TECHNISCHE UNIVERSITÄT DRESDEN

DRESDEN concept

Institute of Waste Management and Circular Economy

SELECTION OF OPTIMAL WASTE TREATMENT TECHNOLOGIES FOR UKRAINIAN CONDITIONS

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WATRA Project – Workshop UA
Kharkiv
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Institute of Waste Management and Circular Economy

Content

Sanitary Landfill

MBT Technology

Recycling Technology

Waste Incineration

WATRA PROJECT

The project “Waste management in transition economies” (WaTra) aims to

(1) develop study and roadmap: “Reforming of the waste management in post-socialistic economies: case studies Eastern Germany, Ukraine and Belarus”

(2) organise waste management workshops and trainings in Ukraine and Belarus

(3) enhance further cooperation between partners through development of the joint project proposal

Basic Requirement: Sanitary Landfill!

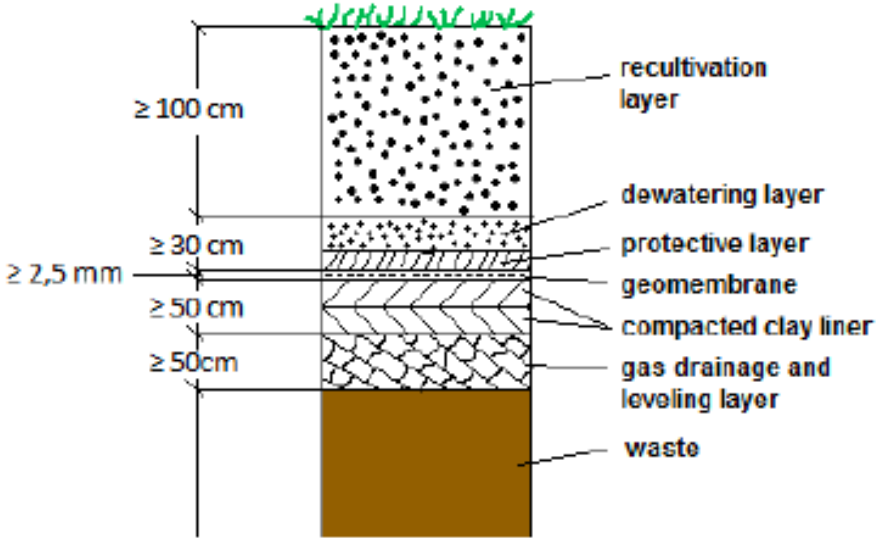
“Low Tech”

- TOC ≤ 18 mass-%
- No gas collection
- Methane oxidation 50%

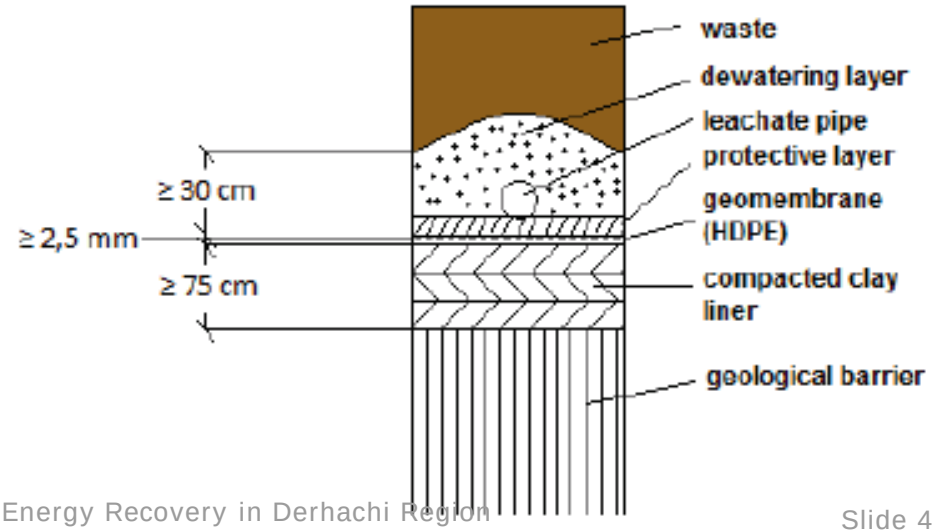
“High Tech”

- landfill class II according to the German landfill ordinance
- multi-barrier concept
- TOC ≤ 18 mass-%
- Landfill gas collection
- CHP with 35% electrical efficiency power unit (net)
- CHP with 10% thermal efficiency power unit (net)

Structure of surface sealing system landfill class II



Landfill base lining class II



MBT variations

MBT: Mechanical Biological Treatment

MBS: Mechanical Biological Stabilisation

MPS: Mechanical Physical Stabilisation

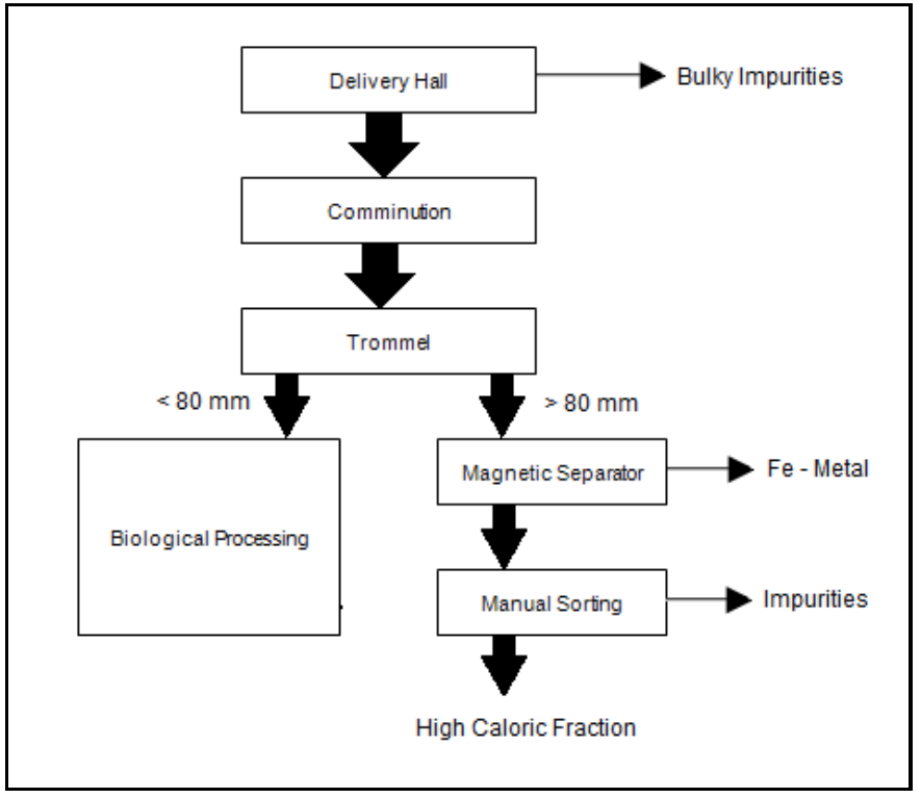
Always combinationen of mechanical and biological / physical treatment

→ different aims and order

Low and High Tech - MBT

“Low Tech”
Impurities 5 %
Metals 2 %
RDF 35 %
Degradation 18 %
Treated material to landfill 40 %

“High Tech”
RDF 35 %
Biogas 7 %
Metals 2 %
Treated material to landfill 14 %
Waste water and degradation losses 42 %



Example „Low Tech“ MBT

Investment costs for MBT (in Derhachi Region)

	Input [t/y]	Low Tech	on landfill site or ZUBR	High Tech
Derhachi	11,200 – 15,200	2.7 – 3.7 Mio €	0.22 – 0.3 Mio €	4.0 – 5.4 Mio €

Basic terms: Composting vs. Rotting

Composting (Biowaste)

Aerobic biological operation process to handle (separate collected) **biodegradable waste** to form a humus-like product, containing valuable nutrients

Rotting (Residual waste)

Aerobic biological operation process to handle **household waste** (mixed with biological waste) to reduce volume, mass, biological activity

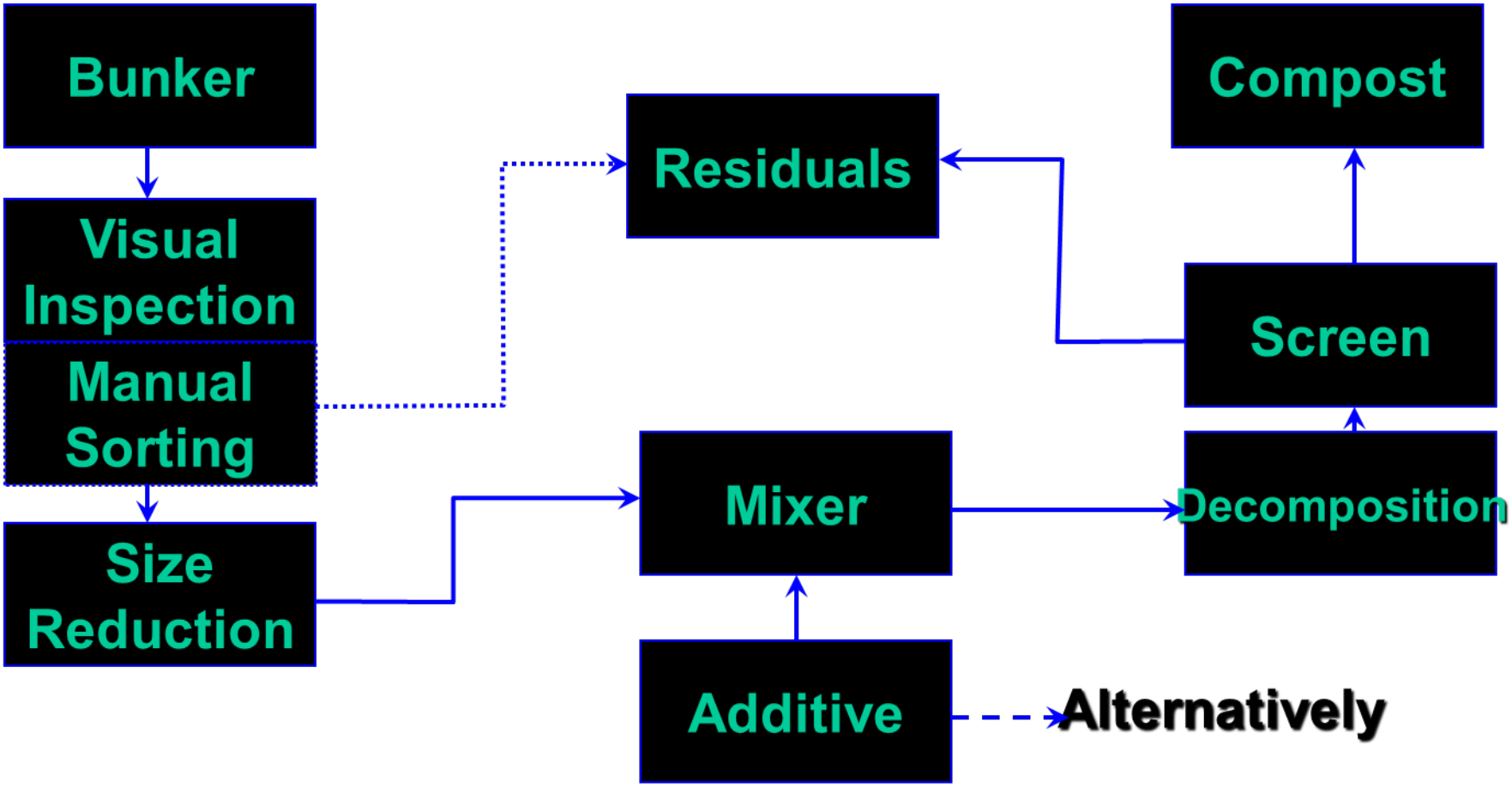
Treatment steps

Size reduction

Sieving

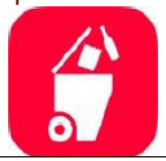
Triangular windrow composting

Treatment steps – Basic process



Overview of collection systems in place in the 28 EU countries

Source Separation

Collection type	Paper	Glass	Plastic	Metal	Bio-waste
Door-to-door (single fraction) 	AT, BE, BG, CY, DE, DK, FI, HU, IT, LU, LV, NL, SI, UK	BG, FI, LU, LV, NL, SI, MT	AT, LV, NL, DK	FI, NL, DK	AT, BE, CZ, DE, FI, EE, IT, HU, LU, NL, SI, SE, IE, UK
Co-mingled ...plastic + metal 			BE, BG, CY, DE, FR, IT, HU, LU, SI		
...3 fractions	RO, MT: paper, plastic, metal UK: plastic, metal, glass				
...all in one bin	EL, IE: paper, glass, plastic, metal				
Bring points 	CZ, EE, ES, FR, HR, LT, PT, PL, SE, SK	AT, BE, DK, CY, CZ, DE, EE, ES, FR, HR, IT, HU, LT, PT, PL, RO, SE, SK	SE ES, HR, LT, PT, PL (all plastic/metal in one container)	AT, EE, SE	ES
Civic amenity sites 	Primary collection: CZ (metal waste), SK (metal and bio-waste), LV (metal) Addition collection of all waste streams: all countries PL: rare distribution of civic amenity sites				

AT Austria
BE Belgium
BG Bulgaria
CY Cyprus
CZ Czech Republic
DE Germany
DK Denmark
EE Estonia
ELGreece
ES Spain
FI Finland
FR France
HR Croatia
HU Hungary
IE Ireland
IT Italy
LT Lithuania
LU Luxemburg
LV Latvia
MT Malta
NL Netherlands
PL Poland
PT Portugal
RO Romania
SE Sweden
SI Slovenia
SK Slovakia
UK United Kingdom

Source: BiPRO/CRI 2015

Efficiency of different collection shemes

(also dependend on other regional factors)

Survey of the 28 EU-memberstate capitals separate collection systems

Collection type	Paper	Glass	Plastic	Metal	Bio-waste
Door-to-door (single fraction) 	29 kg/cap Highest: 58	6 kg/cap Highest: 25	9 kg/cap Highest: 32	1 kg/cap Highest: 1	20 kg/cap Highest: 73
Co-mingled plastic + metal 	30 kg/cap Highest: 53	5 kg/cap Highest: 12	6 kg/cap Highest: 12	3 kg/cap Highest: 4	
Bring points 	12 kg/cap Highest: 76	12 kg/cap Highest: 53	7 kg/cap Highest: 26	2 kg/cap Highest: 9	19 kg/cap Highest: 33
Civic amenity sites 	3 kg/cap	2 kg/cap	1 kg/cap	2 kg/cap	6 kg/cap

Separate Collection Door-to-Door

4 Bins system

established system in Germany

packaging waste / other valuables ?

paper cardboard

bio-waste

residual waste

2 Bins system

wet waste dry waste

some research attempts

3 Bins system

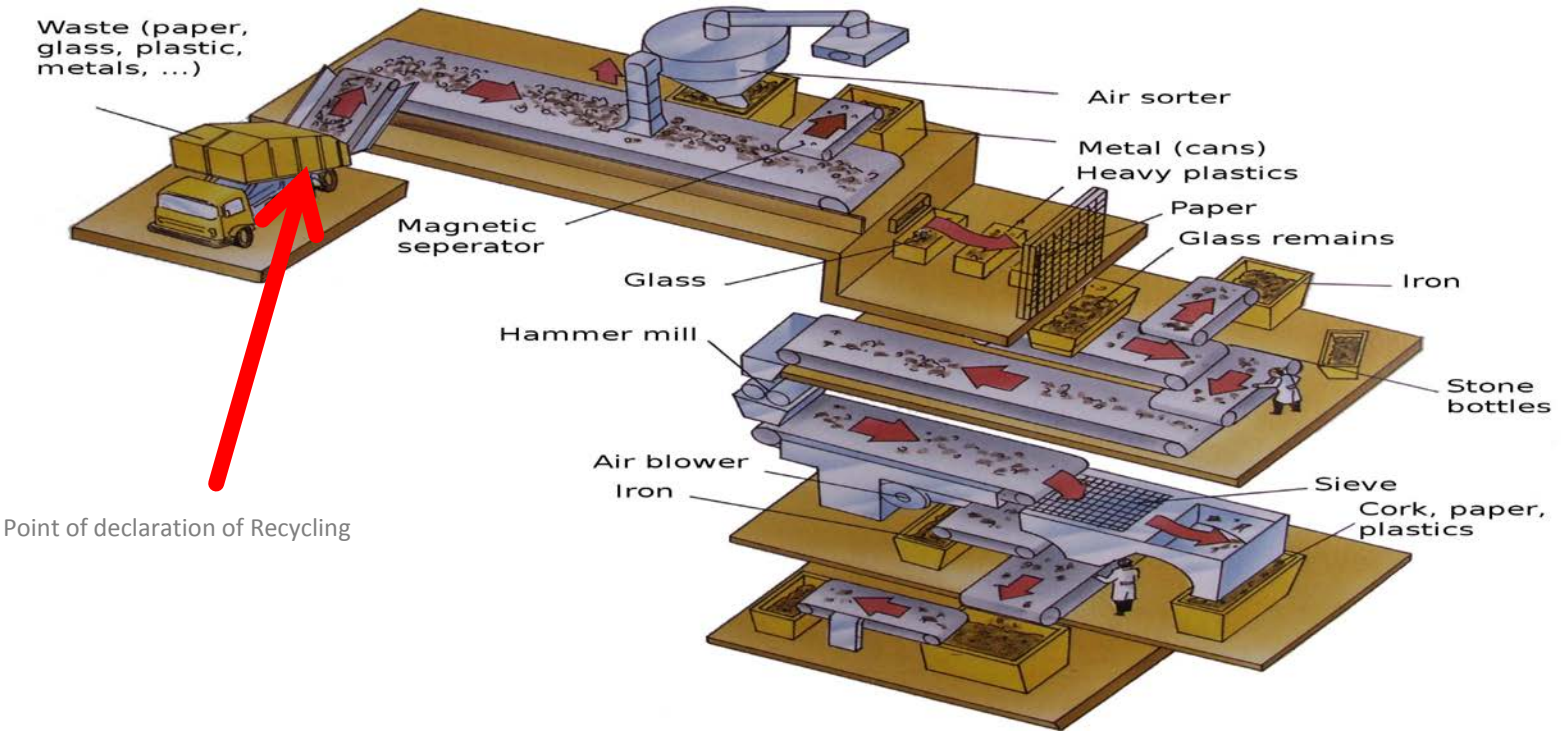
applied in other European countries

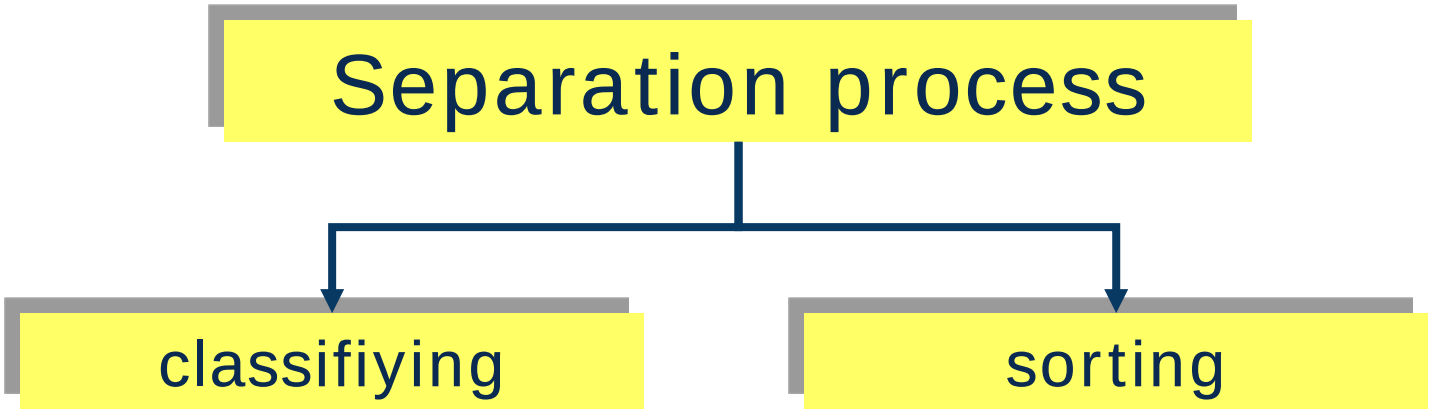
residual waste | bio-waste | valuables

Collection of Valuables? Quality!

Why often low quality recyclates?

In Germany recycling rates achieved by declaration of recovery at input of MRF → therefore facilities run on high throughput rather than generating high qualities (among other aspects)





Material separaton by particle size (sieve classification)

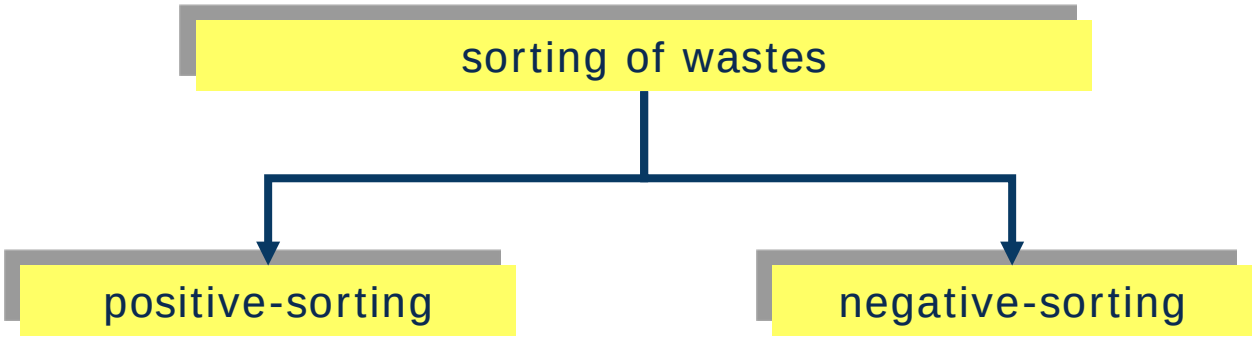
Subgroup is sifting (hydraulic classifying): Material separation in the fluid medium (use of Buoyancy / inertia and gravitational forces)

Separation by other properties than particle size:

Color, density, shape, transmission, conductivity, molecular structure, magnetism,...

The problem is often: heterogeneity und moisture of wastes

SORTING: Separation by other properties than particle size, evaluation of particles by material properties like:
color, density, shape, transmission, conductivity, molecular structure, magnetism,...



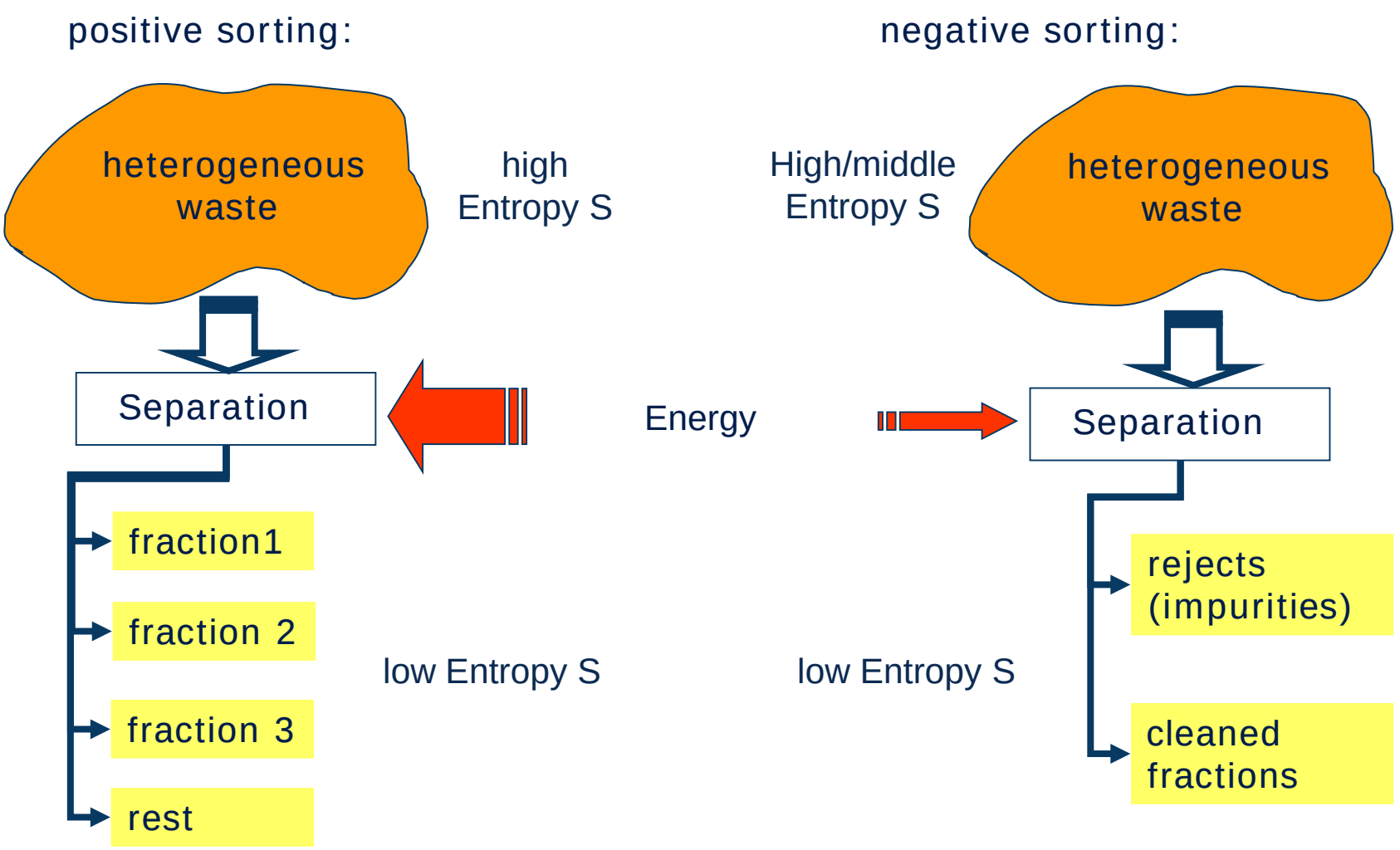
Example:

Sorting of PE-particles out of a light packaging flow

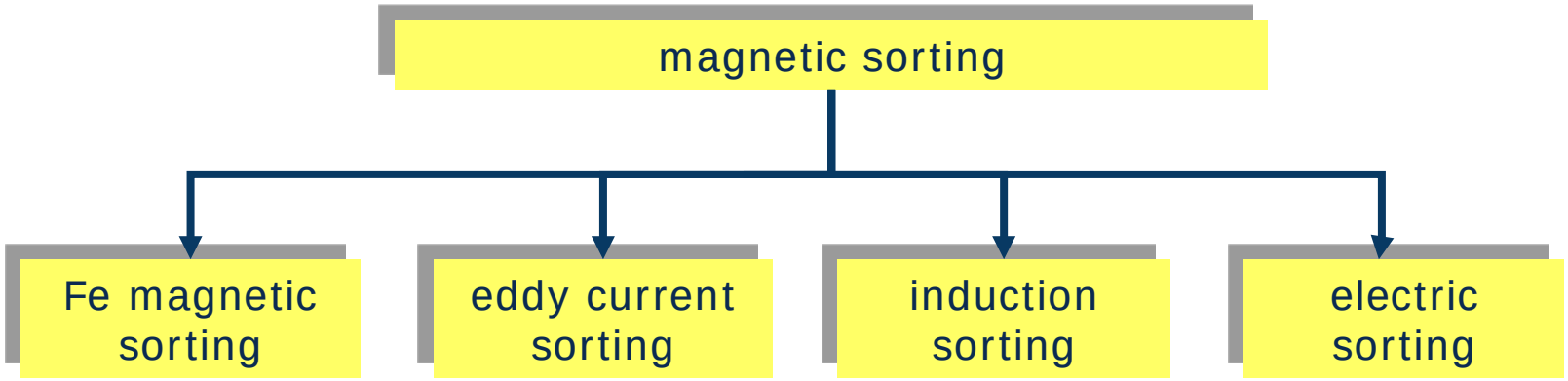
Example:

Removal of impurities out of a bio-waste flow

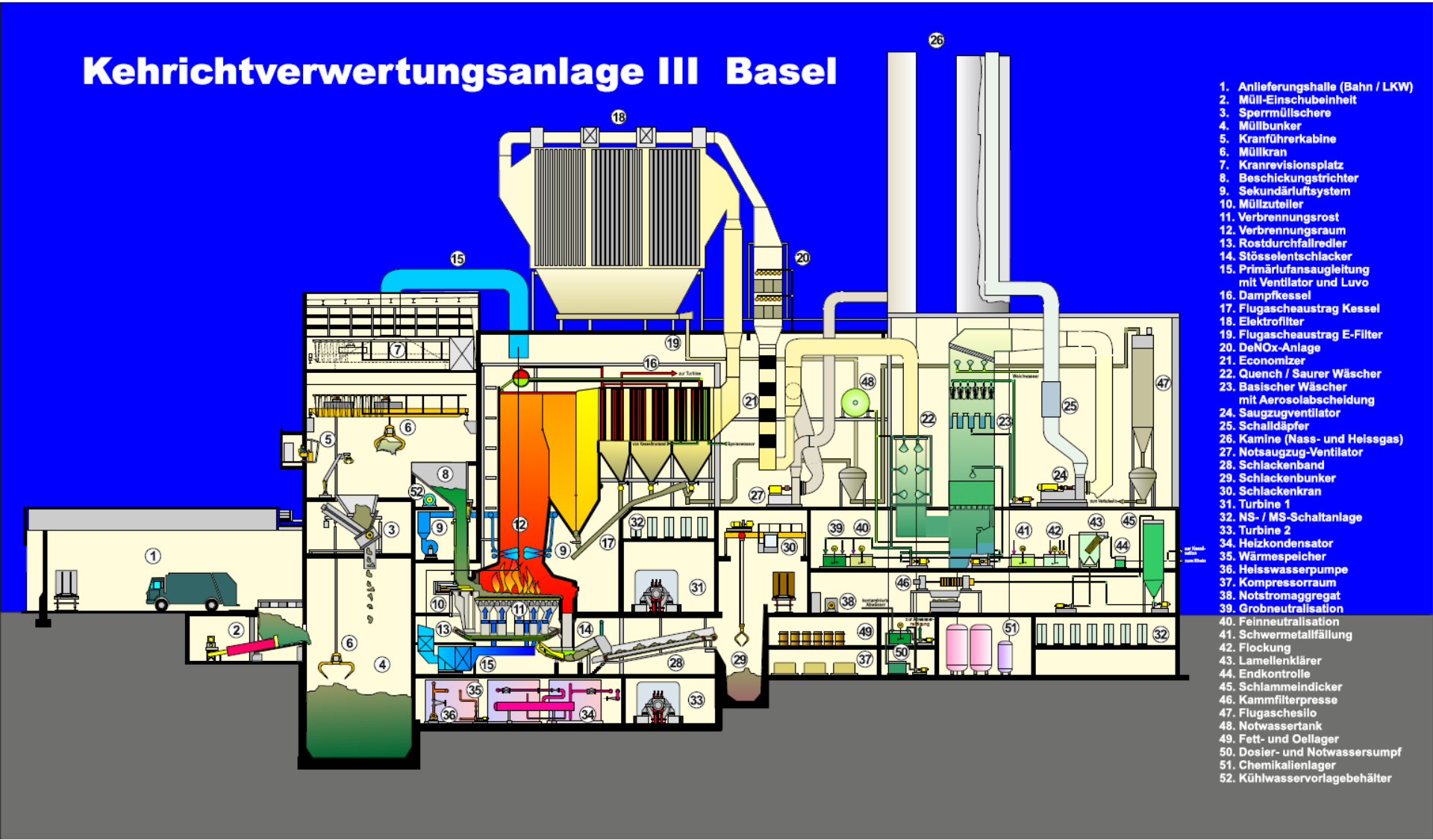
Recycling Technology



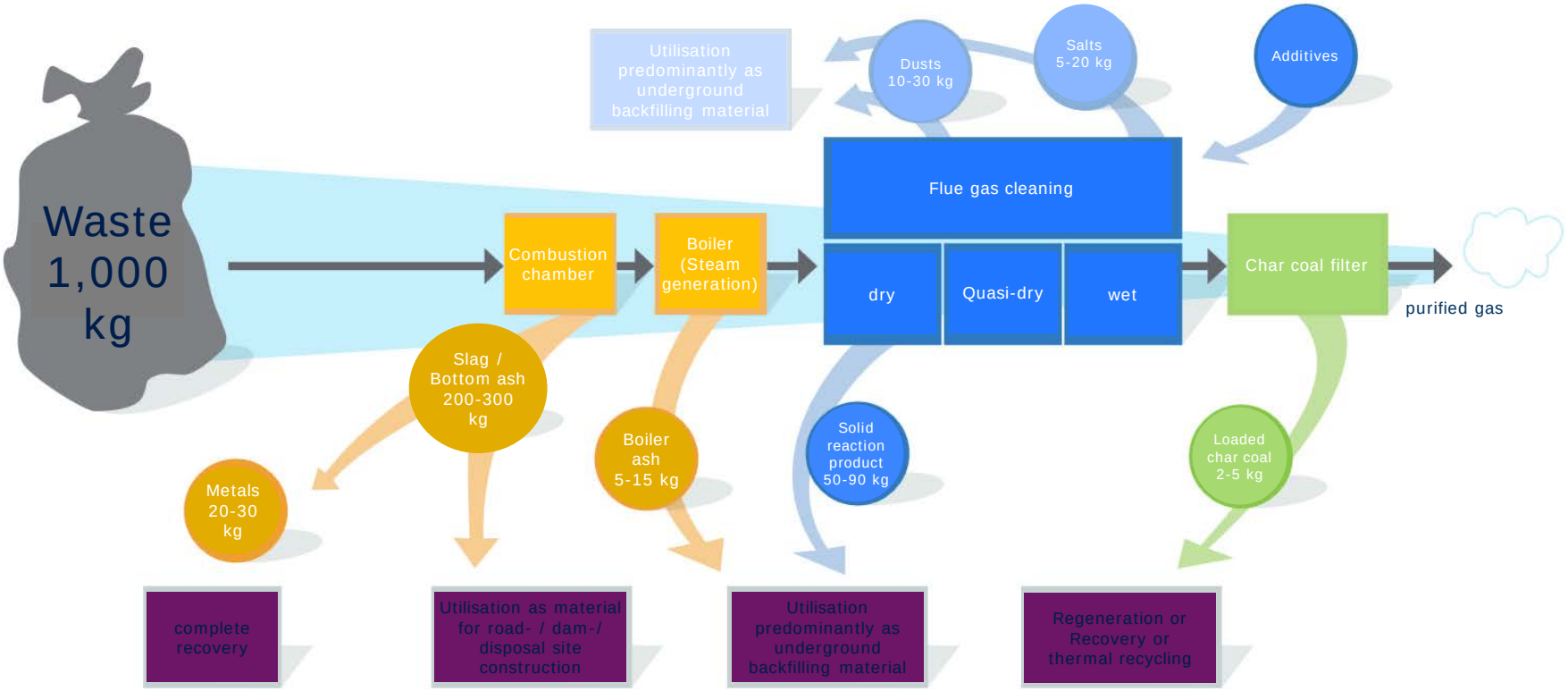
magnetic sorting:
Is the separation of heterogeneous materials of magnetizable and non-magnetizable particles by the effect of magnetic forces.
The separation is based on the effect, that magnetizable materials are attracted by a magnet, whereas non-magnetizable materials produce no inherent magnetic moment.



Waste Incineration plant



Quantity distribution of residues in the WI process



Source: ITAD annual report 2013

Noise barriers in the Netherlands made of slag
Source: CEWEP 2011

Choosen Incineration Technology Derhachi Region

Grate-firing incineration plant

Efficiency of incineration	97%
Concentration N2O in mg/Nm^3	2
Flue gas volume in Nm^3/t input	5,500
Auxiliary fuel	
- fuel oil in % of thermal input	2%
- natural gas in % of thermal input	0.5%

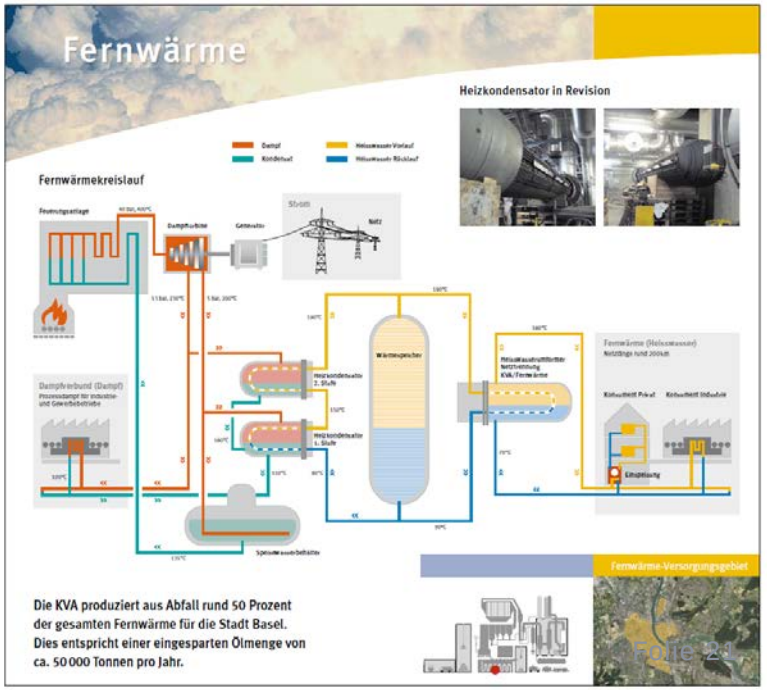
Version 1:

- Electrical net efficiency 10%
- Thermal net efficiency 35%

Version 2:

- Electrical net efficiency 30%
- Thermal net efficiency 0%

Example Combined heat and power extraction from waste incineration plant (KVA Basel)



Anaerobic Digestion

Wet mesophilic two-step digesters

Output streams

- impurities 5 mass-%
- wastewater 60 mass-%
- digestate 25 mass-%
- biogas 10 mass-%

Specific gas yield:

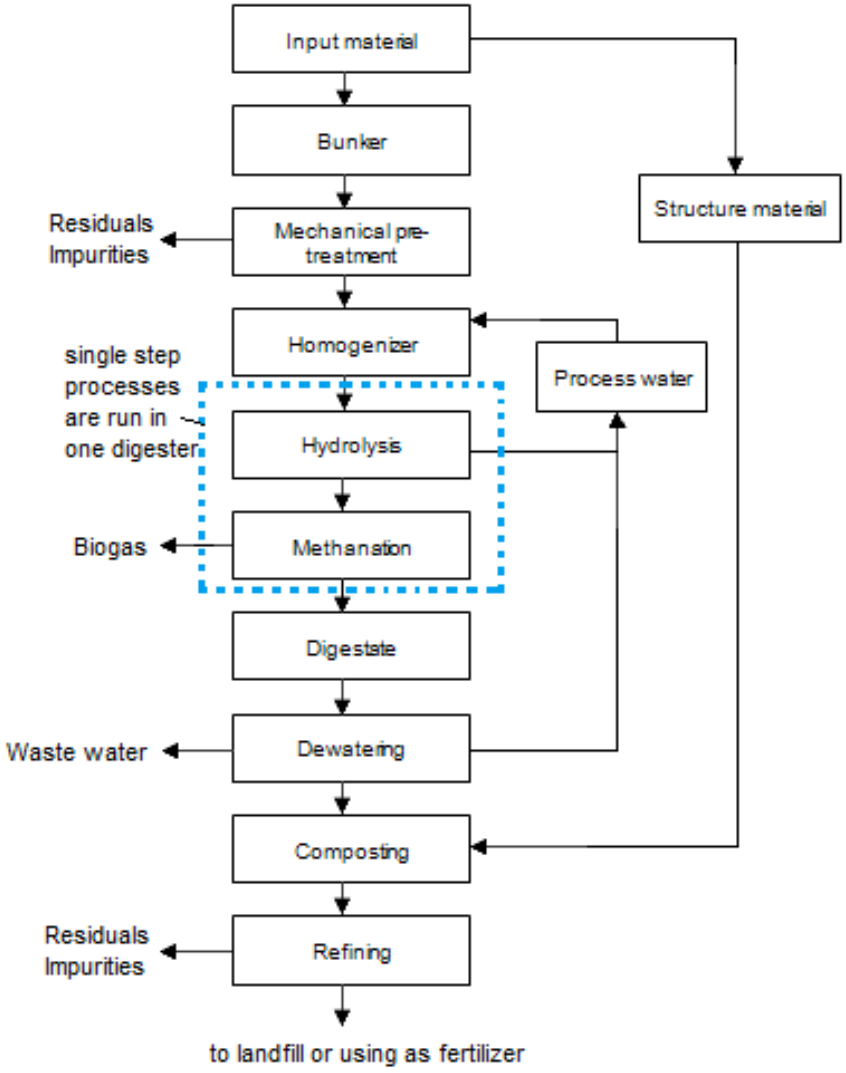
- Organic 500 Nm^3/t VDM
- Wood 40 Nm^3/t VDM

CHP

- electrical net efficiency 35%
- thermal net efficiency 12%

Own consumption

- electricity 50 kWh/t_{input}
- heat 30 kWh/t_{input}
- fuel oil/diesel 11 kWh/t_{input}



Costs

Most of the costs depend on the local markets

Not enough sufficient information about the real costs and the actual circumstances in the case study regions

Overview of the investment and operational costs for each treatment possible

Investment costs

- property
- site search/expert opinions
- development costs
- buildings
- facility units
- site vehicles/truck scale

Operational Costs

- staff costs
- electricity
- insurance
- service costs

Considerations of revenues

Incineration plants have higher investment costs than MBT

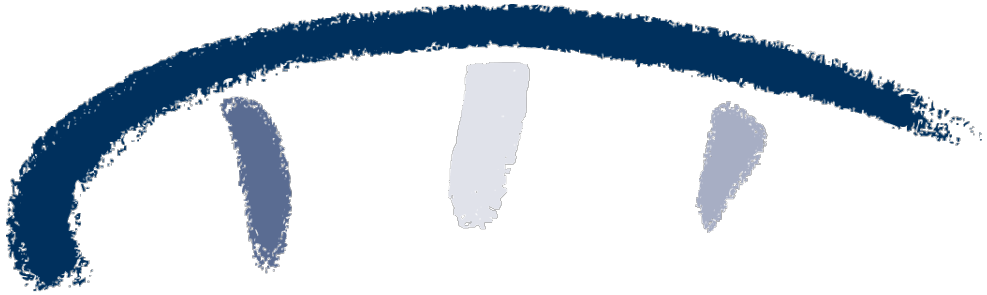
Especially MBT on a landfill site with low technology can be realized with relative low investments

Conclusion

Establishing sanitary landfill should be the first step reducing environmental and climatic impacts

Implementation of low tech technology is recommended

Separation of biowaste leads to less greenhouse gas emissions from landfill



»Wissen schafft Brücken.«