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Sustainable stabilization of landfills – environmental revitalization and resources potential

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***Inovatīva atkritumu stabilizācija - vides ietekmju mazināšana
un resursu potenciāls aprites ekonomikā***

Projekta numurs 1.1.1.2/16/I/001

Pētniecības pieteikuma numurs 1.1.1.2/VIAA/3/19/531

The aim is to find sustainable resources recovery potential for fine fraction of landfill waste with objectives

- estimate recovery perspectives
- investigate interactions among remnant pollutants and organic matter in landfill fine fraction
- provide scientifically approved recommendations for land recovery and ecosystem revitalization in landfills in circular economy perspective

Material Recovery

Since 2002 prices on minerals have grown substantially

Global demand for minerals will double next 25 years, scarce elements are depleted soon
– landfill mining is recovery option



Landfill Mining

- ✓ Is the materials and energy recovery (excavation) from historically dumped waste – it is Innovation
- ✓ Reducing greenhouse gas emissions
- ✓ Landscape restoration



New market



Well established market

Completely new market

Benefits from Landfill Mining

is material and valuables recovery

Perspectives in Baltic States:

1700 closed landfills

2 million tons of refuse derived fuel

0.33 million tons of metals

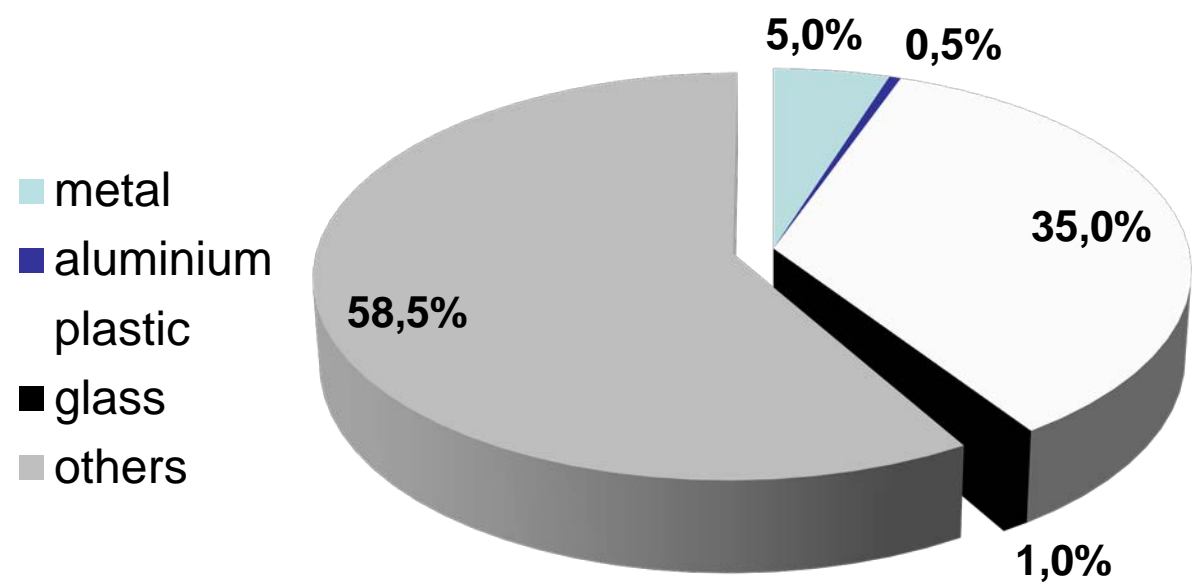
140 000 kg of Rare Earth Elements

Market potential

- Potential of revenues total in Latvia:

Landfills content	Shares	Weight, t	Price, t		Amount
metal	5.0%	110 000	€	189	€ 20 790 000
aluminium	0.5%	11 000	€	1 000	€ 11 000 000
plastic	35.0%	770 000	€	90	€ 69 300 000
glass	1.0%	22 000	€	-	€ -
others	58.5%	1 287 000	€	-	€ -
Total	100.0%	2 200 000			€ 101 090 000

Materials by type



Landfills content	Shares	Weight, t
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others	58.5%	1 287 000
Total	100.0%	2 200 000

Quality of Material from Landfill Mining

Challenges:

Innovative landfill mining includes extraction – plastic is wet and dirty; metallic elements mostly in residual bound with organics. Solutions: washing and drying plastic; separation of industrial waste from household waste. Latter is reject.

For RDF production burnable fractions are plastic

Innovative landfill capping includes LFM, where fine fraction is used mixed with soil and vegetation to improve greenhouse gas (methane) degradation by natural means; most adequate recipe for new capping material is the challenge

Quantitative and qualitative studies will be performed with real case studies during the project

Case study: Kudjape



Kudjape landfill/dump, Saaremaa island, Estonia

In operation 40 years, most active during last 20 years

Estimated volume 200.000 m³

Municipal waste

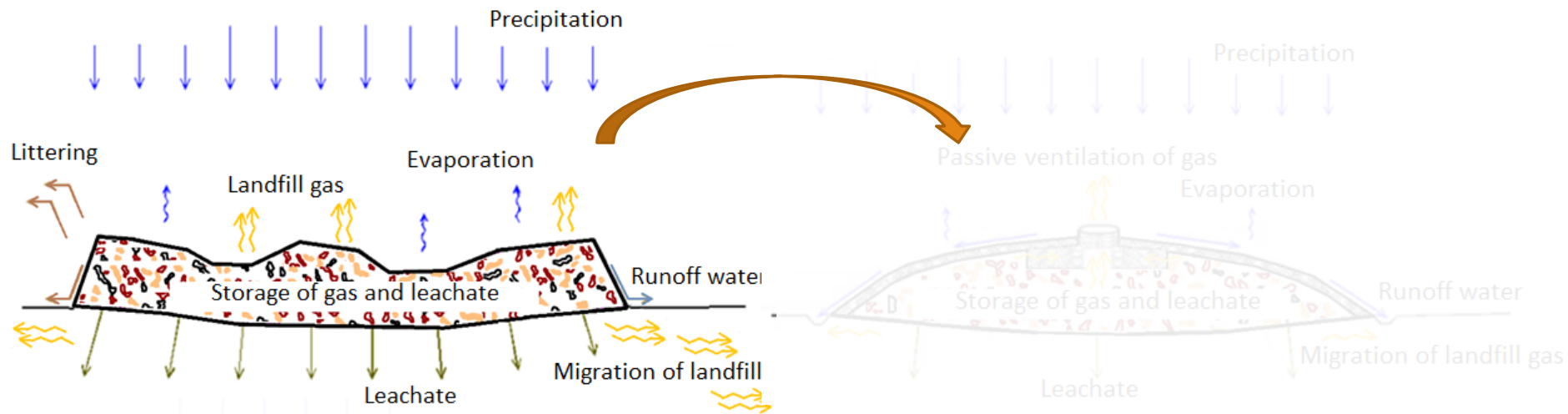
NO bottom liner

By **law** had to be capped 2013

Main issue: **Landfill gas**

- Gas collection? Passive ventilation?

Typical cover design in small dumpsites



Kudjape case was different

Simple closure design of a LF was **not agreed** by authority;

- Fear of gas → 1,5 m cover layer was prescribed;

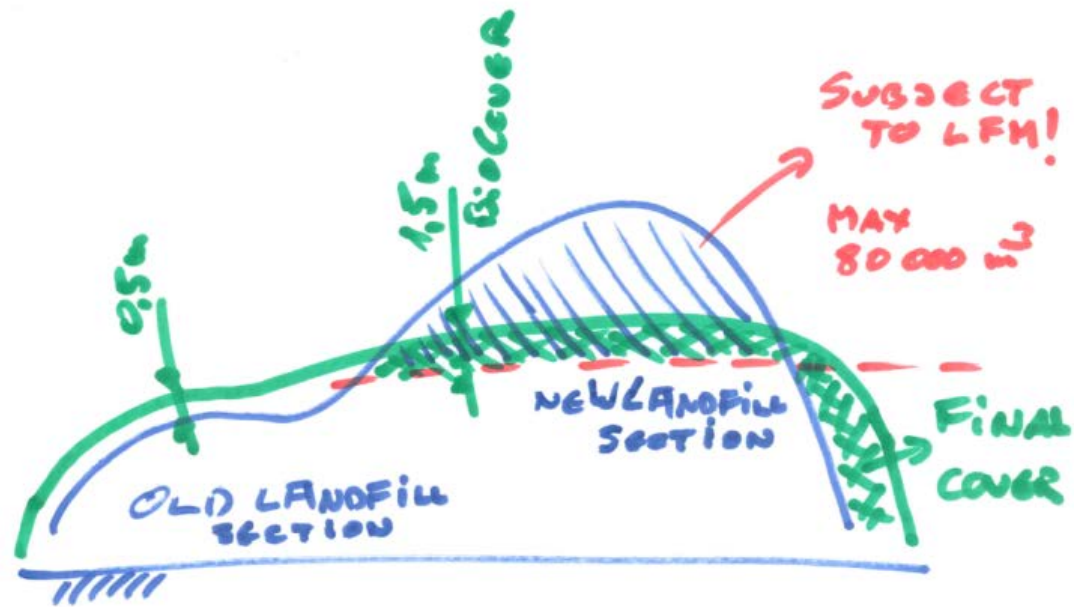
Cover material was **not available**.

- Cover material demand 60.000 t – locally not available
- To transport it from distances/overseas?
- Is it ethical to force LF using clean soil for covering waste?

What if we take cover material from the same landfill?

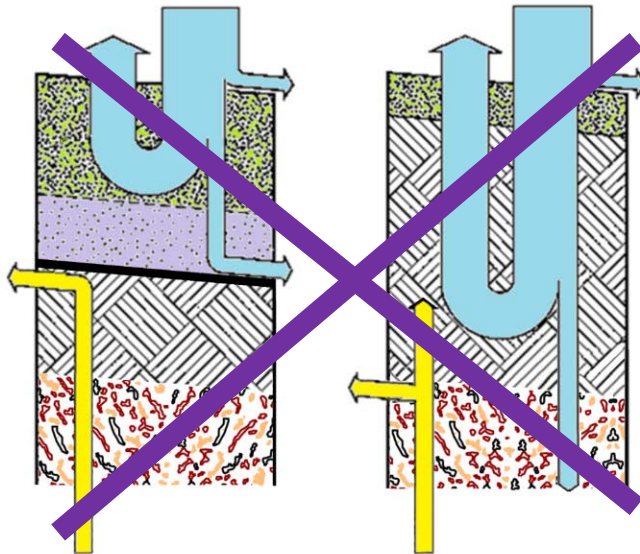
- This technology is called **Landfill Mining** (LFM)

Master plan

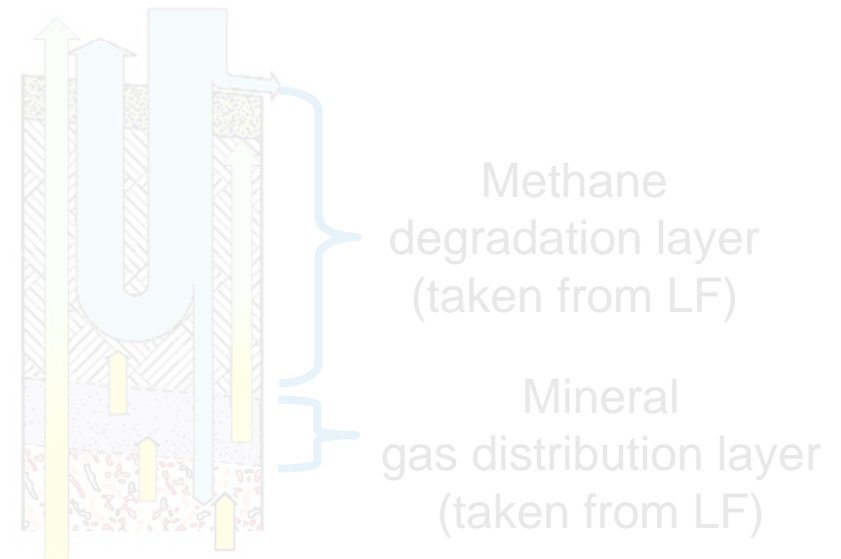


Design of a cover layer

Impermeable cover layer



Semi-permeable cover layer



Methane degrades: $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

Excavation in progress

About 55.000 tons were excavated during one year.



Methane degradation and biowaste separation and valorization challenges



Separation of waste + Sustainable landfilling + Sustainable closure = Clean Environment



Conclusions

Sustainable closure of landfills is important for circular economy

Monitoring of soil, water, leachate and gasses are compulsory

Hydrogeology and modelling

Emissions assessment / calculations are recommended

Resources recovery estimates and technological challenges solutions should be discovered in future

Future of landfills is: logistics centres for recycled material and industrial / thematic parks through revitalization of degraded areas

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THANK YOU VERY
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