

# Sustainable management of historic landfill sites - Mine it or leave it?

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Antwerp, 26/02/2018

## SUSTAINABLE LANDFILL MANAGEMENT & THE ROLE OF LANDFILL MINING

### Goals of waste management

- 1) Protection of human health & the environment
- 2) Resource conservation

### ⇒ Options for the management of historic landfills

- A) Regulated aftercare: Limit environmental damage through cover, emission treatment & monitoring
- B) Remove the source of contamination & re-landfill offsite / upgrade existing landfill
- C) Landfill mining

## LANDFILL MINING – DEFINITION

Landfill mining is a process whereby solid wastes which have previously been landfilled are excavated and processed **to recover items of value**, such as:

- Plastics
- Metals
- Glass
- Wood
- Soil
- New landfill space
- Land
- ...



## DRIVERS OF LANDFILL MINING

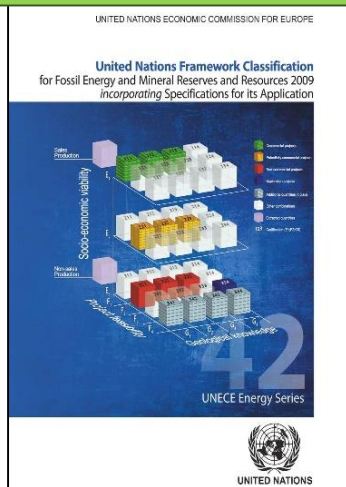
- Prevent soil & groundwater contamination
- Upgrade unlined landfills to a lined system
- Reduce closure & aftercare costs
- Material recovery
- Energy recovery
- Reduce greenhouse gas emissions
- Land reclamation
- New landfill space & lifetime extension of existing landfills



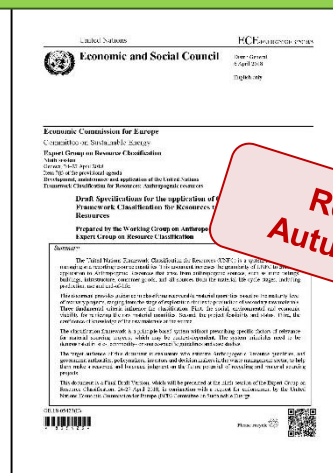
# HOW TO CLASSIFY LANDFILLS UNDER UNFC

## United Nations Framework Classification for Resources (UNFC)

### Generic Specifications for all resources



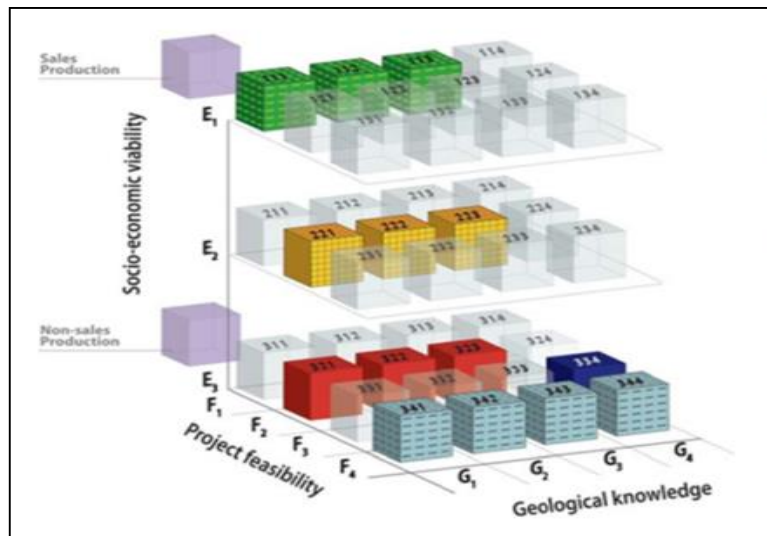
### Specifications for Anthropogenic Resources



## UNITED NATIONS FRAMEWORK CLASSIFICATION FOR RESOURCES (UNFC)

- Provide decision support for the management of old landfill sites
- Compare & prioritize different potential landfill mining projects
- Communicate critical factors & potential barriers (Winterstetter et al. 2015, 2018)

1. **Knowledge on composition**  
**G1 – G4**
2. **Economic viability**  
**E1 – E3**
3. **Technical feasibility & project status**
4. **F1 – F4**



## MINE IT OR LEAVE IT?

Screen data base  
Estimate a landfill's  
resource potential &  
contamination level

### 1. Prospection

### 2. Exploration

Assess recoverable  
materials / land as a  
function of technology &  
project set-ups

Evaluate a landfill mining project  
under specific technical, legal,  
economic, environmental & social  
conditions

### 3. Evaluation

### 4. Mining

## CLASSIFICATION

## PROSPECTION

Screen old landfills for criteria such as  
land price, high metal share, contamination potential,  
flooding risk, high aftercare costs,  
**= depending on interest of the evaluator**

Narrow down the number of potentially interesting landfills

Not relevant ones E3F3G4, with no information

1





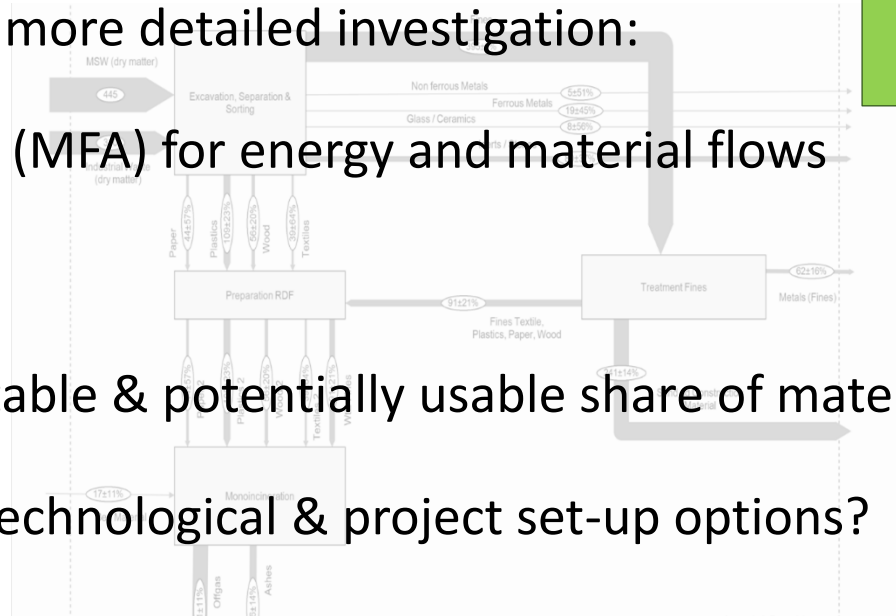
## EXPLORATION

For promising landfills more detailed investigation:

Material Flow Analysis (MFA) for energy and material flows

to demonstrate:

- a) The landfill's extractable & potentially usable share of materials
- b) Potential different technological & project set-up options?



2

## EVALUATION

For landfills with promising composition & project set up :  
Discounted Cash Flow Analysis

3

$$NPV = -C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \dots + \frac{C_T}{(1+r)^T}$$

$-C_0$  = Initial Investment

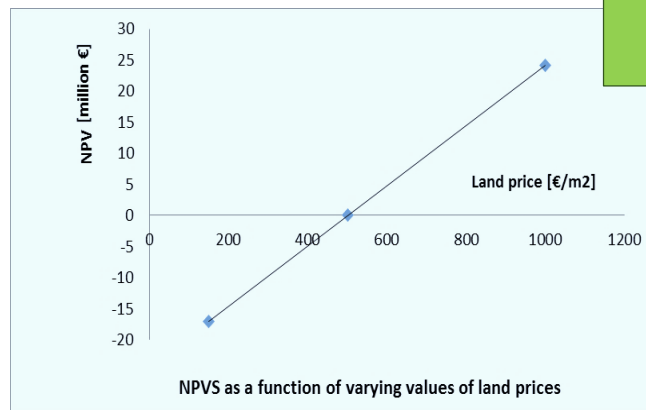
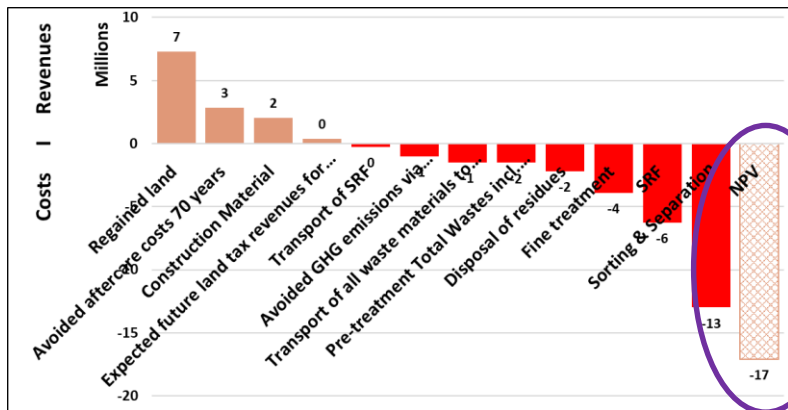
$C$  = Cash Flow

$r$  = Discount Rate

$T$  = Time

**Net Present Value (NPV) > 0:  
Project viable**

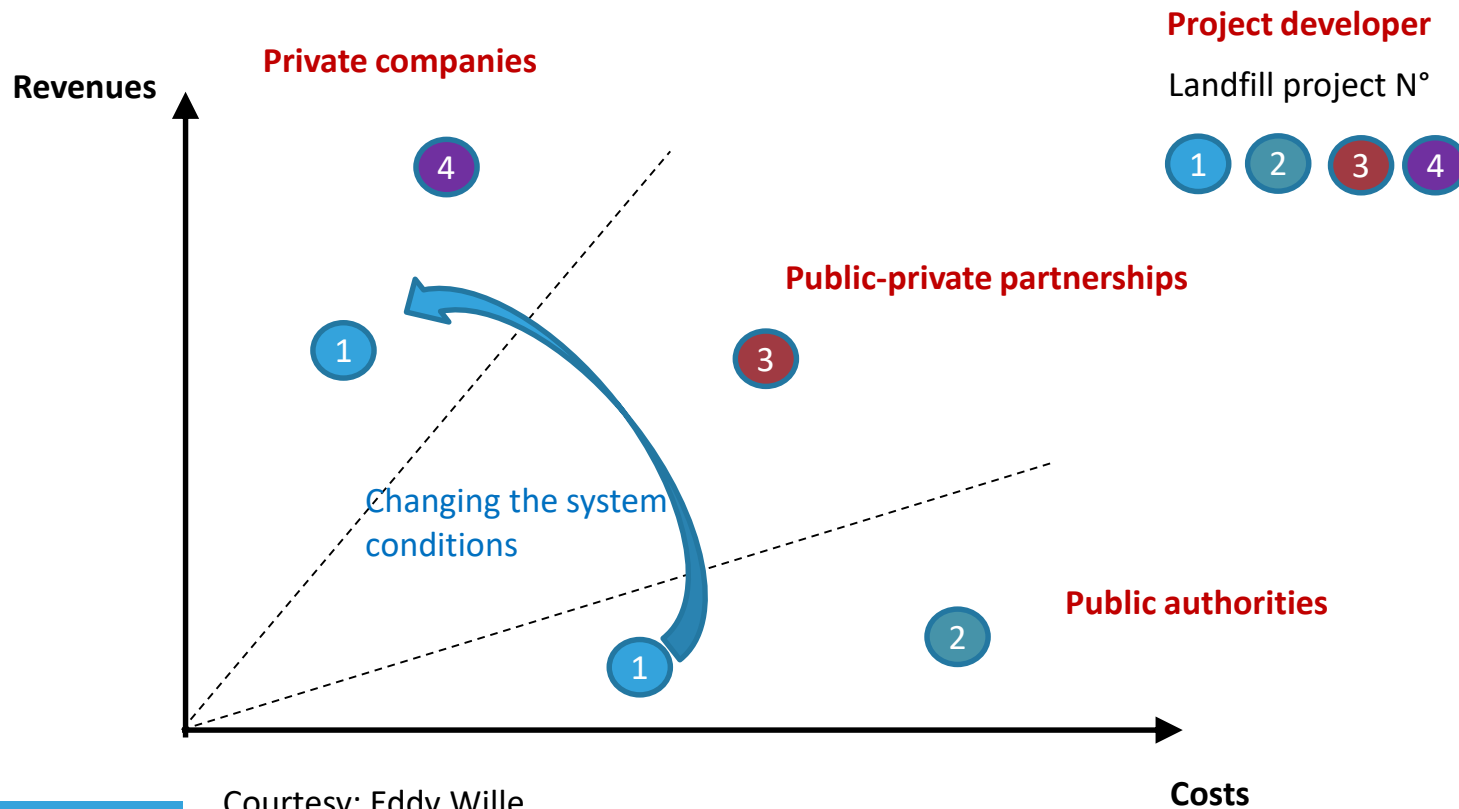
## ECONOMICS NEGATIVE?



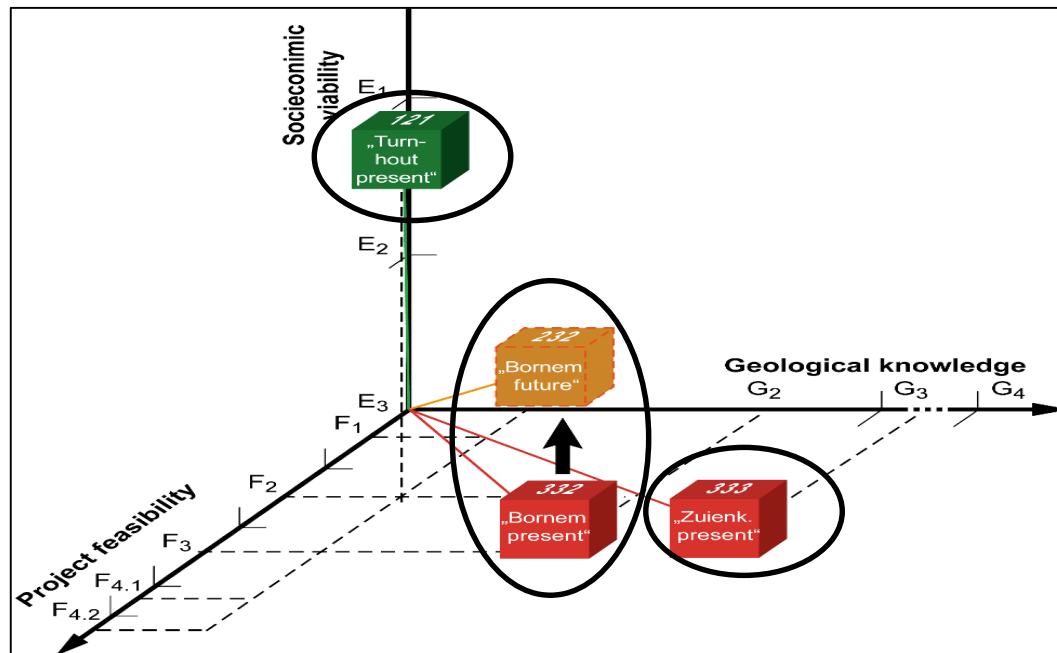
3

**NPV < 0: Project currently not viable!**

- Realistic chances for economic extraction in the foreseeable future?
- Check: Development of prices, costs, new legislation, government incentives etc



# CLASSIFICATION UNDER UNFC



## Legend:

**E3F3G2:**

Bornem landfill under present conditions

**E2F3G2:**

Bornem landfill under potential future conditions

**E1F2G1:**

Turnhout landfill under present conditions

## CONCLUSIONS

**Evaluation must be performed on a case by case basis:**

- ✓ **Drivers & evaluation perspective:** Remediation, resource / land recovery, landfill space....
- ✓ **Site-specific parameters:** Type, location & land price, volume, composition,
- ✓ **Project-specific parameters:** Stakeholder (private or public investor), choice of technology, project set-up, permits & licenses, neighbors etc.
- ✓ **Systemic context:** Legislation, markets, regional infrastructure etc.
- ✓ **Timing of mining:** Future development of costs, prices, legislation, available data and information.

**UNFC allows for systematic comparison & prioritization of different potential LFM projects & other resource recovery projects**

# Thank you!

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