



Lessons learned and recommendations based on the 4.5-yr project experience

Benchmark of existing ELFM initiatives

- Difficulty to collect data from private companies
- ELFM projects are often considered as confidential
- Recovery of raw materials from landfills is not the only driver to start an ELFM project

Drivers:

- Reclaiming land (e.g., redevelopment project in a high land pressure area)
- Environmental risk (e.g., flooding risk, pollution)
- Health issues
- Landscape visual impact
- Regaining void space (in case of a landfill still in operation)
- Infrastructure projects
- Recreative areas
- Biodiversity/biomass
- Green Energy

Benchmark of existing ELFM initiatives

Most profitable drivers:

- Recovery of land (especially in areas characterized by high land value)
- Implementation of redevelopment projects
- Onoz site – value of lime and ashes – low value of the land
- Lingreville – environmental risks, visual aspects (wastes in the see)
- Le Marais – environmental risks – protection of the drinking water quality – infrastructure project

Benchmark of existing ELFM initiatives

The benchmark identified a series of reasons explaining why the existing initiatives were not economically successful:

- Not assessing the **presence of asbestos**
- **Bad estimation of volume** due to soil irregularities and unexpected buried volumes of waste materials.
- **Bad estimation of waste composition**
- **Overestimation of the selling prices** of metals and other materials.
- The **percentage of “fine”** materials was generally higher than expected (more than 40%).

Benchmark of existing ELFM initiatives

RAWFILL's solutions:

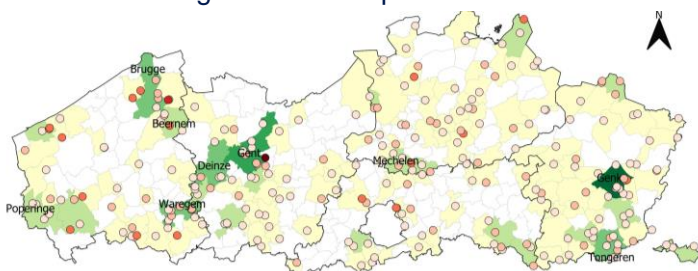
- ELIF included the possibility to integrate asbestos quantities into the description of the waste mass.
- HADESS methodology (multi-methods geophysical imaging combined with targeted sampling) can improve the estimation of waste volumes.
- RAWFILL provides a standard methodology to describe the waste composition more precisely.
- It is necessary to assess better the quality of metals and other materials in order to evaluate the profitability of the valorization. This data is now included in the business model.

The Cedalion tool in practice:

Afforestation potential of landfills?

Step 1: prospection

Indicating afforestation potential of landfills



Legende

Gemeenten met meer dan 5 SP met basspotentieel en waarvoor nog verder bodemonderzoek nodig is, zijn aangegeven met bijhorend label.

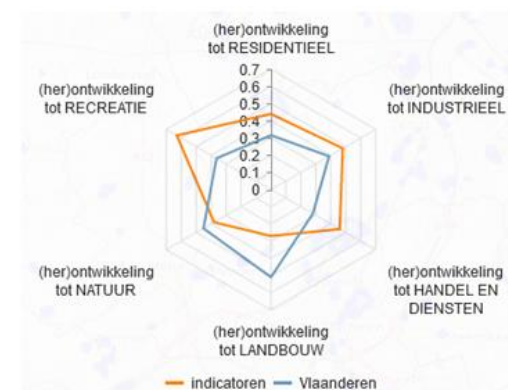
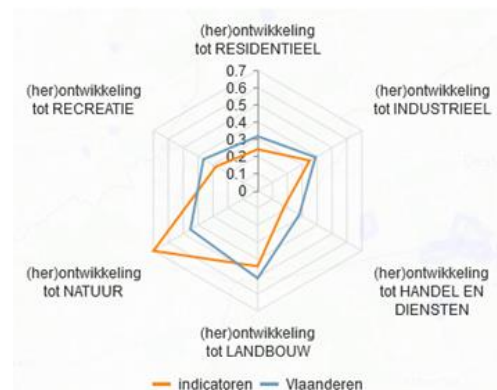
Ranking per CEDALION categorie				Recalculate ranking				Ranking based on data in working database			
Ranking Waste-to-Material		Ranking Waste-to-Energy		Ranking Waste-to-Land		Ranking Intermediate Use		Ranking Waste-to-Material		Ranking Waste-to-Energy	
Minimum	5.0	Minimum	6.0	Minimum	11.0	Minimum	9.0	Minimum	5.0	Minimum	6.0
Maximum	73.0	Maximum	55.0	Maximum	115.0	Maximum	83.0	Maximum	73.0	Maximum	55.0
Average	27.2	Average	38.7	Average	53.8	Average	51.4	Average	27.2	Average	38.7
Median	21.0	Median	33.0	Median	55.0	Median	52.0	Median	21.0	Median	33.0

Landfill	Value	Landfill	Value	Landfill	Value	Landfill	Value	Landfill	Value	Landfill	Value
1914	73.0	49	55.0	2172	115.0	1735	83.0	1	Medium term interim use	Infrastructure development (e.g. solar panels)	
2480	72.4	184	55.0	2284	113.3	28	82.0	1	Orion	Land value/pressure	
87	71.0	455	55.0	5181	111.0	986	82.0	9	Orion	Land value/pressure	
2727	71.0	2272	55.0	2292	109.3	1460	81.5	13	Medium term interim use	Agricultural development	
3181	71.0	15	54.0	2295	109.7	595	81.0	13	Orion	Land value/pressure	
3128	70.0	195	54.0	2006	105.5	2553	81.0	22	Medium term interim use	Potential ecological risk in the future (non-inert waste)	
710	69.5	1010	54.0	1623	105.0	2701	81.0	22	Medium term interim use	Nature development	
3503	69.0	1029	54.0	61	103.5	2817	81.0	22	Long term interim use	Nature development and conservation	
2773	68.8	2100	54.0	955	103.0	802	80.5	22	Long term interim use	Nature development	
1623	68.5	2186	54.0	2675	103.0	1972	80.5	22	Orion	Land value/pressure	
2273	68.0	73	53.0	8366	102.3	336	80.0	27	Long term interim use	Nature development and conservation	
3336	68.0	949	53.0	948	102.0	687	80.0	28	Long term interim use	Nature development and conservation	
348	67.0	816	53.0	1503	102.0	1043	80.0	28	Long term interim use	Nature development and conservation	
2045	67.0	1209	53.0	2273	101.8	2220	80.0	39	Medium term interim use	Potential ecological risk in the future (non-inert waste)	
2364	67.0	2390	53.0	710	101.5	2669	80.0	39	Long term interim use	Nature development and conservation	
2419	67.0	2419	53.0	1045	101.3	1674	80.0	40	Orion	Land value/pressure	
2550	67.0	2507	53.0	2095	101.3	2844	80.0	41	Long term interim use	Agricultural development (e.g. agroforestry)	
2675	67.0	3048	53.0	2550	101.3	3411	79.7	43	Medium term interim use	Agricultural development	
3331	67.0	1433	52.5	350	101.0	1394	79.5	52	Long term interim use	Agricultural development (e.g. agroforestry)	
1433	66.5	1219	52.0	1047	101.0	1074	79.5	52	Long term interim use	Nature development	
3	66.0	1318	52.0	3343	101.0	52	79.0	58	Orion	Land value/pressure	
195	66.0	1521	52.0	1895	100.5	131	79.0	61	Orion	Land value/pressure	
1899	66.0	1876	52.0	1791	100.3	737	79.0	66	Orion	Land value/pressure	
1503	65.5	72	51.0	77	100.0	908	79.0	72	Orion	Land value/pressure	
69	65.0	90	51.0	2681	100.0	1568	79.0	74	Orion	Land value/pressure	

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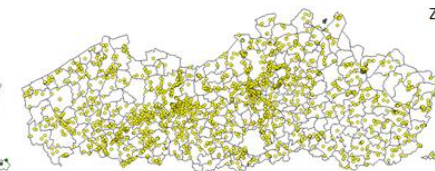
Co-funded by the
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SBZ bos



Zonne-energie



SBZ natuur



Woonuitbreiding



Buurtgroen



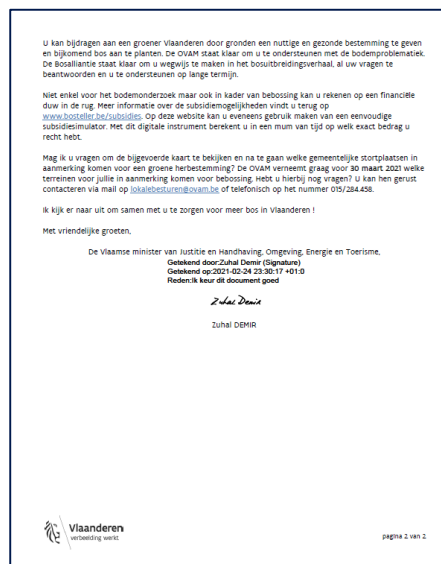
Windenergie



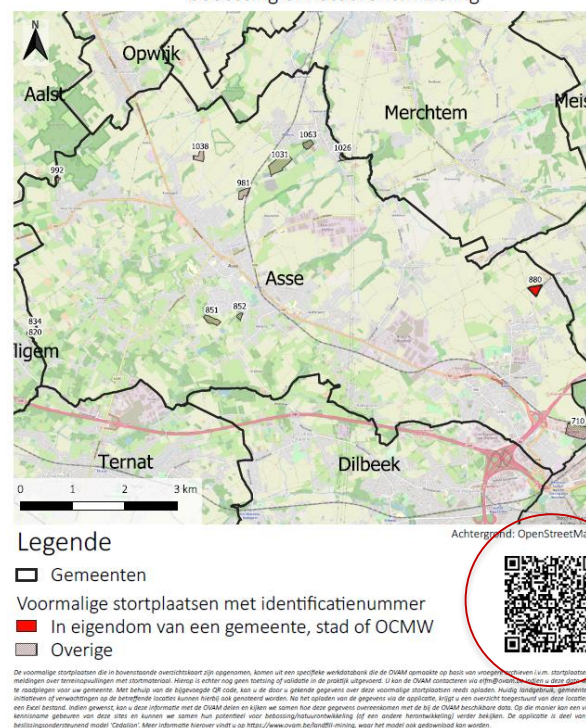
The Cedalion tool in practice:

Afforestation potential of landfills?

Step 2: Letter send from the office of our minister, with Cedalion QR code and a map of the landfills



SAMEN MAKEN WE MORGEN MOOIER
OVAM
Overzichtskartaat van de door de OVAM gekende voormalige stortplaatsen in Asse, die mogelijk in aanmerking komen voor bebouwing of natuurontwikkeling



Data collection & validation by municipalities

The Cedalion tool in practice:

Afforestation potential of landfills?

Step 3: Municipalities can access Cedalion GIS data online by means of the OVAM online platform for local authorities

Cedalion GIS data on municipal data platform

OVAM Samen maken we morgen mooier

GI Oudisbergen (Nieuwe fusiegemeente)
Zoeken Documenten Zoeken afteestanden Dossier 77697 Opdracht 8985472

Gemeentelijke inventaris Zoeken Melden Schadegeval Bodemverontreiniging Beheer Afmelden

Misl OVAM
bodem@ovam.be bodemvragen/stantenbeheer
lokalebesturen@ovam.be inventarisvragen

Wettige links

- OVAM-Website
- Bodemdecreet
- Vlaarbo
- Emia-referentielijst Vlaamse sublietien
- Bisico Inrichtingentool (BIT)
- Hyle bij overdracht
- Gesloten
- Elder cardiodie nlicht
- Elder inventaris van risicooronden
- Handleiding en Richtlijnen
- Informatie over de Gemeentelijke Inventaris (GI)
- Informatie over het Grondeninformatieregister (GIR)
- Informatie over het Raamcontract Bodemonderzoeken
- Ditbaal meldingsformulier voor schadegevallen en melding bodemverontreiniging

Documenten

Titel
Inventaris Provincies Antwerpen, Limburg en Vlaams-Brabant
Draaiboek
Bestek Raamcontract Bodemonderzoeken Antwerpen - Vlaams-Brabant - Limburg

Gis-bestanden

Gis-bestanden - Laatste oeverijod op 12.04.2021 20:23:59

Version: 4.4.21 --- Bamboo Build: Mistral - Operational - Mistral build and deploy to nexus - release-4.4 - Default Job 25 --- Branch: Revision: b6f41d3c85a099eac7c693c5f515b9c1f801b2d --- Timestamp: 13.25.10 31/03/2021

Descriptive document with more information about Cedalion and the field application

Kenmerken van de voormalige stortplaatsen

Op basis van beschikbare dossierinformatie werden de onderstaande kenmerken van de voormalige stortplaatsen opgenomen in de Cedalion dataset of inventaris. Deze inventaris is gebaseerd op het beslissingsondersteunend model Cedalion, dat ontwikkeld is in kader van het Europees Interreg project RAWFILL. Meer informatie over dit project vindt u [hier](#), het beslissingsondersteunend model kan u [hier](#) downloaden.

In deze databank ontbreekt echter nog heel wat informatie. Daarom werd binnen RAWFILL ook een applicatie ontwikkeld waarmee bepaalde informatie over de stortplaatsen op een eenvoudige manier opgeladen kan worden via onderstaande QR code. Zo kunnen gemeenten deze databank aanvullen, updaten of corrigeren op basis van terreinkennis en/of documentatie die zij beschikbaar hebben.



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Een stap-voor-stap handleiding voor het gebruik van deze QR code vindt u [hier](#) (deze handleiding is opgesteld in kader van het bebossingsproject waarvoor we de gemeenten contacteerden begin maart 2021). Het DLM ID komt overeen met het ced_id (zie algemene info in dit document). De naam van de stortplaats kan u zelf vrij kiezen.

In de veldapplicatie wordt voor criterium 6 - Omgeving gevraagd om te duiden wat het actueel en potentieel landgebruik is op de stortlocatie. Dit wordt gevraagd in de vorm van ja/nee vragen voor de verschillende landgebruiken. Om hiervan reeds een algemene inschatting te geven, heeft VITO met behulp van het Ruimtemodel Vlaanderen de huidige en toekomstige bestemming op de stortplaatsen uit onze dataset bepaald. Daarom wordt hier gewerkt met het percentage aandeel van het stort dat onder een bepaald landgebruik of bestemming valt. Informatie uit de praktijk die via de applicatie verzameld kan worden, blijft hier echter zeer belangrijk en kan de informatie uit het Ruimtemodel dan ook overrulen.

Kenmerken van stortplaatsen en terrein

Cedal_id:	DLM ID
Stort_opp:	oppervlakte van het stort (ha)
Diepte_mv:	diepte van het stort onder het maaiveld (m)
Hoogte_mv:	ophoging van het stort boven het maaiveld (m)
Volume:	volume van het stort (m³)
Afdek:	type afdeklaag van het stort (geomembraan, minerale afdeklaag of grond)
Terrein:	kenmerken van het terrein (gras, braak, struikgewas, bomen of andere)
Helling:	hellingsgraad op het terrein (vlak, minder dan 15° of meer dan 15°)
Erosie:	indicatie van erosie (geen, zwak of ernstig)
Toegang1:	aanwezigheid van verharde wegen rondom de stortplaatslocatie (ja of nee)
Toegang2:	toegankelijkheid voor zwaar vervoer (ja of nee)

The Cedalion tool in practice:

Afforestation potential of landfills?

Lessons learned:

- Increase of interest in redevelopment of landfills if a certain advantage is offered (in this case a free preliminary soil investigation)
- If afforestation is not an option, local authorities are triggered to consider alternatives for redevelopment
- Increasing awareness
- Importance of a clear communication on the purpose of the QR and the specifications of the application
- Local authorities often preferred other ways of sharing their data (in the way in which they have it available)

Geophysical investigations performed on landfill sites

Desk study and prior information collection

- Desk study is required prior to the geophysical investigations in order to select the most suitable geophysical methods to characterize the selected landfill.
 - Historical study
 - Geological map
 - Satellite image analysis :
 - to detect the main landfilling activities on site;
 - to predetermine the landfill lateral extension;
 - to identify different layers of waste deposits;
 - to detect the potential presence of unexploded WWII bombs.

Geophysical investigations performed on landfill sites

Desk study and prior information collection

- Site visit :
 - to identify potential disturbances/noise sources on the landfill (e.g. fences, metallic objects on the surface)
 - to check the accessibility (vegetation, etc.)
 - to verify the presence of a geomembrane

Geophysical investigations performed on landfill sites

		Mapping		Profiling							
		EMI	MAG	ERT	IP	MASW	SRT	GPR	HVSRN	SP	GRA
Landfill structure	Lateral extent										
	Cover Layer thickness										
	Vertical extent										
	Buried utilities										
Landfill characterisation	Waste zonation										
	Leachate content										
Environmental conditions	Host material										
	Groundwater table										
Staff required for survey											
Required time for survey											
Required time for processing											

Primary method
 May be used but not the best method
 Unsuitable

Geophysical investigations performed on landfill sites

Two steps:

- **Step 1:** a quick survey of the landfill conducted using geophysical mapping methods (electromagnetic induction or magnetic) to identify the lateral zonation of waste.
- **Step 2:** to investigate identified zones in more detail, profiling methods (such as electrical resistivity tomography or induced polarization) providing better vertical resolution can be applied.

Waste sampling

- Every detected geophysical anomaly should be sampled in order to provide a detailed correlation analysis.
- On municipal solid waste landfills, sampling data from boreholes are not necessarily well correlated with geophysical data.
- Boreholes provide high-resolution images very locally (punctual information)
 - not representative of the heterogeneity found in these landfills.
 - too small borehole diameter might not provide representative samples since waste items with a larger diameter could be “pushed to the side”.
 - be used to detect interfaces between distinct waste facies.



Preference should be given to trenches and trial pits

Waste sampling

- Trenches and trial pits
 - incorporate a larger volume than boreholes
 - a limited depth of investigation
 - Temperature measurement (useful parameter for biodegradation process)

Elaboration of a business model

- key to assess if the landfill is suitable to launch profitable ELFM project.
- should take into account not only the material, energy and land recovery but should also assess the economic values of social and environmental benefits.
- Prices were difficult to obtain as private companies involved in ELFM project are not keen to share their substantial financial revenues.
- Main expenditure items are staff costs, waste transportation and treatment costs.

Elaboration of a business model

- It is only valid for a short time span and should be updated regularly based on the current market price
- Main revenues highly depend on the excavated material quality and quantity
- If ELFM project not profitable → the development of an interim use
- Business model template is available on the RAWFILL website.

Preliminary assessment of the environmental and social impact for RAWFILL landfill pilot sites

	Impacts during the ELFM operations	Impacts after the completion of the ELFM project
Land		<ul style="list-style-type: none">• (+) Increase of the land value surrounding the site.• (+) Limitation of the urban sprawl on greenfield.• (+) Limitation of greenfield use for new redevelopment project.• (+) Creation of a protected natural area (in some cases).

Preliminary assessment of the environmental and social impact for RAWFILL landfill pilot sites

	Impacts during the ELFM operations	Impacts after the completion of the ELFM project
Soil	<ul style="list-style-type: none"> (-) Risk of soil contamination. 	<ul style="list-style-type: none"> (+) No more risk of soil contamination.
Air	<ul style="list-style-type: none"> (-) Risk of explosion or fire. (-) Emission of dust during excavation. 	<ul style="list-style-type: none"> (+) No more landfill gas emission. (+) Improvement of the air quality.
Water	<ul style="list-style-type: none"> (-) Risk of surface and groundwater contamination. (-) Risk of leakage. 	<ul style="list-style-type: none"> (+) No more risk of leakage of contaminants directly to the groundwater and the surface water (+) Improvement of the groundwater quality.

Preliminary assessment of the environmental and social impact for RAWFILL landfill pilot sites

	Impacts during the ELFM operations	Impacts after the completion of the ELFM project
Landscape	<ul style="list-style-type: none"> (-) Negative visual impact. 	<ul style="list-style-type: none"> (+) Reduced prominent shape of the landfill → less or no disruptive landscape. (+) Restoration of a natural dune complex. (+) Reshaping of the site and slope stabilization.
Biodiversity	<ul style="list-style-type: none"> (-) Disturbance of the fauna and flora. 	<ul style="list-style-type: none"> (+) Diversification and increasing of the biodiversity on site. (+) Eradication of invasive species (e.g. the Japanese Knotweed).

Preliminary assessment of the environmental and social impact for RAWFILL landfill pilot sites

	Impacts during the ELFM operations	Impacts after the completion of the ELFM project
Climate	<ul style="list-style-type: none">• (-) Generation of CO₂ during the ELFM operations (excavation, waste transport, etc.).	<ul style="list-style-type: none">• (+) Avoids methane emissions → Reduction of the greenhouse effect.• (+) Revalorization of the metal content and other materials recovered from the landfill → Avoid CO₂ production.• (+) Valorization of the combustible fraction → substitution of fossil fuels.

Long-term effect of the RAWFILL project

- no country has currently specific national/regional frameworks or legislation that encourage ELFM projects.
 - Only the region of Flanders (Belgium) has enacted specific regulations: environmental permit code for ELFM projects, exemption of waste taxes, specific calls for brownfields with landfills.
- Need to continue the implementation of an interregional policy platform for the exchange of experience and a long-term perspective for a NWE or EU-wide consensus/strategy on ELFM.

LFM – not prohibited, not promoted

Long-term effect of the RAWFILL project



- At the moment, no specific rules were enacted at the EU level and member states apply various legislative frameworks to facilitate ELFM. Due to the fact that most ELFM projects are at the level of a pilot, nor the need nor the experience of a comprehensive legislation is in place.

European Parliament – 20th November 2018



Long-term effect of the RAWFILL project

Greendeal in Wallonia

- Like most of the NWE regions, there was no legal framework for ELFM project in Wallonia.
- Inspired by the Green deal from the Netherlands.
- A first Greendeal was signed in Wallonia to launch a ELFM project at Onoz site (one of the RAWFILL pilot sites).
- Serves as leverage for other ELFM initiatives in Wallonia.

LFM, when?

- LFM yes, but not only for material recovery
- LFM allows the increase of the LF capacity for waste storage
- LFM will reduce the environmental risks for environment (drinking water, etc..)
- LFM will allow the development of new projects on the recovered land
- LFM will reduce the costs of post management activities of a landfill
- LFM is one of the options for the dynamic management of landfills
- LFM is difficult to develop without an adapted legislation in the field of waste and landfills
- LFM depends on local conditions
- If needed, the aeration of a landfill should be activated before starting an LFM project
- **Interim use options are available, while waiting the right moment for LFM activities**

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Thank you!