

DEVELOPMENT, OPTIMISATION AND MODELLING OF A SEPARATION PROCESS FOR ENHANCED LANDFILL MINING MATERIALS

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CLOSING THE CIRCLE - A DEMONSTRATION OF ENHANCED LANDFILL MINING



GROUP
MACHIELS

CLOSING THE CIRCLE • ENHANCED LANDFILL MINING

C. DUURZAAM NATUURGEBIED

B. CLOSING THE CIRCLE

A. ACTUELE SITUATIE

- ① FASE I: TIJDELIJKE OPSLAG
- ② PLASMA DEMONSTRATIE INSTALLATIE
- ③ FASE II: FULL SCALE CLOSING THE CIRCLE

Koerselste Duik

Naar Eindhoven

Kieftwijk

HELCH

Eco Valley

Mijnteril

Lindeman

Wolfsdijk

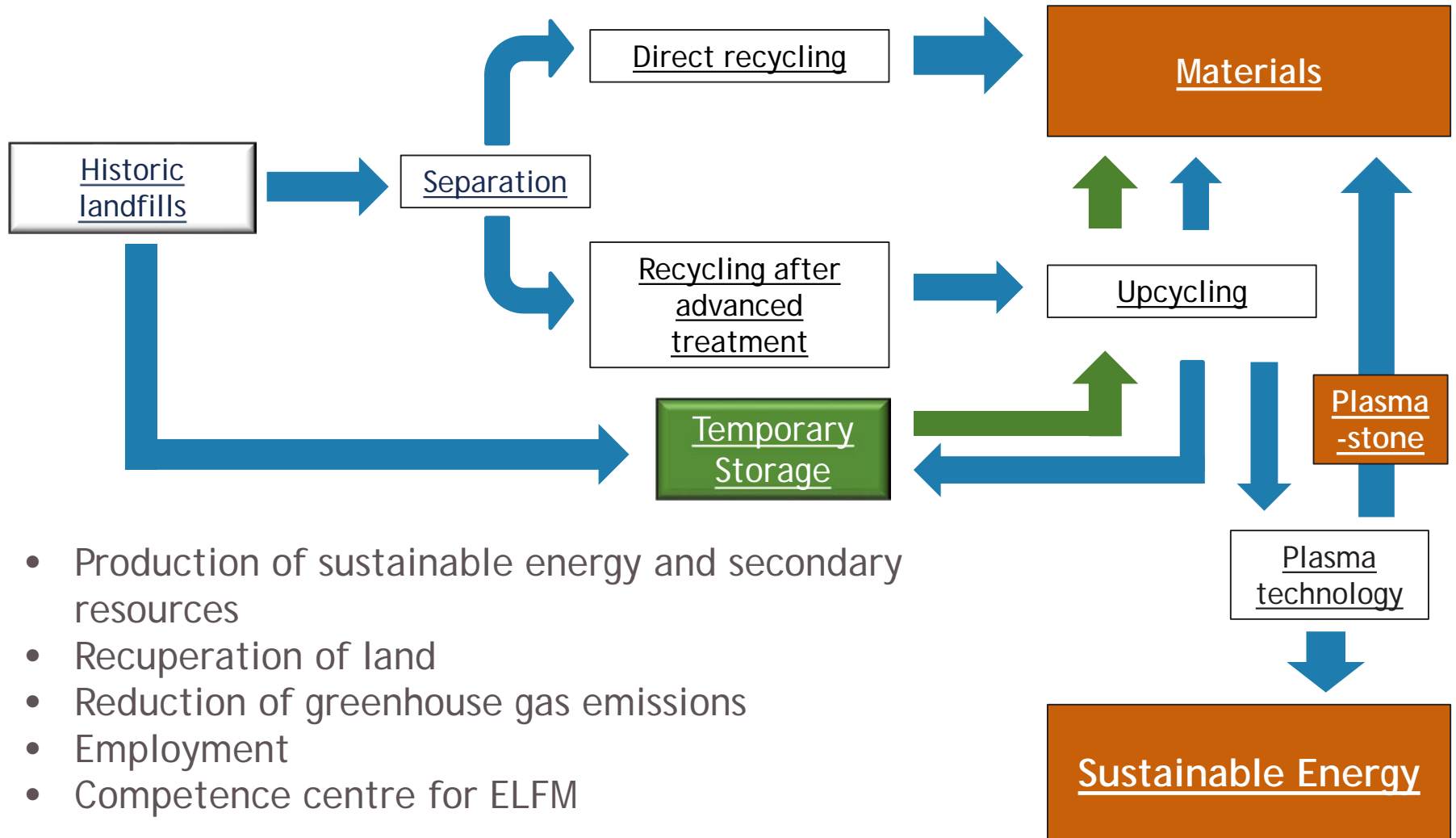
A - ANORGANISCHE OPSLAG

O - ORGANISCHE OPSLAG

Key figures:

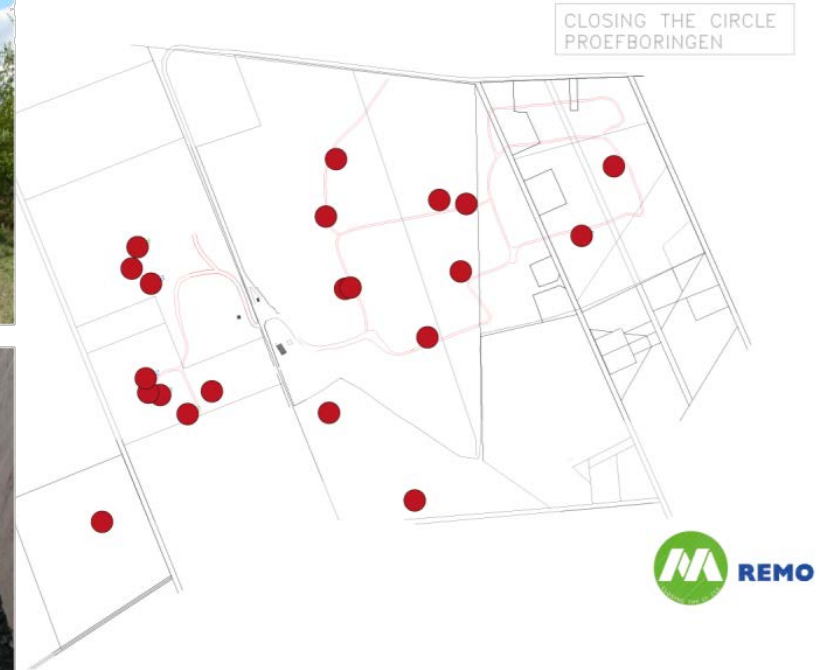
- Total area: 230 ha
- 135 ha landfill
- 16+ Mtons waste stored
- 30 ha CtC installations
- Duration 20 yrs

THE CTC ELFM PROJECT



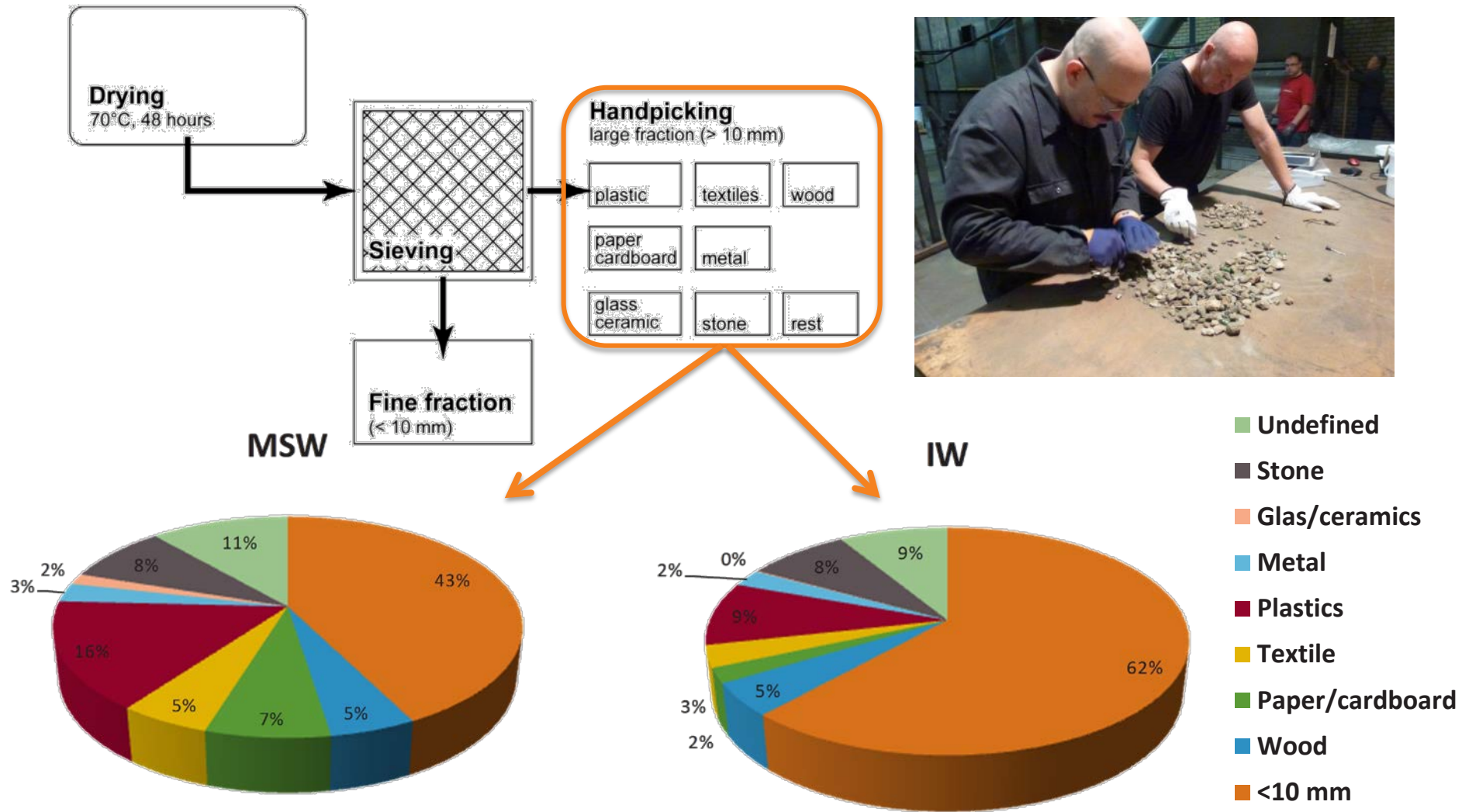
EXCAVATION OF WASTE

Log book indicates types of waste
- Both IW and MSW waste zones



- » Representative samples taken
- » 1 m intervals up to depth of 15 m

SAMPLE ANALYSIS



DEVELOPMENT OF NEW PROCESS FOR EFLM

Trials with existing process flows → large scale separation tests

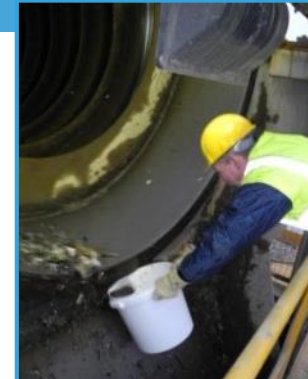


METHODOLOGY & ASSESSMENT OF RESULTS

From samples to results

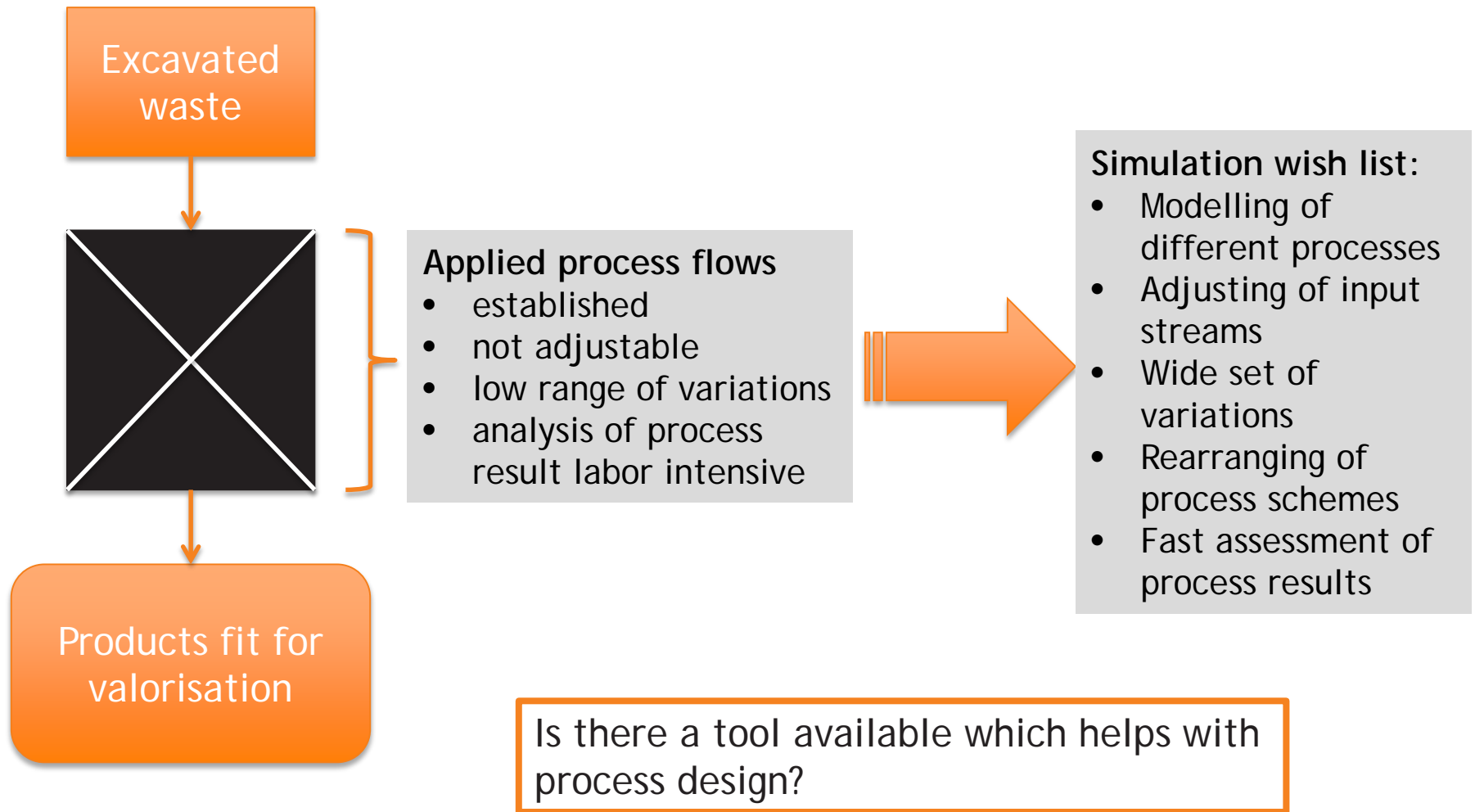
What did we learn?

- » Characterization of
 - » Input & Output streams
- » Evaluation & Assessment of performance
- » **Lessons learned:**
- » Screening not very successful
 - » high moisture content → pre-treatment: drying
 - » entanglement of material → pre-treatment: chopper/shredder/...
- » Windsifter (Zigzag) not very successful
 - » high moisture content → pre-treatment: drying
 - » entanglement of material → pre-treatment: chopper/shredder/ ...




Efficiencies	HW/AI W	IW untreat ed	IW Pre-tr. BHS
Bivitec screen	3.1%	22%	49%
Zigzag windsifter	100%		
Paper	5%		
Plastics	4%		
Textile	2%		
Wood			

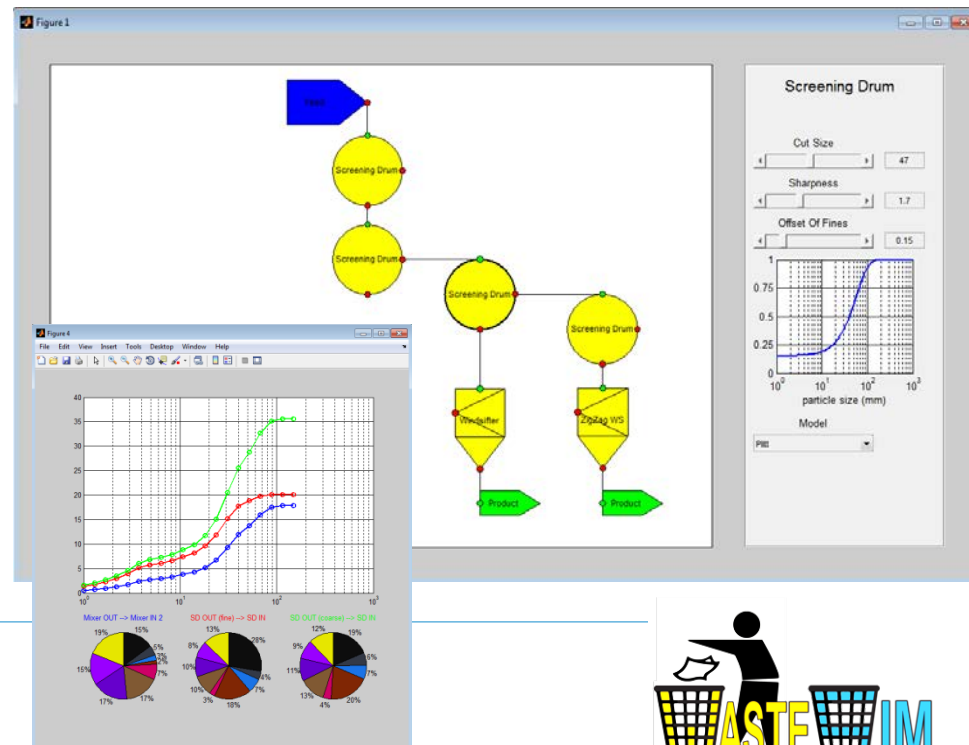
FROM TRIALS TO SIMULATION - THE LONG WAY



FROM TRIALS TO SIMULATION: WASTE SIM

Why not *REUSE* experimental data?

- » Each analysis step produces vast amount of data:
 - » Insights on separation efficiency & performance of each applied unit
- » → Why not use it?
- » Integration into model
- » → WasteSim! 
- » Waste processing simulation software developed at VITO
- » Commanded via graphical user interface and user scripts



CREATING THE TOOLBOX

How to set up the model?



- » Index card per separation technology
 - » **General description:** Physical principle, applications, options
 - » **Unit Model:** Description, general trends, mathematical description
 - » **Material Model:** Relevant material properties, material requirements
 - » **Cost Model:** Price, Energy usage, Maintenance

Example: Overbelt magnet

Distribution: Confidential



Separation unit index card: Overband Magnet

» Short overview

General overview

- To separate coarse strongly magnetic particles from a stream
- Also known as: over-belt / suspended magnet

» General description

General description

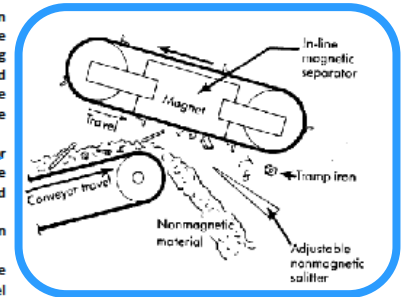
Suspended magnetic separators have been used over many decades to improve material purity and to protect processing machinery. Particularly when the belt speed is high and/or if large tramp iron objects are to be removed, suspended magnets are recommended.

Units based on permanent magnets or electromagnets are manufactured, with the permanent magnet design being restricted to lighter burdens.

Suspended magnets can be put anywhere in the separation process flow.

Two orientations with respect to the conveyor belt are common: in-line (parallel to the belt) and cross-belt (perpendicular to the belt). Because the tramp iron must be attracted and turned by 90° from the movement of the conveyor belt, a cross-belt magnet usually has to be larger and stronger than an in-line magnet.

On the one hand there are units with manual cleaning, where the operator manually has to remove the tramp iron from the magnet after a while. On the other hand are the self-cleaning units that are equipped with a moving belt with paddles to push the tramp iron forward.



» Technical drawing

» Example picture

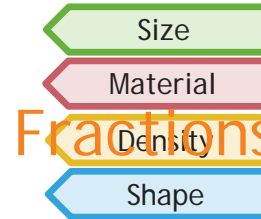
» Included separation units:

- » Vibrating Screen
- » Trommel Screen
- » Air Classifier (Wind sifter)
- » Dense Medium Separator
- » Overband Magnet
- » Magnetic Drum Separator
- » Eddy Current Separator

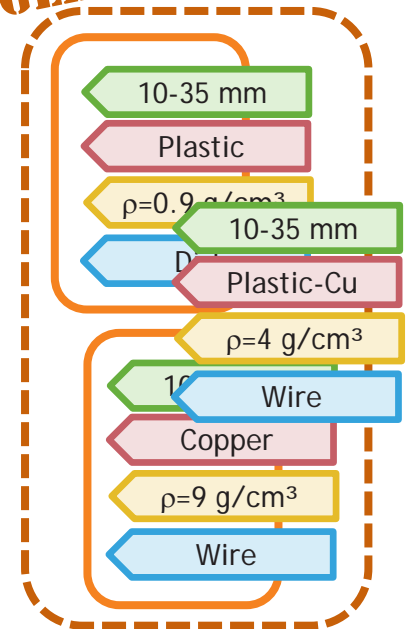
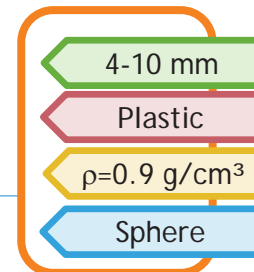
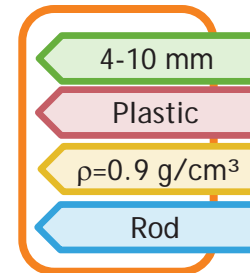
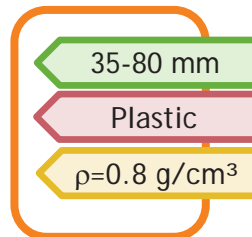
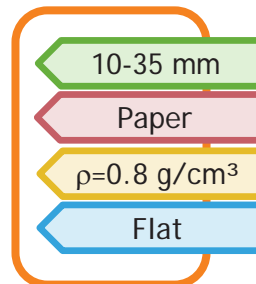
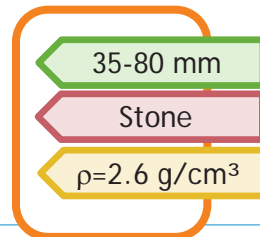
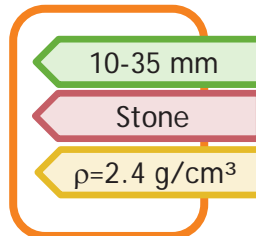
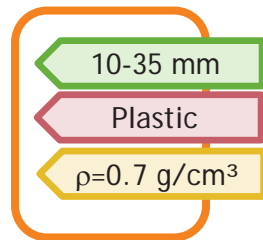
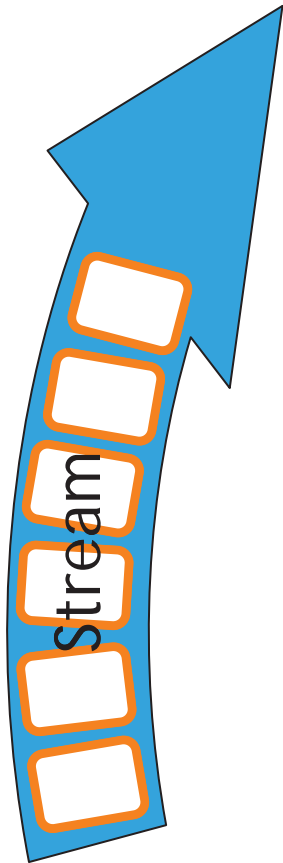




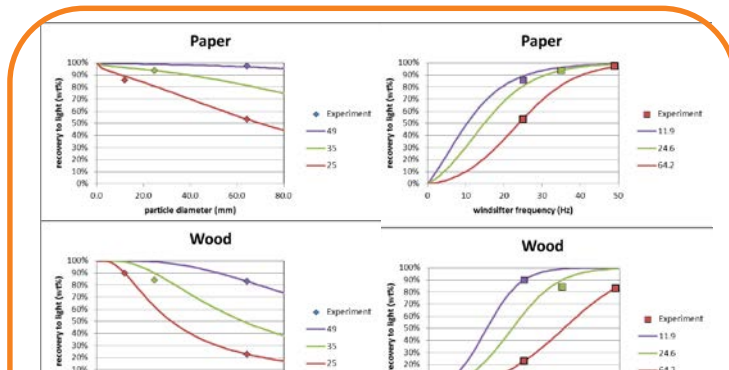
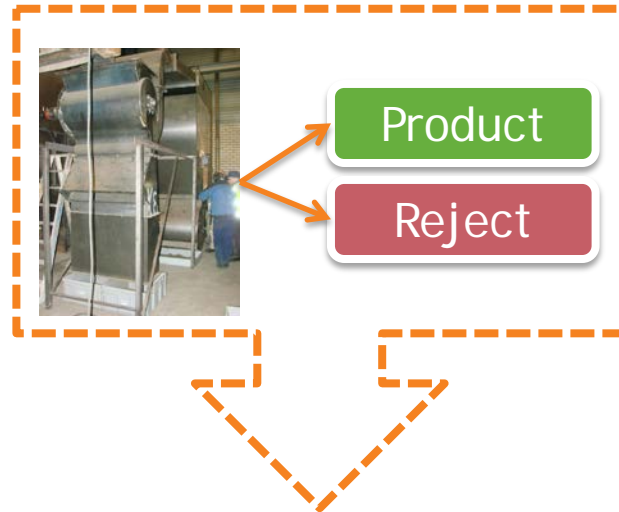
Particle properties:



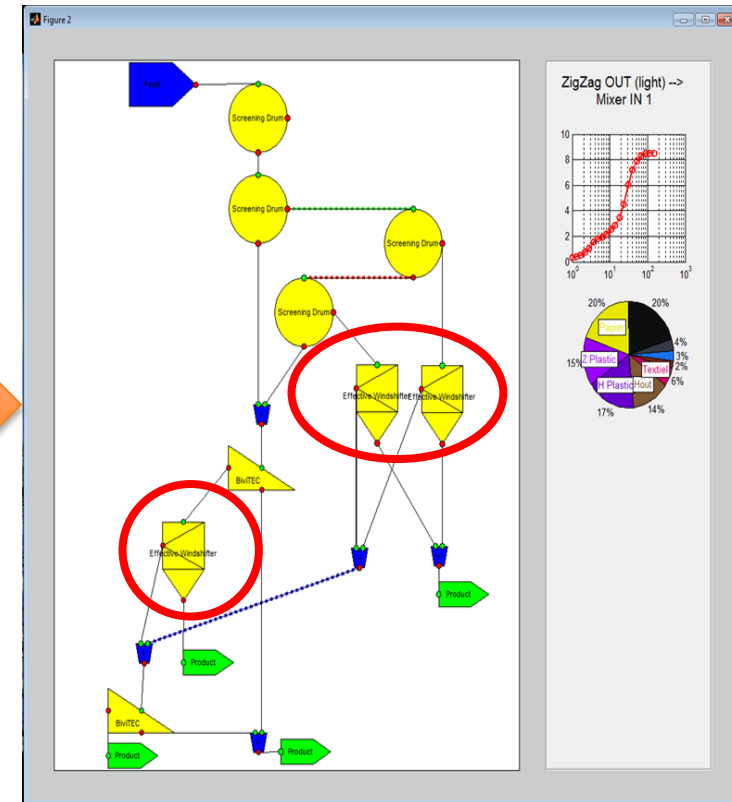
ENTANGLEMENT



Example: Wind sifter



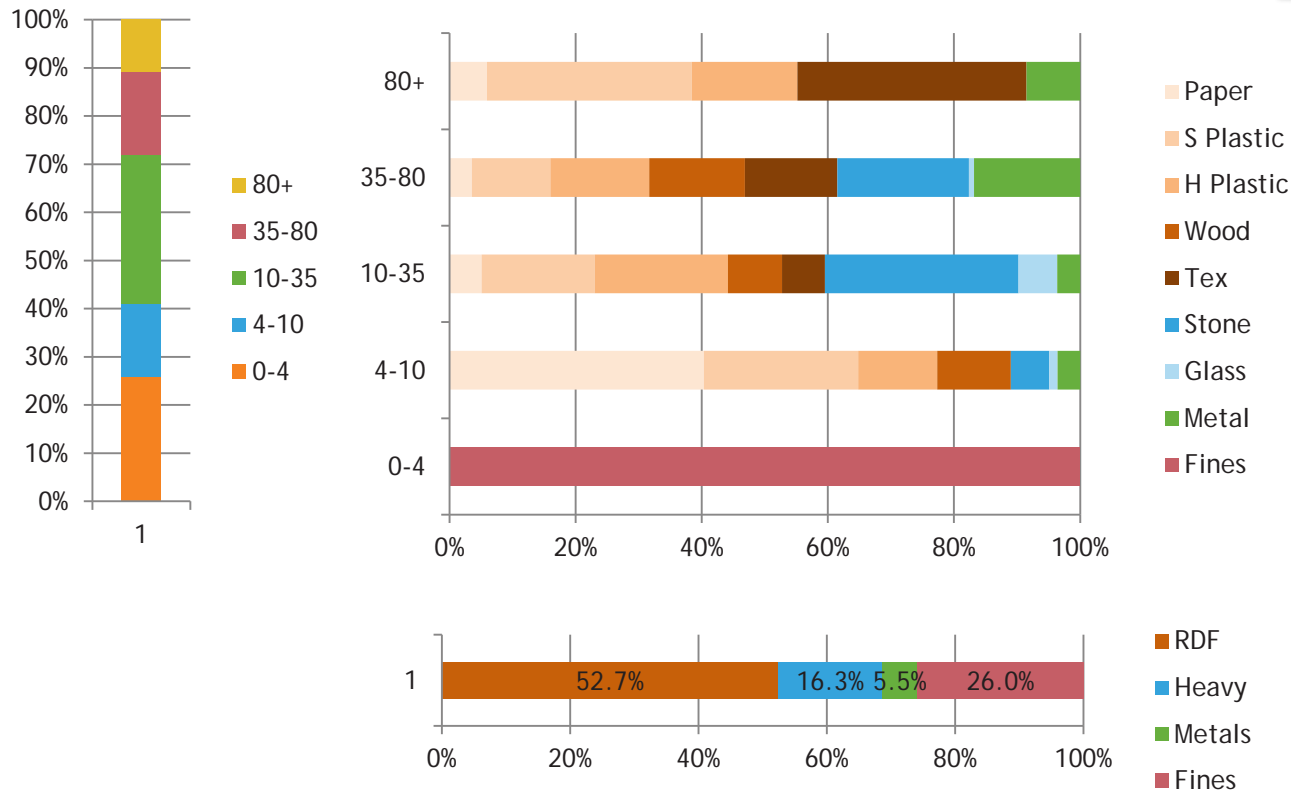
Extensive analysis of experimental data



ELFM: INPUT MATERIAL



Average composition of 10 drillings, at about 7 depths, household waste



Integration
of ELFM
data into

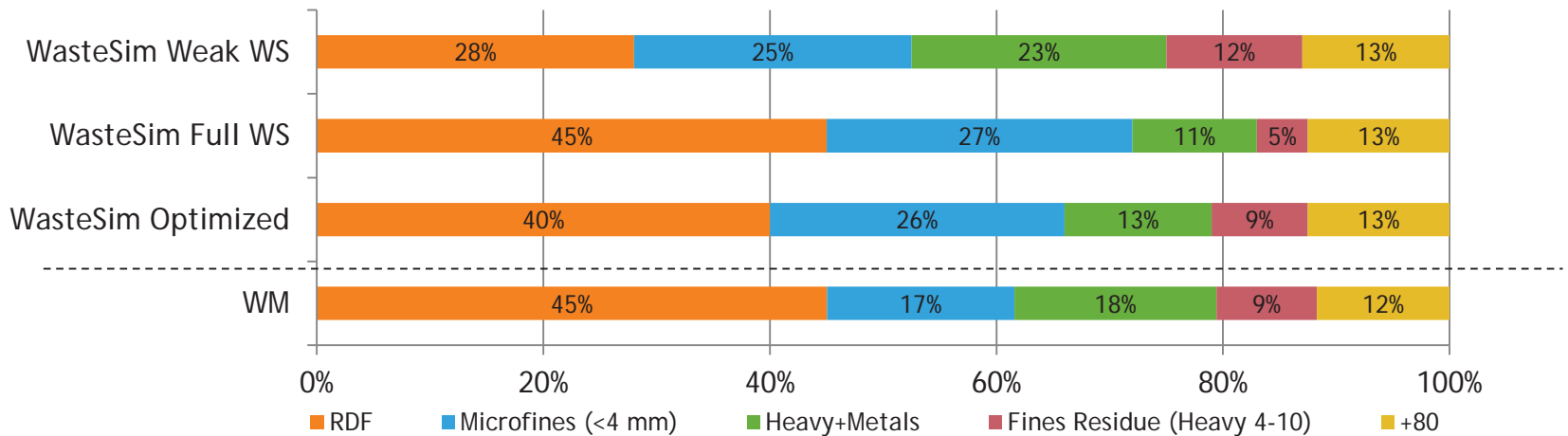


RESULTS OF WASTE SIM



Comparison of WasteSim models with “WM” model based on experience of experts

» Output Mass balance

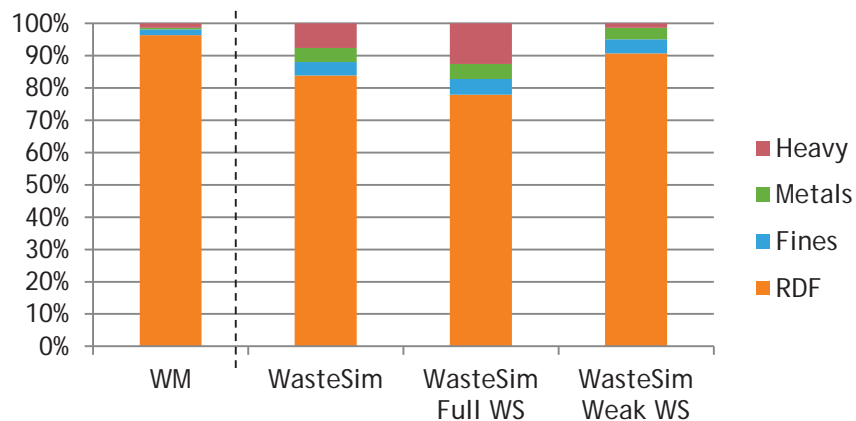


» Wind sifter speed mainly affects Heavy metals and RDF output ratio

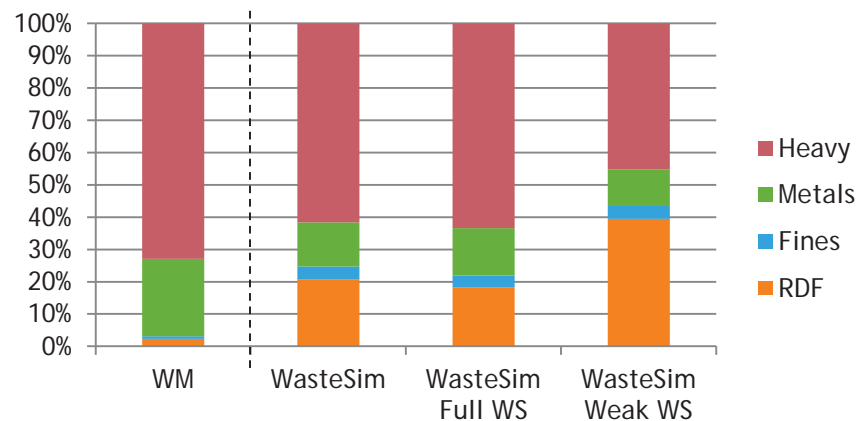
WASTE SIM: DEMONSTRATOR RESULTS



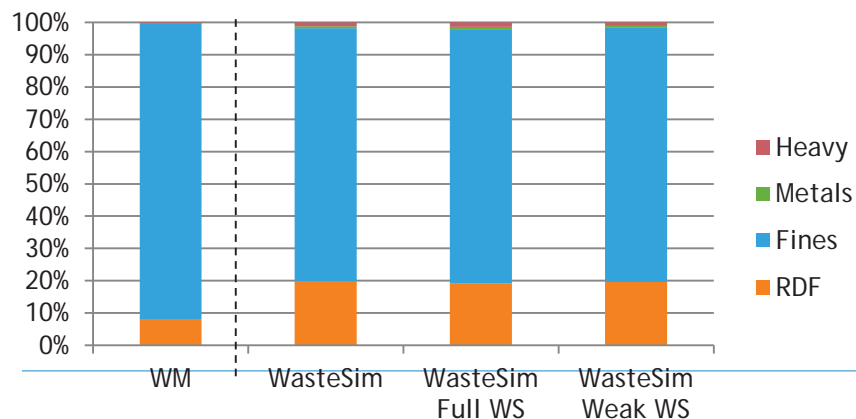
RDF



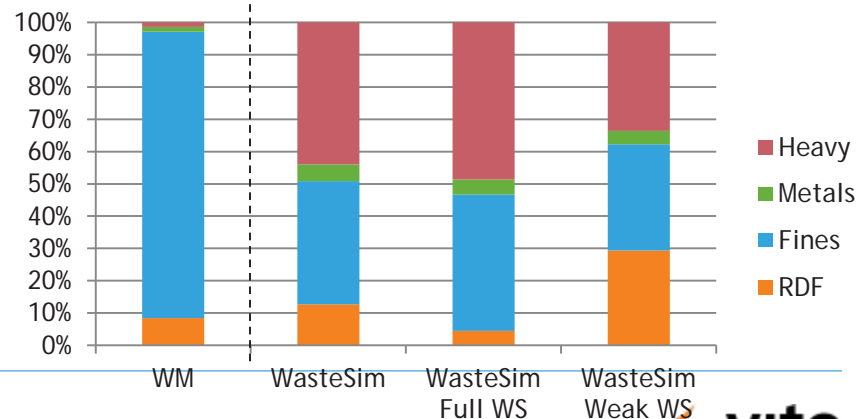
Heavy+Metals



Microfines (<4 mm)



Fines Residue (Heavy 4-10)





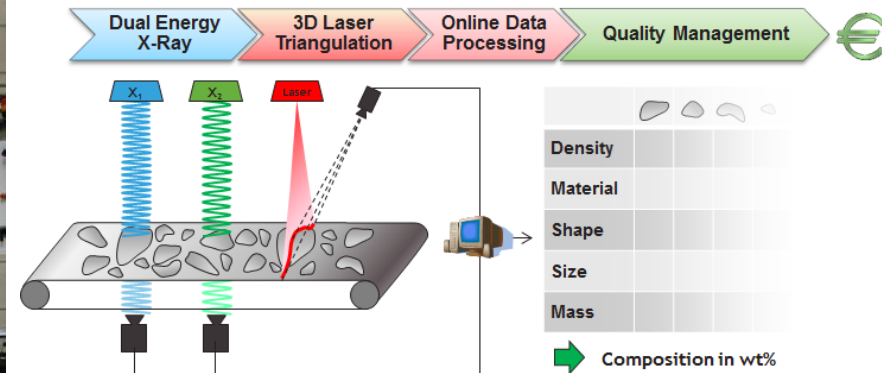
- » Design of waste process in advance based on material analysis
 - » First evaluation of process with help of model
 - » No problems with direct access of material
- » Adjustment and variation of data and process design possible
- » Creation of vast data usable for other applications/projects
 - » Availability of research data for future generations
 - » New projects strengthen the unit models
- » “Virtual” sorting possible
 - » Extensive datasets of EFLM/CtC project studies integrated
- » **Mighty tool to design optimized processes!**



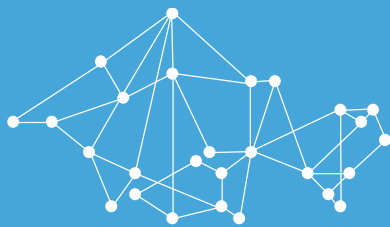
- » WasteSim is calibrated by experimental data
- » WasteSims database is based on separation tests and characterization studies
- » WasteSim can be used to design and optimize a process flow
- » Waste Sim covers the interdependency of material properties (particle size, material type)
- » WasteSim is flexible toward input variations
- » WasteSim prived high added value in comparison with intuitive estimations
- » **BUT:**
 - » *A model is only as strong as the data on which it is based. More experimental data is needed to improve the unit models.*
- » Project currently under integration process → Characterise to Sort

Characterise to Sort

Developing technologies for advanced waste stream characterisation



- » Extension of WasteSim database is work under progress!
 - » Other waste streams
 - » Other process steps



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