COCOON
Interreg Europe

European Union
European Regional
Development Fund

Dynamic Landfill Management :
a new paradigm.

Eddy Wille, Michaël Van Raemdonck

OVAM (Public Waste Agency of Flanders)

5th ELFM Symposium – Leuven, 6 February 2020

COCOON

Consortium for a coherent European Landfill Management

- Submitted May 13, 2016
- Focus on landfill management of former landfills (former proposals on Landfill Mining didn't make it)
- Accepted October 2, 2016
- Officially started 01/2017 till 12/2021 (2 phases – 31.12.2019)

- Deliverables:
  - Report on mapping of landfills in partner regions (see questions on status landfills MEP-EC at first ELFM-meeting 15 Oct 2015)
  - Good practices handbook

COCOON partners

COCOON
Interreg Europe

i-CLEANTECH VLAANDEREN
enabling the future

WASTESERV
CREATING RESOURCES FROM WASTE

SAMEN MAKEN WE MORGEN MOOIER
VAM

LfU
Landesamt für Umwelt

sadeco
saneamientos de Córdoba
empresa municipal

ERA

DEPARTMENT OF ENVIRONMENT

Rijkswaterstaat
Ministerie van Verkeer en Waterstaat

WTH COCOON ?

What's the history behind COCOON ?

elfm
enhanced landfill mining consortium

EURELCO
EUROPEAN ENHANCED LANDFILL MINING CONSORTIUM

KU LEUVEN centre for High Temperature Processes and Sustainable Materials Management

GROUP MACHIELS

KU LEUVEN SIM2 Sustainable Inorganic Materials Management

SMART GROUND

MSCA-ETN SULTAN
European Training Network for the Remediation and Reprocessing of Sulfidic Mining Waste Sites

Life reclaim

eit RawMaterials Connecting matters

EUROPEAN COMMISSION
Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Industrial Transformation and Advanced Value Chains
Resource Efficiency and Raw Materials

COCOON Interreg Europe

RAWFILL

Regeneratis

NEW-MINE
EU TRAINING NETWORK FOR RESOURCE RECOVERY THROUGH ENHANCED LANDFILL MINING

MINEA

Interreg North-West Europe
EUROPEAN UNION
European Regional Development Fund

WTH Landfills ?

What's the history of landfills ?

An environmental history according COCOON-member Eddy Wille

End 18th century: urbanization

- Quality of life in the **cities**
- Miasms (odour) as a cause of diseases (malaria comes from French 'mal aire' , bad air)
- Outcome: Decree of August 1790 ('salubrité' - safety) – Mayor (municipality)

Mid 19th century: industrialization

- Safety of the **workplace**
- Labour Movement (Karl Marx wrote 'The Communist manifesto' in Brussels, 1847)
- Outcome: Act on well-being of workers – Federal government

Mid 20th century: consumer society

- Degradation of the **environment**
- Book Silent Spring by Rachel Carson (1962)
- Outcome: specific environmental legislation – European Union

Start 3rd millennium: global economy

- **Worldwide effects** of economic growth (environment, depletion of raw materials,…)
- Various reports on climate change, water shortage, loss of biodiversity, …
- Outcome: Sustainable Development Goals – United Nations

Increasing level

21st Century : Age of Interactions / Complexity

WTH Landfills ?

What's the history of landfills ?

A history of landfilling according to COCOON-member Dr. Ulrich Stock

Level	The level is marked by …
Landfill 1.0	Removal of waste from settlements from a health point of view. Only requirement : Landfill is outside the city limits.
Landfill 2.0	Waste became more dangerous ➢ First regulations (site, operation, closure). Development of approval procedures. ➢ Every city and village had a landfill. 500.000 in EU member states.
Landfill 3.0	Growing environmental awareness. ➢ Development of state of the art of landfill construction and waste treatment. ➢ Base and surface sealing systems became standard of landfill construction.
Is Landfill 3.0 the end of the landfill development ? No, because the ICM-method produces landfills, consisting of a landfill body with an endless pollution potential which is covered by sealing systems with limited lifetime.	
Landfill 4.0	Eternal safe landfill, connecting with using the resource potential of the landfills (materials, energy, land) ⟶ Dynamic Landfill Management

WTF Landfills ?

What’s the future of landfills ?

Johnny Rotten

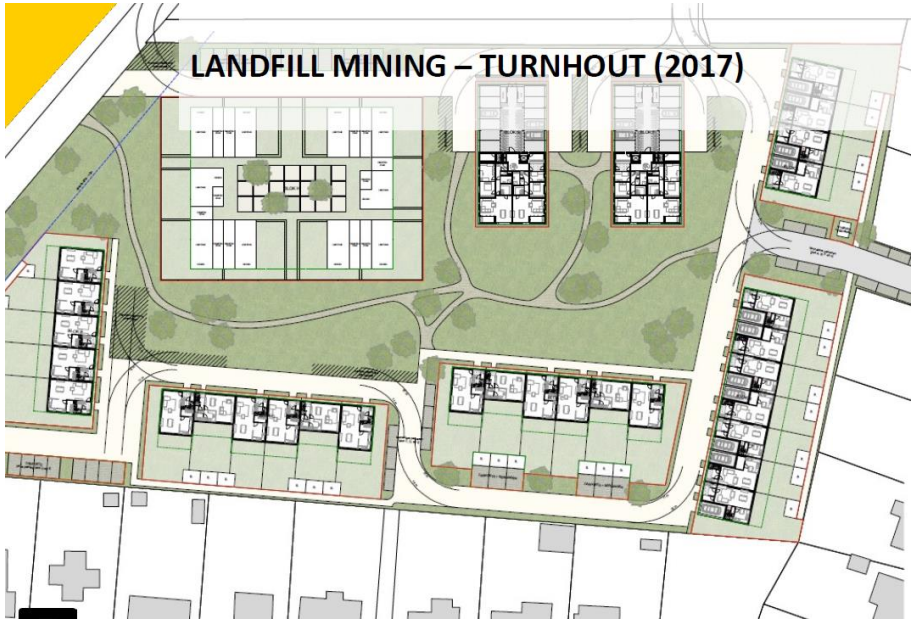
Landfills ? A f# final waste disposal site without any future.

René Magritte

Landfills ? Use your imagination, act circular and create a bright future.

Reclaiming Land(fills)
1 MSW LF - Turnhout

Residential land use project



Reclaiming Land(fills)
2 Hemixveer - Hoboken

Residential land use project
Incl. park & stormwater storage

Reclaiming Land(fills)
3 Industrial LF - Gent

Industrial land use project

Reclaiming Land(fills)
4 La Floridienne - Ghent

Logistics land use project
Incl. harbour infrastructure

Reclaiming Land(fills)
21 Eiland - Zwijnaarde

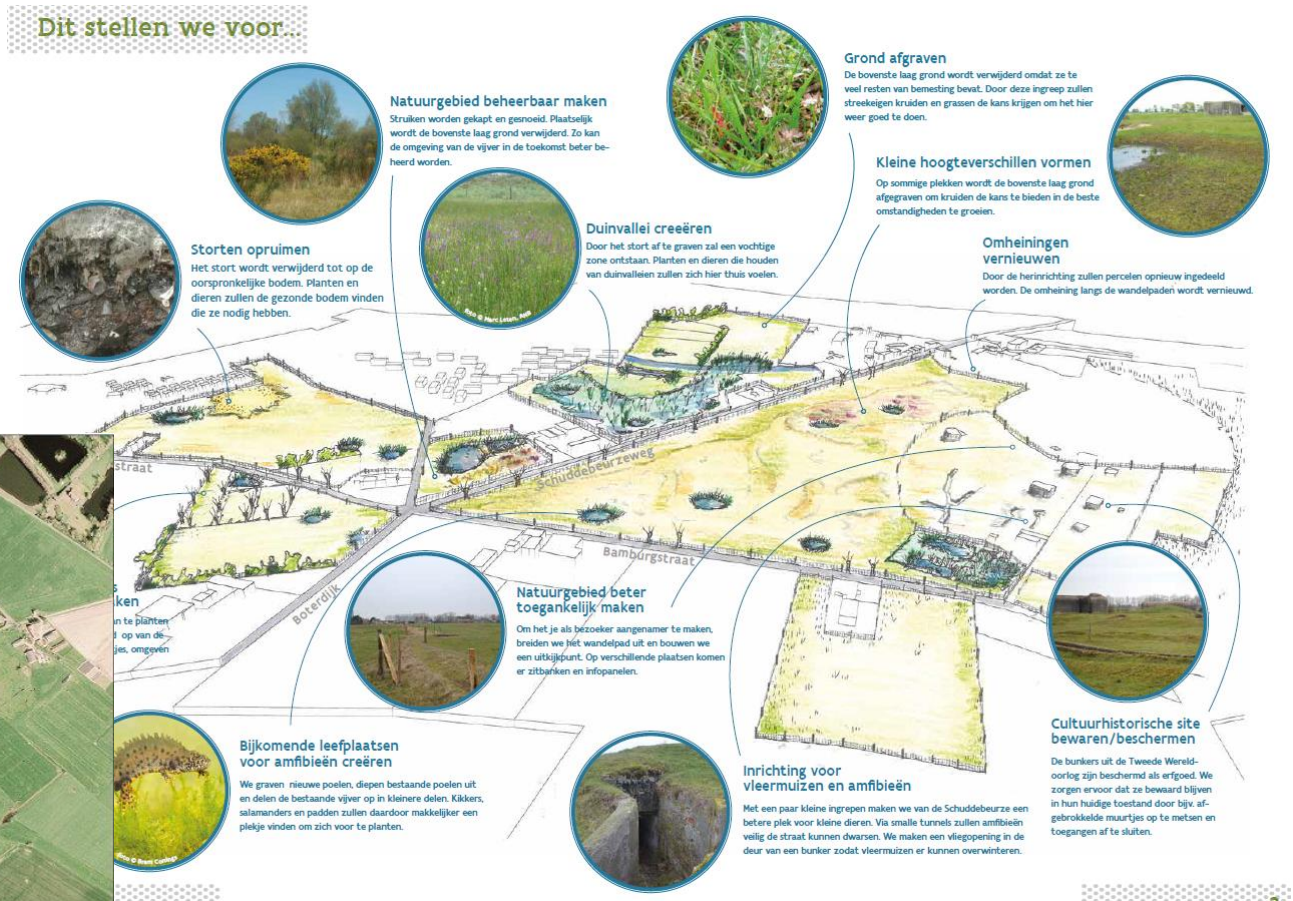
Mixed land use project
Incl. logistics, research park, nature preservation

Reclaiming Land(fills)
10 Gipsberg - Zelzate

Mixed land use project
Incl. interim use, nature preservation

Reclaiming Land(fills)
12 Schuddebeurze - Lombardsijde

Nature preservation project



Reclaiming Land(fills)
Lingreville - Normandie

Coastal erosion restoration project

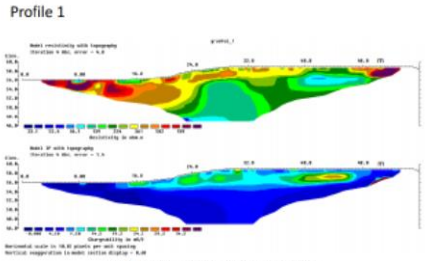
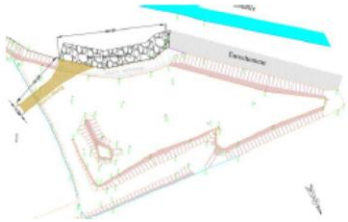


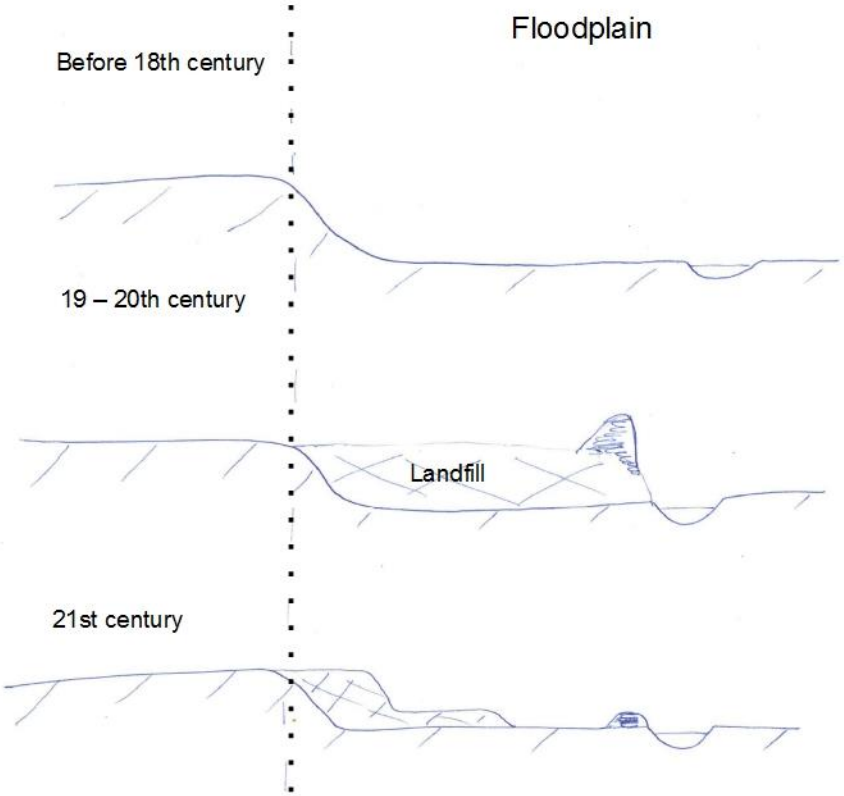
Fig. 2. Normal gradient array measurements.



Crédit photo : Ouest-Fran

Reclaiming Land(fills)
MSW Landfill - Flanders

Flood protection project



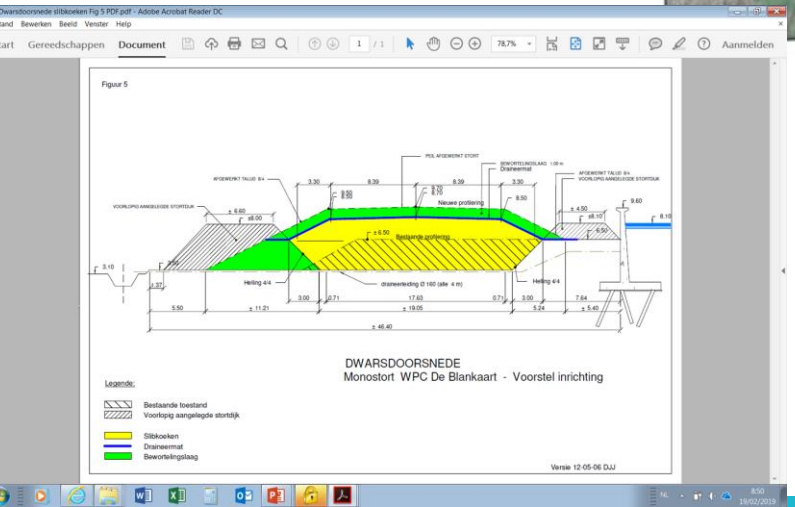
Reclaiming Land(fills)
MSW Landfill - Zaventem

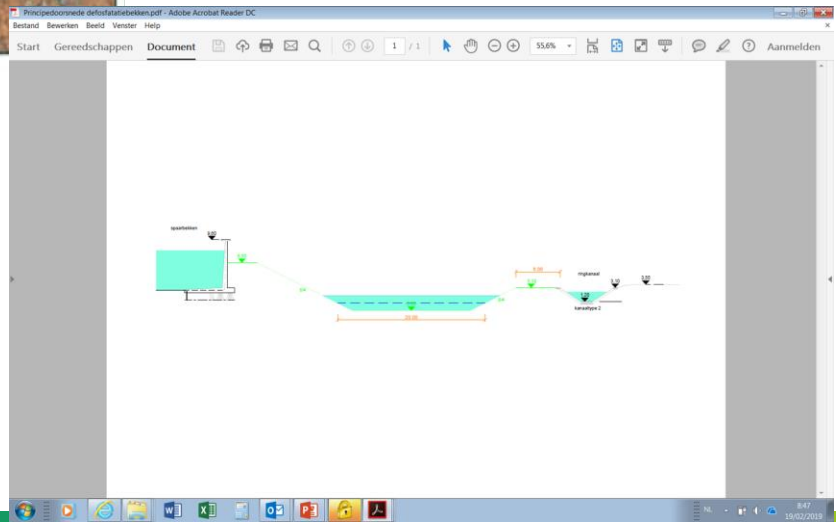
Flood protection project

Reclaiming Land(fills)
15 Mono LF - Diksmuide

ELFM-project :

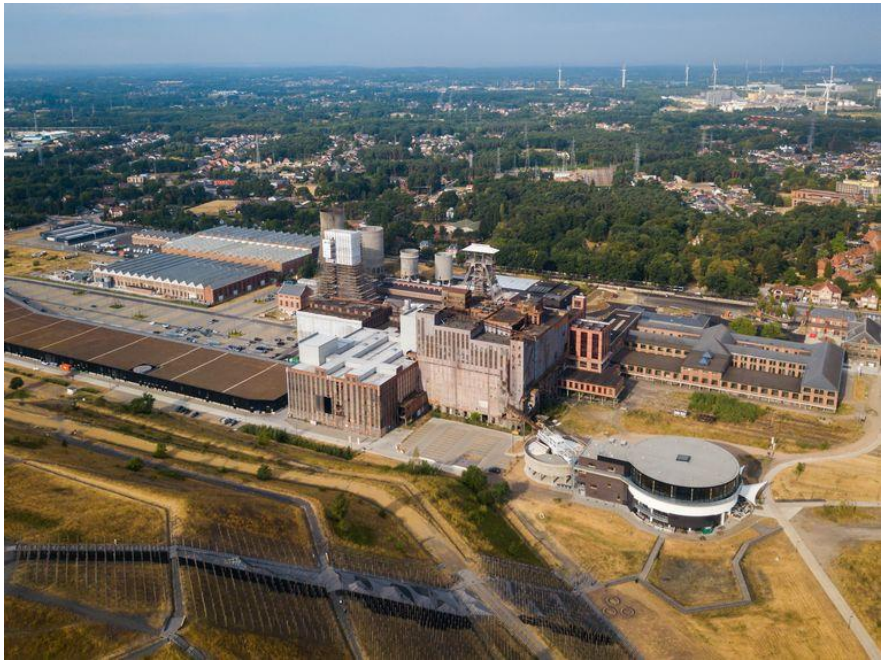
- 100% valorization of landfilled waste;
- 100% land reclamation;
- Future use: phosphate recovery unit;
- Drinking water production.





Reclaiming Land(fills)
22 Coal tip - Beringen

Mixed land use project
Offices, recreation, housing, nature preservation



WTF Landfills ?

What’s the future of landfills ? Virtual reality or real stuff ?

Johnny Rotten

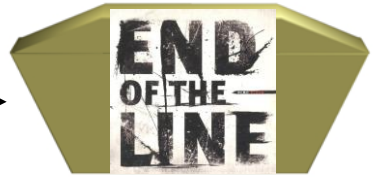
Landfills ? A f# final waste disposal site without any future.

René Magritte

Landfills ? Use your imagination, act circular and create a bright future.

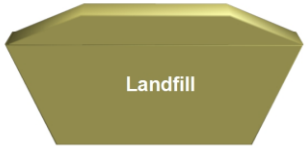
COCOON objective : develop, integrate and improve relevant cross-cutting policy instruments on landfill management in the EU

Landfilling : final waste disposal sites as the end of the line in a linear economy



Is this the end of story ?

Risk based approach (source – pathway – target) : install a safe infinite containment



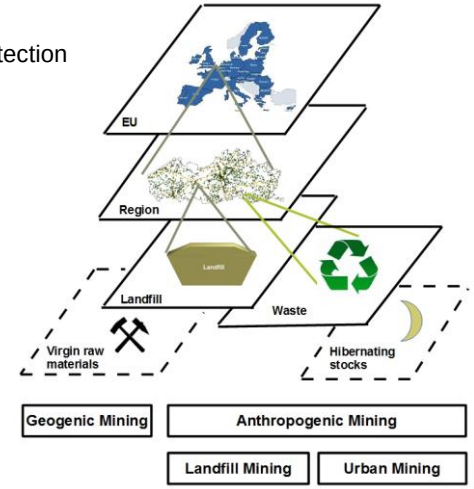
guarding the status quo :
Is this static concept robust to environmental changes ?

COCOON-analysis :

- Poor exchange of data of (former) landfills
- Majority of old landfills (<1999) seldom state of the art; often lacking LT-monitoring & aftercare
- LT-effects not limited to landfill scale: local level to global level
- External impact underestimated: climate change, spatial pressure, flooding, soil sealing, drinking water protection
- Rarely landfilling with regard to re-mining (monofills)

COCOON-conclusion :

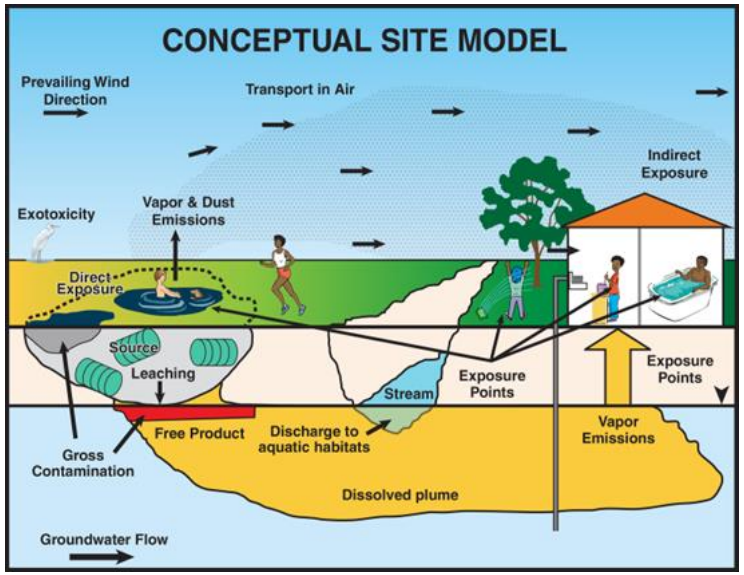
- Dynamic landfill management approach required in view of demand and supply
- Integration in broader frameworks : circular economy, resource efficiency, sustainable development



Transiti ON

to a dynamic landfill management focusing on Resources and Reserves in order to provide Waste to Materials/Energy/Land & Protection of Resources.

Conceptual Site Model



Traditional Conceptual Site Models set focus mainly on impact and risks. Seldom detailed data on landfilled waste (quality and quantity), networks, infrastructure, geotechnical characteristics,…
Often limited scale (spatial, timing,…) and information on 'what's leaving the black box and entering the vicinity'.

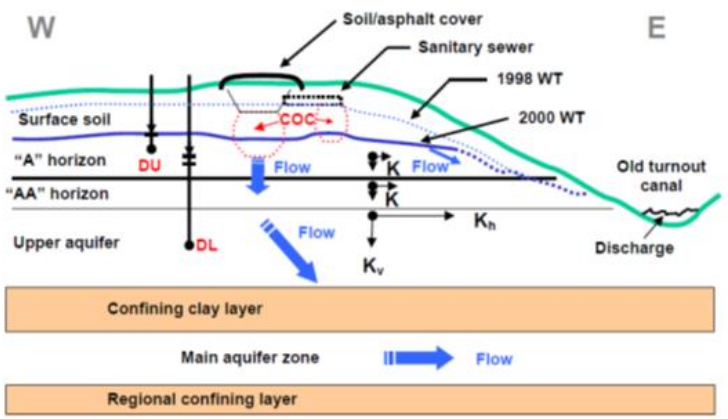
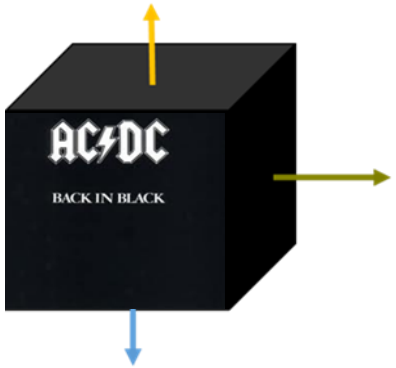
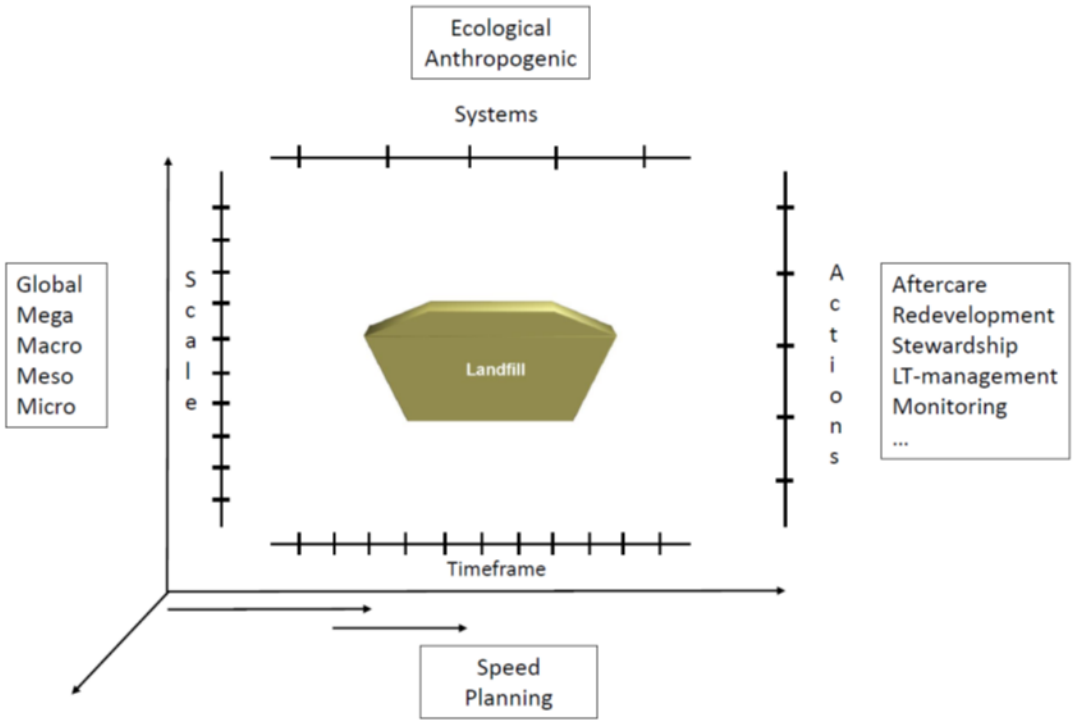


Figure 3-1. Initial conceptual site model showing a confining layer between two aquifers.

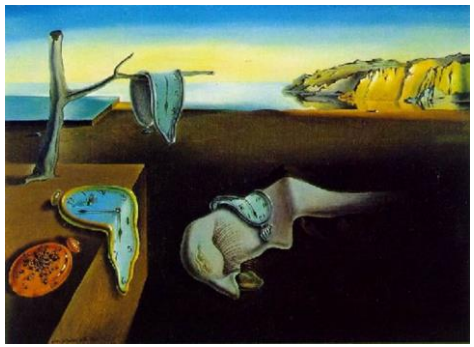


Complex Adaptive Systems



Complexity :

- Diversity of stakeholders;
- Uncertainties about causes, consequences & remedies;
- Different formal & informal laws and levels of government;
- Difficulty to rapid change of configurations;
- Complex dependencies which constantly change.



Salvador Dali

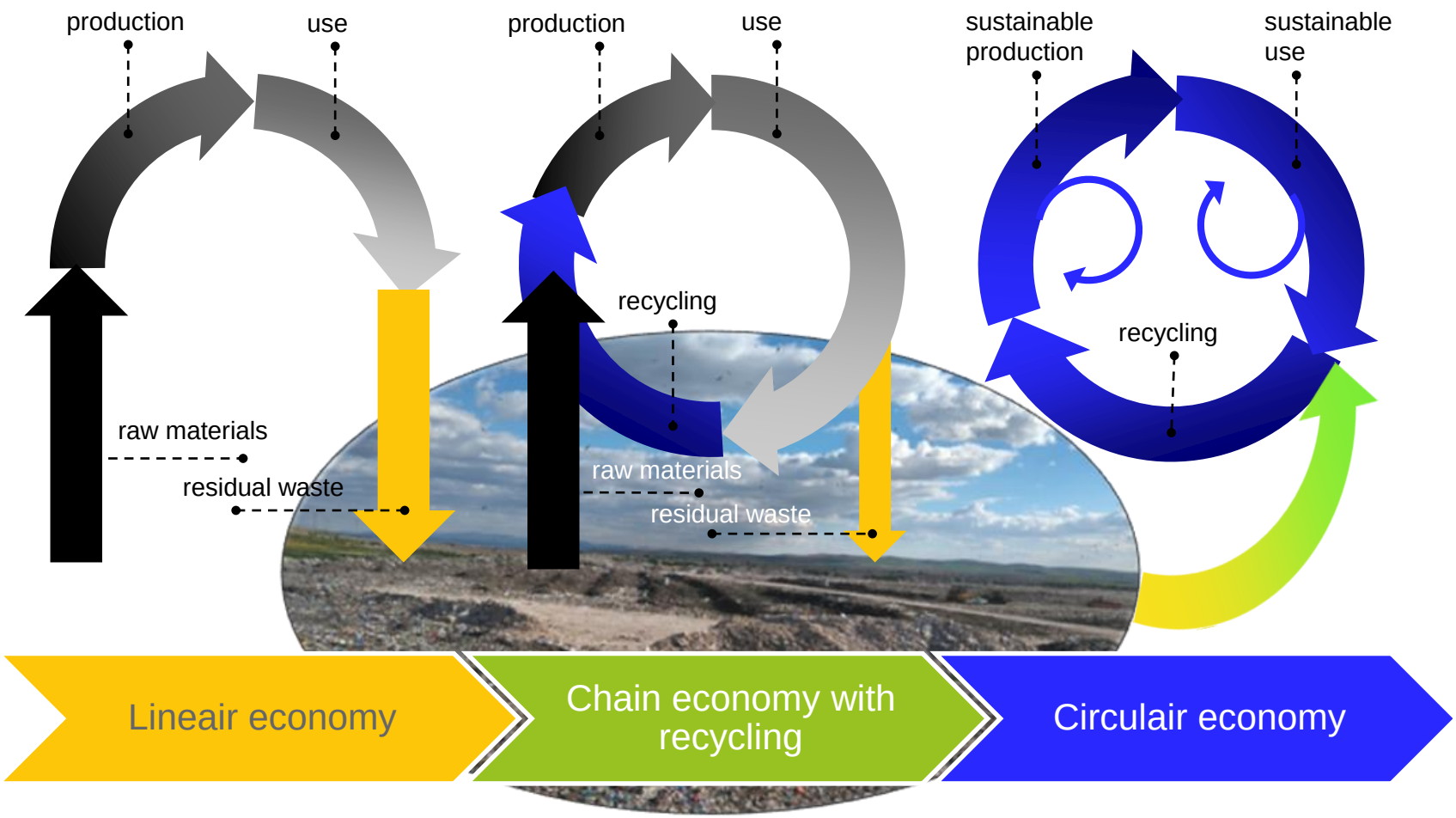
Flexibility in timeframes (4D)
& (re)thinking the inside

(an unknown and unexpected embrace)

Geert De Geyter

Realisations of COCOON

Transition of Landfills : Dynamic Landfill Management from waste to resources



Dynamic Landfill Management

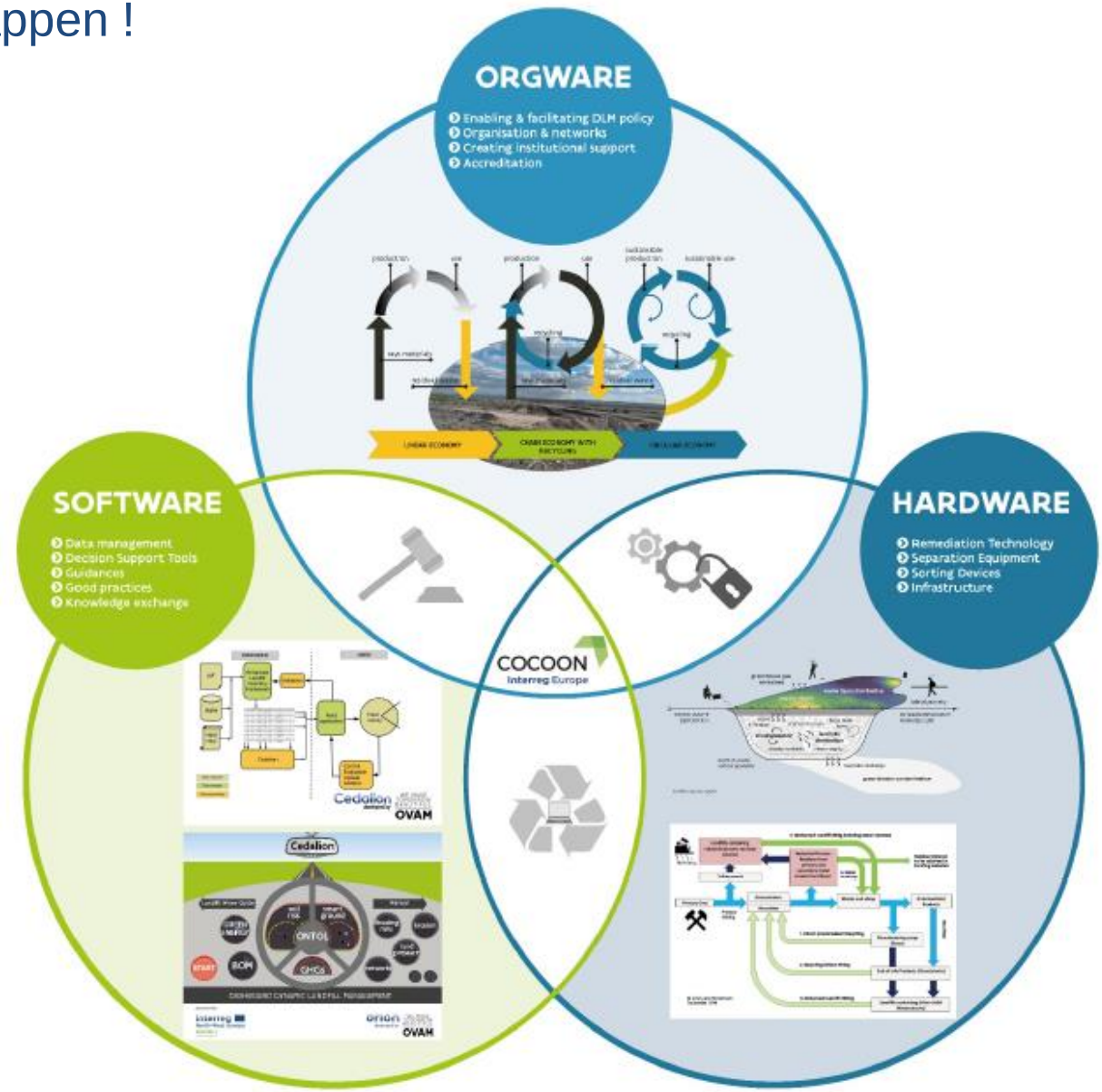
Basics :

- **Long term management**
- **Applicable to all landfills**
- **Safe health / environment**
- **Compliant with EU-directives**
- **In line with new EU-policies (resource management, circular economy, land stewardship, Green Deal,…)**
- **Link with Sustainable Development Goals**
- **…**

➢ **Landfill as final waste disposal site / temporary storage / eternal available resources ?**

Dynamic Landfill Management

Make it happen !



Decision making and models

Tackling the complexity of the system

- Setting up a Conceptual Site Model :
  - Integrating multiple dimensions
  - Defining its purpose and applicability
- Feeding the model : Enhanced Inventory Framework
  - Detecting sources of data
  - Collecting data (Geophysical prospection)
  - Data quality control (Guidelines)
- Developing the Decision Support Tool :
  - Defining the output and outcome
  - Constraints for use
- Testing the DST in practice
- Feed back loops :
  - Adjustments DST, CSM, data requirements
  - Interactions (policies, legal aspects, economy,…)

The myth of Orion, Cedalion & Eos

Servant Cedalion is leading the temporary blinded giant Orion to the light Eos.

The metaphor of dwarfs standing on the shoulders of giants (Latin: nanos gigantum humeris insidentes) expresses the meaning of "discovering truth by building on previous discoveries".

Isaac Newton in 1675: "If I have seen further it is by standing on the shoulders of Giants."

https://www.ovam.be/landfill-mining

DST 1 : Cedalion

data management

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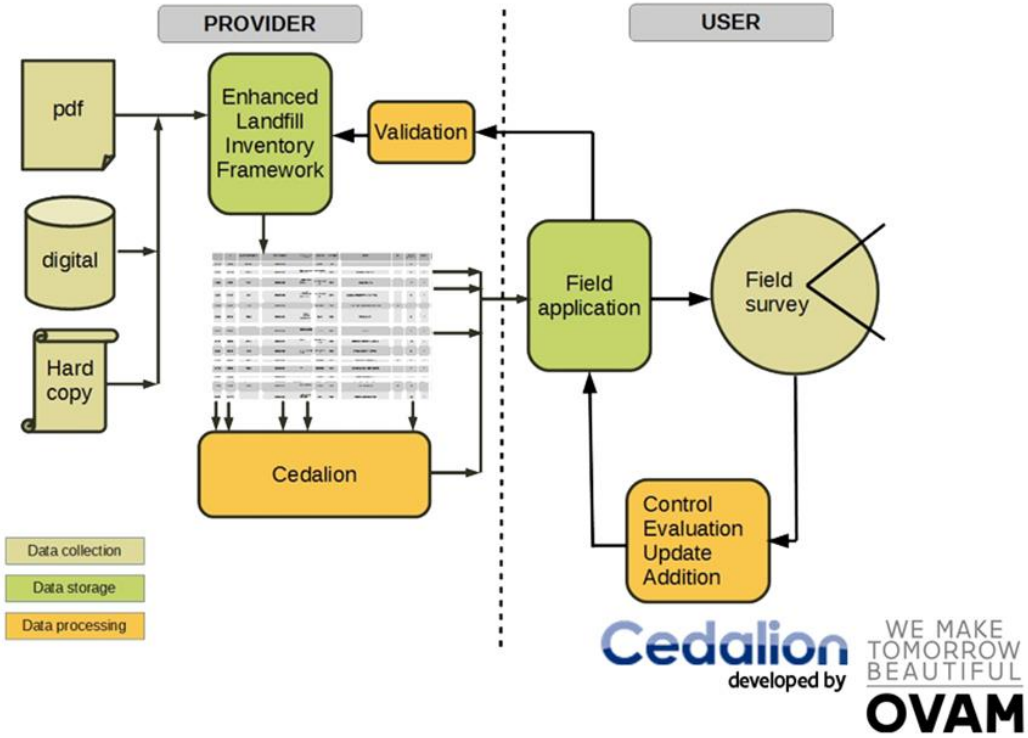
European Regional Development Fund

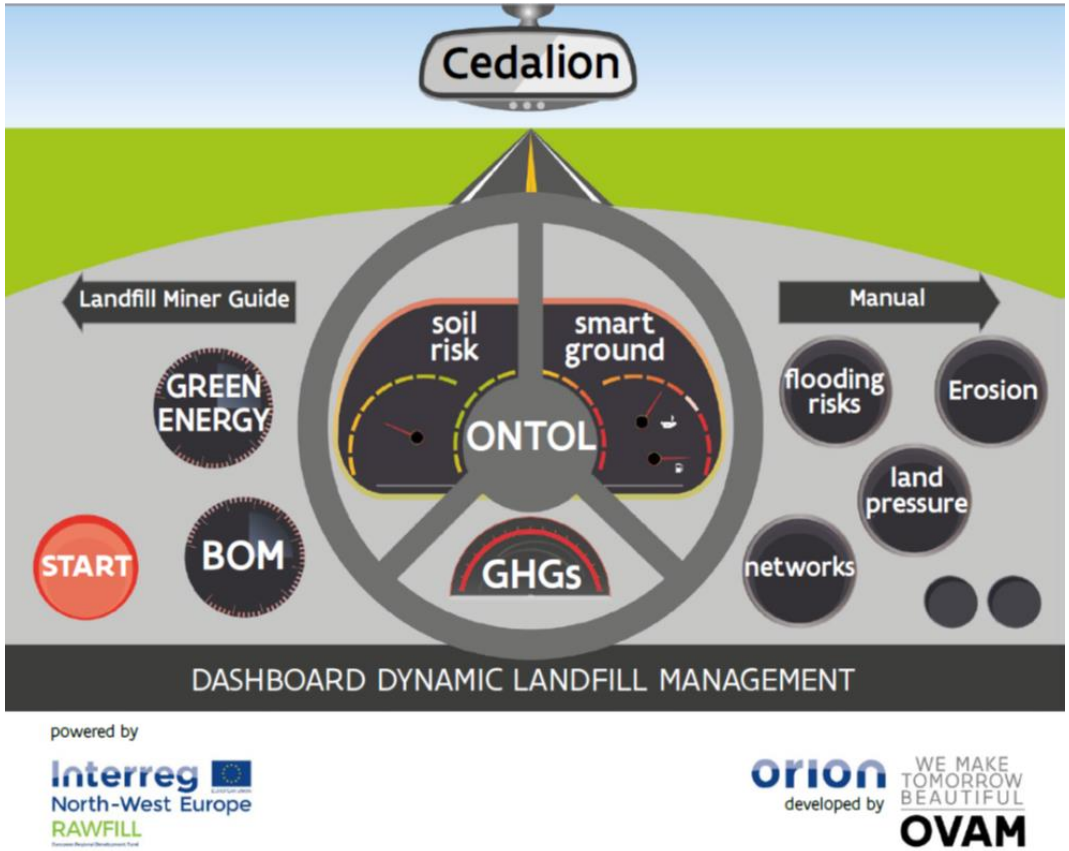
Objective : Getting actors interested in landfills by providing information and viable options which they can evaluate and customize. Civil servant science ?



Cedalion developed by OVAM
WE MAKE TOMORROW BEAUTIFUL

DST 2: Orion

optimizing good ideas



- Not reinventing but reusing : plug-in system.
- Already available tools have each strong points and limitations.

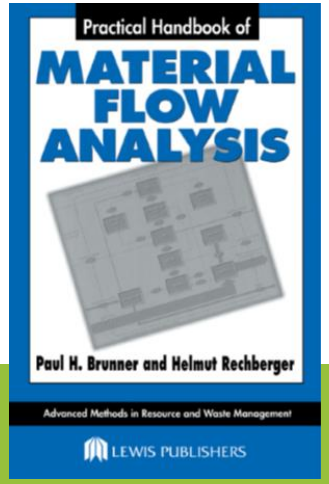
➢ Customization !

ONTOL

Online Tool for the Evaluation of Landfill Mining Projects

- **Rapid** environmental and economic **evaluation** of LFM- projects;
- Facilitating of further **prioritization of LFM-projects;**
- **Comparison of different scenarios** for implementing a LF-mining project;
- Streamlined format (e.g. agreed economic calculation methods; United Nations Framework Classification for Resources (UNFC))
- **Provision of default datasets** (e.g. waste composition, sorting technology efficiencies, waste-to-energy efficiencies, etc.; Orion provides guidance to more specific tools & models)
- screening assessments without the need for extensive data generation

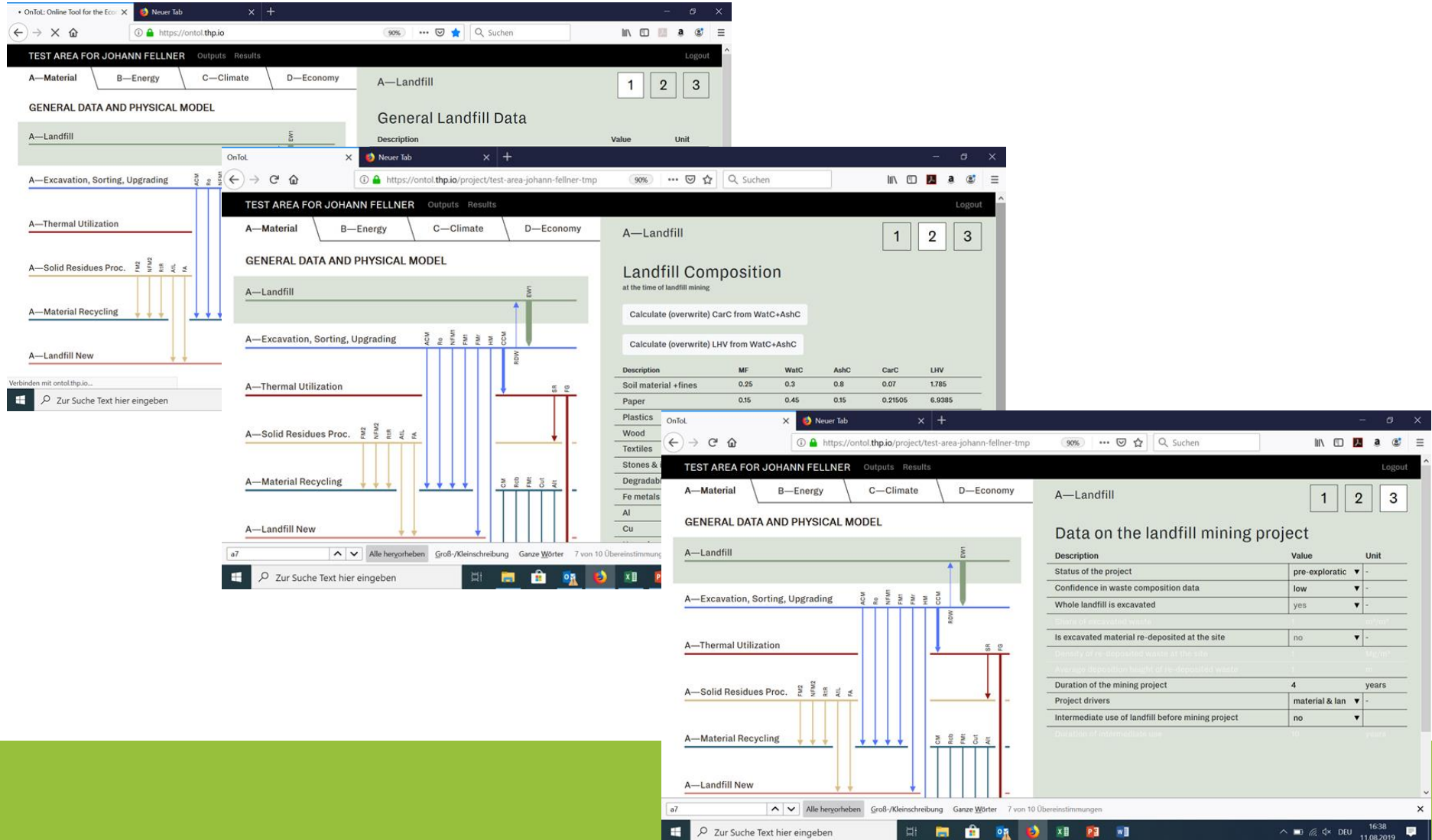
➢ Free software available at : https://www.ovam.be/landfill-mining



Ontol : developed by team of prof. Johann Fellner (Christian Doppler Laboratory for Anthropogenic Resources, TU Vienna - Austria), in collaboration with prof. David Laner (University Kassel - Germany) and Dr. Andrea Winterstetter (University Antwerp & VITO – Belgium). Co-Funded by OVAM (Public Waste Agency of Flanders) & BMNT (Austrian Federal Ministry for Sustainability - Austria).

Input & output of ONTOL

Interreg North-West Europe RAWFILL
European Regional Development Fund



Decision making & models

From Default to Expert values

Interreg North-West Europe RAWFILL

European Regional Development Fund

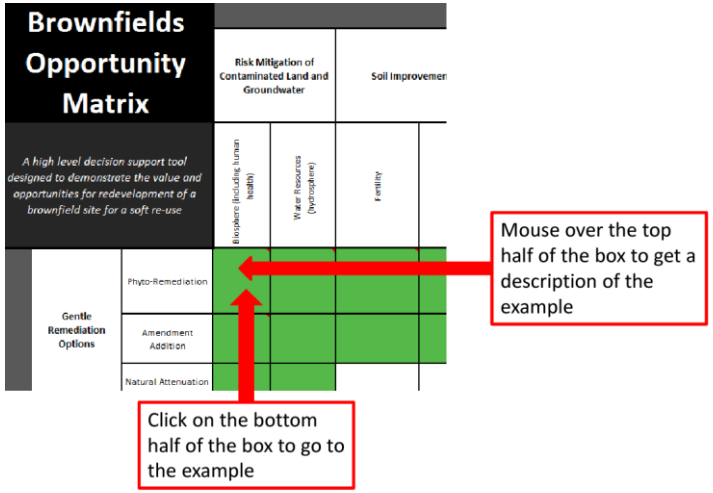
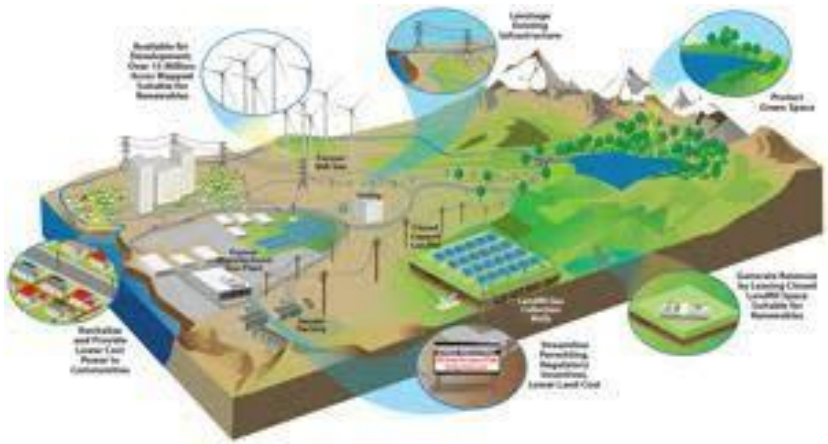
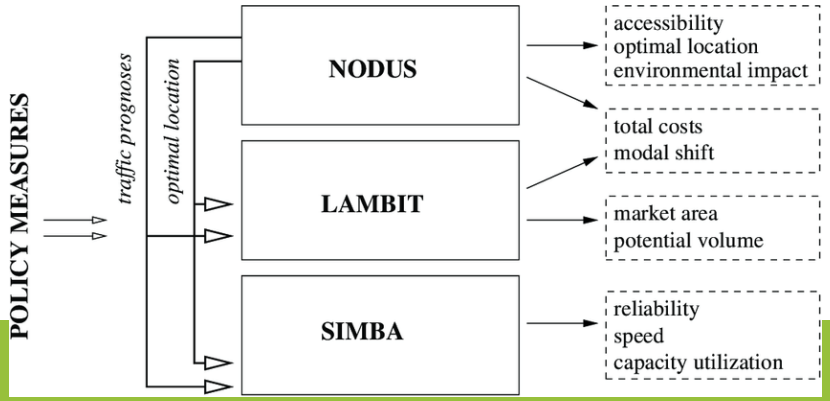
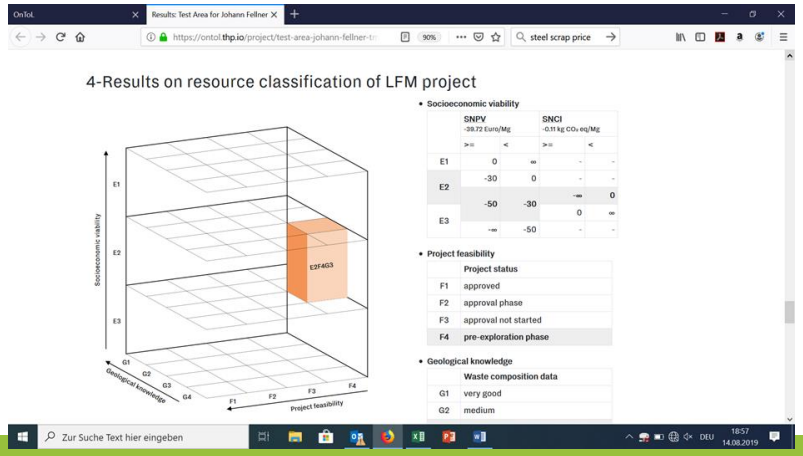


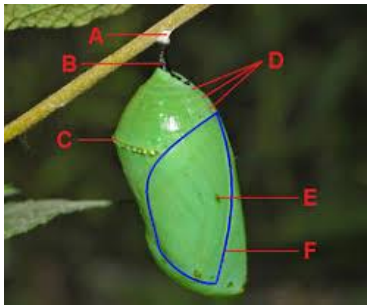
Figure 6: Simple Brownfield Opportunity Matrix Variant © r3 environmental techr







Communication & Landfills



The redevelopment process has several stages and includes uncertainties and risks.
Perception, resistance and support are part of the project.
Recognize complexity and interaction from the start so necessary links can be made.

Geert De Geyter

More information

https://www.interregeurope.eu/cocoon/

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COCOON

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European Union
European Regional
Development Fund

Thank you

Project smedia