feasibility, business plan & business case for launching profitable landfill mining projects.

More information:

<https://www.eurelco.org/single-post/2017/04/10/EURELCO-partners-win-Interreg-North-West-Europe-project-RAWFILL-1>

<http://www.spaque.be/0114/fr/1309/SPAQuE-leader-du-projet-europeen-RAWFILL?from=139&artid=596>

Any general question?

Please contact SPAQuE – Marta Popova, m.popova@spaque.be

2. Request to landfill mining projects managers - Benchmark analysis of existing landfill mining initiatives

2.1 Why do we ask you some information?

We would like to perform a short benchmark analysis of the existing landfill mining initiatives, including main legal, technical & economic issues, focusing on how the raw material content of the landfill was estimated, the accuracy of the evaluation and its economic impact in the (positive or negative) experience results.

We would be pleased to receive from you any suitable information you agree to share related to above topic.

Shouldn't you in charge of supplying this information, please let us know who else we can contact!

We will of course invite you to share the results of RAWFILL through several events that we will organize in the next 3 years, and will send you a detailed summarized report of our works to thank you for your cooperation.

Should you be interested to become part of our Associated Partners team, do not hesitate to come back to us.

Please note we would appreciate to receive some information before 15th June.

The attached questionnaire is given hereunder.

Once again, we would like to thank you for supporting the emergence of a suitable landfill mining industrial sector!

2.2 The Request

Please note that only aggregated results will be published, without mentioning any origin of the data nor specific project information.

No information will be disclosed without your prior authorization.

Here is the information's we would be pleased to receive from your organization:

2.3 Questionnaire

Your organization:

Your name:

Position:

Mail:

Tel:

Name of your project:

Type of project (please select one):

- R&D How many m³ of waste are concerned?
- Pilot size How many m³ of waste are concerned?
- Real size How many m³ of waste are concerned?

Short description of the project:



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Date start:

Date End:

Difficulties encountered:

- Legal issues (please describe):
- Technical issues (please describe):
- Economic issues (please describe):

How did you measure/evaluate the content of raw materials to recover in the landfill?
(please give as much details as you can – that part of the benchmark is very important
for us)

Which feed-back can you give us about that?

What would you recommend to do for a future project?

Would an enhanced landfill inventory structure as we propose to supply with RAWFILL
be helpful for you?

Are you interested in the RAWFILL Decision Support Tool we would like to set up?

Thank you once again for your cooperation!

Any technical question? Please contact Ir. Renaud De Rijdt, renaud.derijdt@gmail.com