

Training course MBT and project calculation

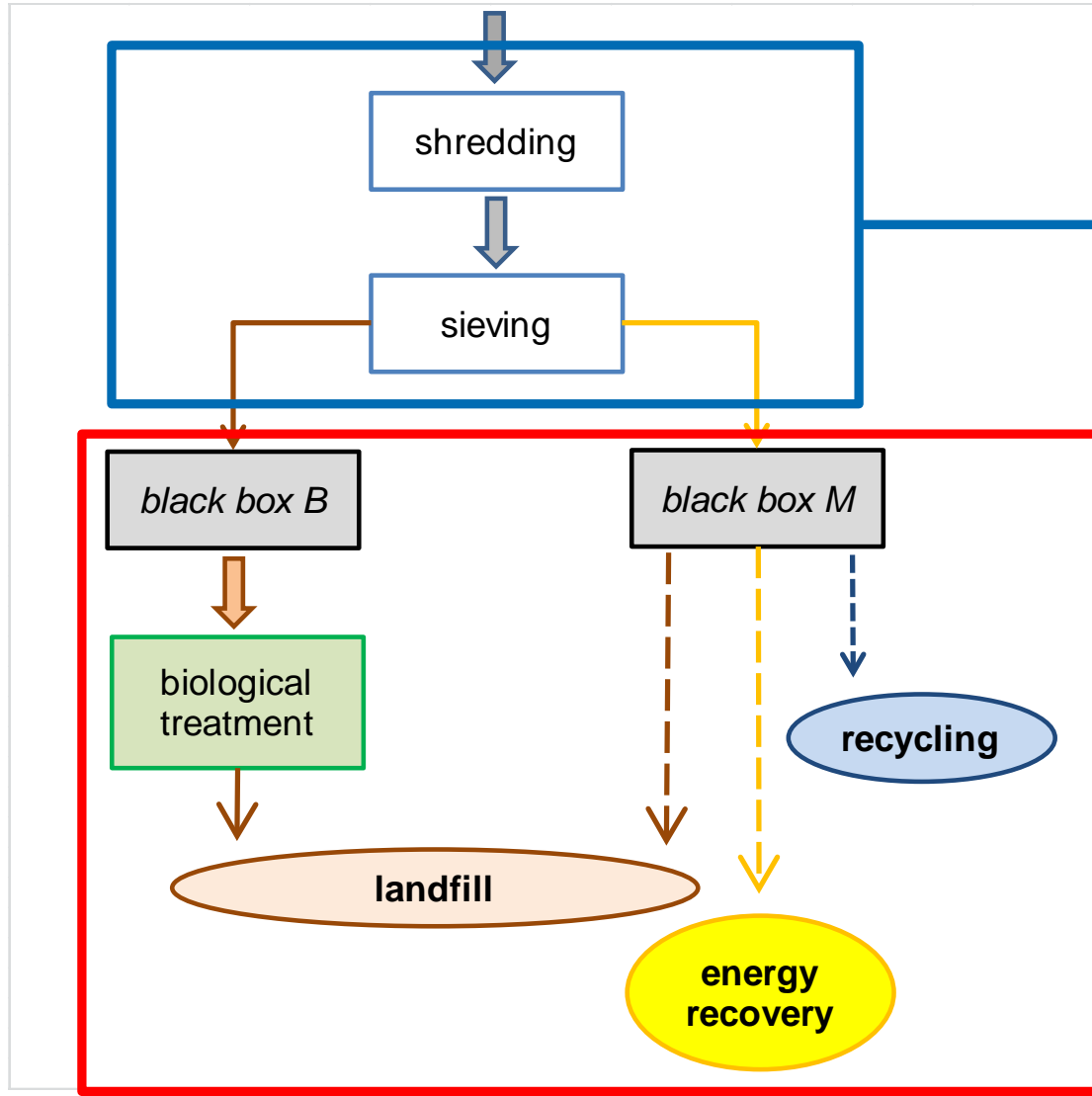
## ***Project calculation***

### **Part 2 MBT calculation**

Kosice 02.10.2017 – 05.10.2017

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# Basic MBT flow sheet



Basic mechanical pre-treatment of MSW

Specific technical application depending on local waste management strategy

**Flexible Design!**

## Economics of MSW Treatment

- For the economical discussion 2 technical solutions are used:
  - small: 50.000 t/y capacity, 1 shift operation (1.600 h/y),
  - large: 100.000 t/y capacity, 2 shift operation (3.200 h/y)both: 31,25 t/h technical dimension
- CAPEX conditions:
  - depreciation 20 years for buildings, 10 years for technology, 5 years for mobile equipment
  - interest 4 %, CAPEX calculated as an annuity
$$a_5 = 22,46 \% \text{ of investment}$$
$$a_{10} = 12,33 \% \text{ of investment}$$
$$a_{20} = 7,36 \% \text{ of investment}$$

## Economics of MSW Treatment

- OPEX is calculated with the following costs for daily operation:
  - staff Ø 30.000 €/y incl. holiday etc.
  - Maintenance shredder 20 % of the investment
  - Maintenance mobile equipment 7 % of the investment
  - Maintenance equipment 3 % of the investment
  - Maintenance buildings 2 % of the investment
  - gasoline 1,- €/l
  - electrical energy 0,16 €/kWh
- Disposal costs calculated in a bandwidth:

?

flow	€/t min.	€/t max.
Landfill	10	50
RDF	-10	50
Recyclables	-10	50

## MSW Treatment cost calculation

- The MBT cost calculation combines:
  - + CAPEX
  - + OPEX
  - + disposal costs

and leads to the final “**treatment costs**” of MSW that has to be covered by fees or taxes.

- A micro economic benefit is always created by the mass loss of the biological process depending on the process design.
- In addition risks and benefits for the operators have to be calculated individually.
- Costs for logistics are not included.

## MBT basic pre-treatment

- Due to the fact that all MBT need a basic structure of receiving area, storage, shredding and screening process, this pre-treatment can be calculated separately. The differences of the offered processes are in the further mechanical treatment and the biological processes.
- CAPEX and OPEX for a basic structure except biological process and any kind of treatment for the bulky flow stream are shown below:

	50,000 t/y	100,000 t/y
site demand	3,800 m <sup>2</sup>	5,000 m <sup>2</sup>
investment	3.0 Mio. €	4.2 Mio. €
CAPEX	320,000 €/y	420.000 €/y
OPEX	420,000 €/y	820.000 €/y
specific treatment costs	16 €/t	14 €/t

# Calculation of the basic pre-treatment

- Basic plant data

throughput	50.000	t/a
operation time	250	d
average capacity	200	t/d
contingencies	20%	
	<b>240</b>	<b>t/d</b>
hmax	30%	
Mmax	72	t/h
trucks load	9	t/truck
	<b>8</b>	<b>Fzg/hmax</b>

## Basic design

<b>circulation area reception</b>		
spez. 20*5 m	100	m <sup>2</sup>
degree of utilization	3	je Std.
<b>area</b>	<b>300</b>	<b>m<sup>2</sup></b>
<b>Bunker</b>		
bulg density	0,25	t/m <sup>3</sup>
Vmax/d	960	m <sup>3</sup>
solids loading	4	m <sup>3</sup> /m <sup>2</sup>
area	240	m <sup>2</sup>
<b>selected</b>	<b>300</b>	<b>m<sup>2</sup></b>
<b>feeding area</b>	<b>300</b>	<b>m<sup>2</sup></b>
<b>total area Bunker</b>	<b>900</b>	<b>m<sup>2</sup></b>
<b>construction volume</b>	<b>9900</b>	<b>m<sup>3</sup></b>
	EP	60
	GP	594.000
		€/m <sup>3</sup>
		€

## Calculation of the basic pre-treatment

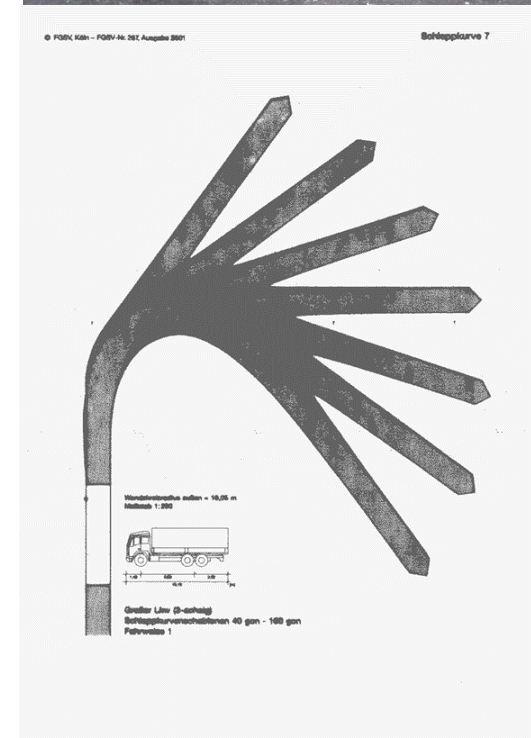
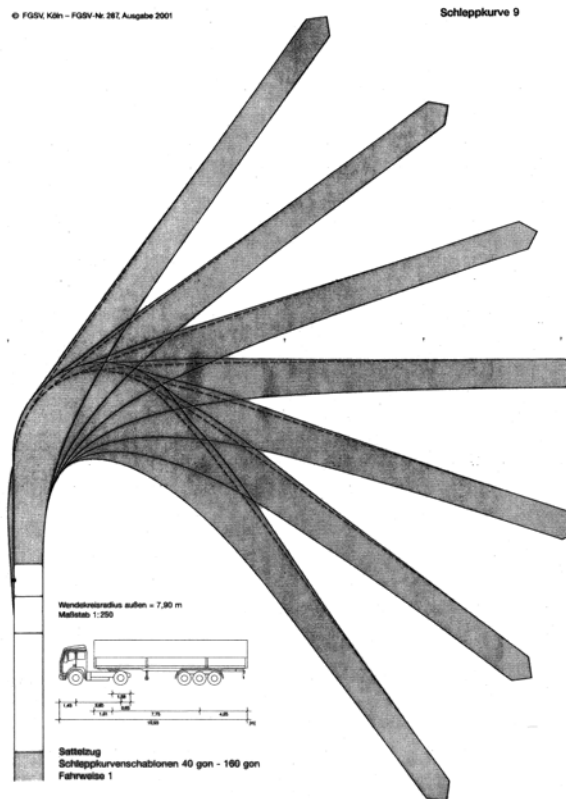
- Circulation area and floor space required





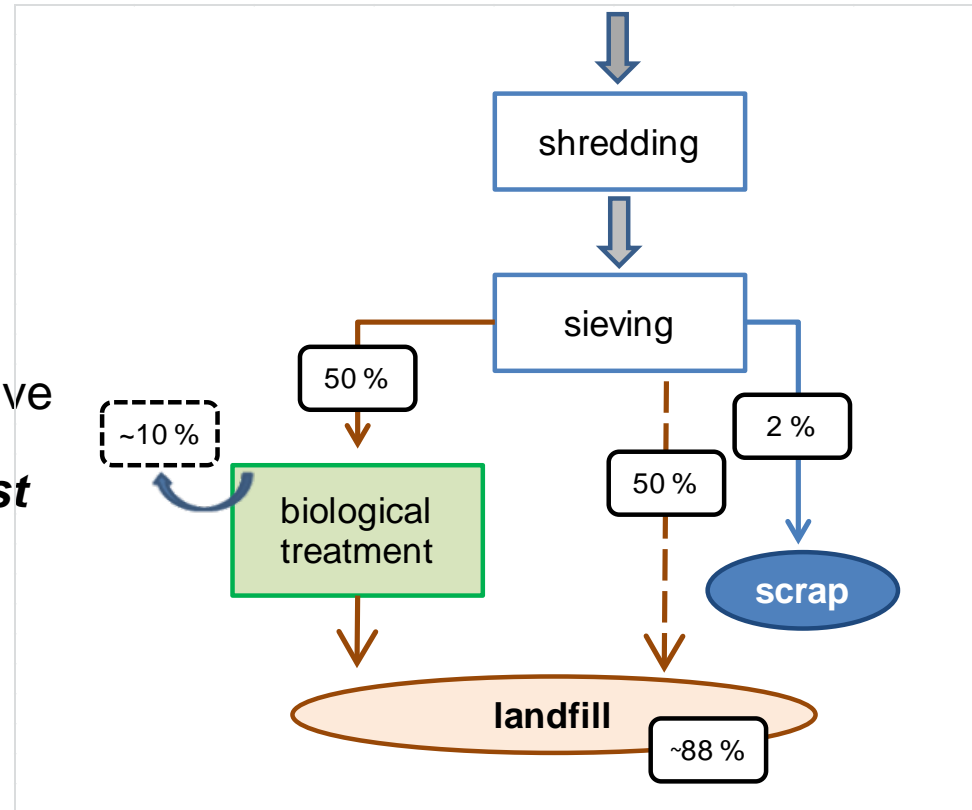
# Calculation of the basic pre-treatment

- Circulation area and floor space required
- Basic design using templates for different types of trucks to identify floor space



## MBT type A

- For a 100,000 t capacity a closed composting system is recommended (A 2)
- System to fulfill the minimum legal requirements of EU directive
- ***Does landfill flow stream must pay landfill tax?***

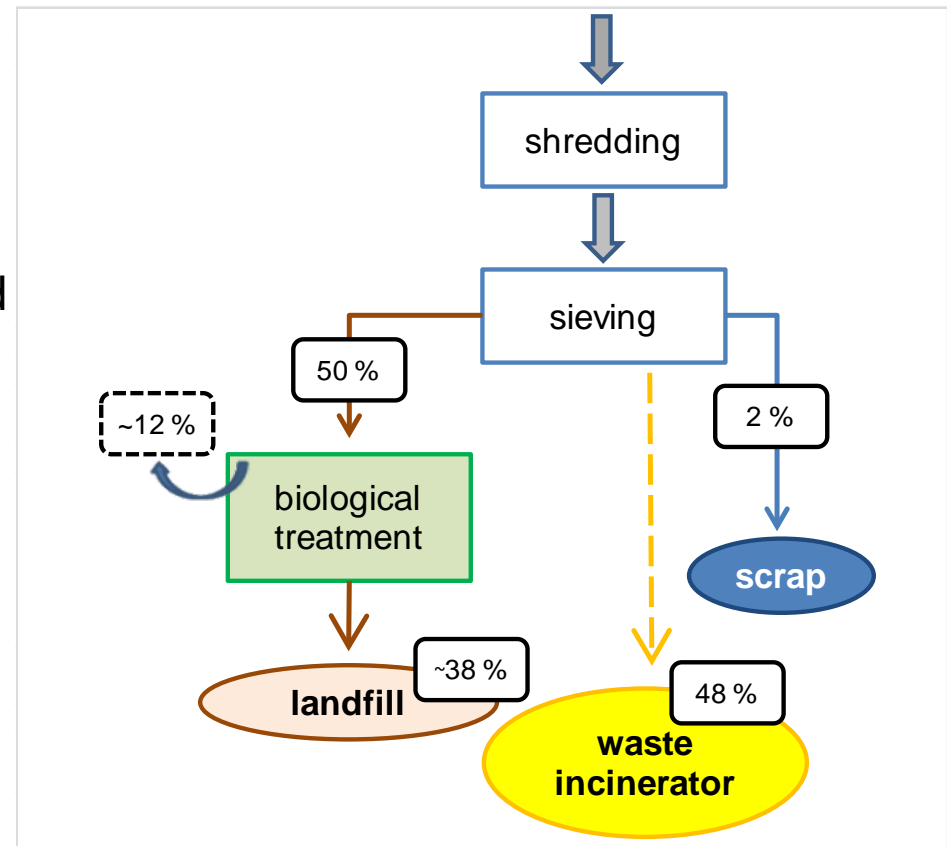


## MBT type A economics

	50,000 t/y (A 1)	100,000 t/y (A 2)
site demand basic MT	3,800 m <sup>2</sup>	5,000 m <sup>2</sup>
site demand BT	8,500 m <sup>2</sup>	4,000 m <sup>2</sup>
Total investment MBT	4.6 Mio. €	21.3 Mio. €
CAPEX	440,000 €/y	1,750,000 €/y
OPEX	510,000 €/y	1,620,000 €/y
Total treatment costs	950,000 €/y	3,370,000 €/y
specific treatment costs	19 €/t	34 €/t
Disposal costs low	9 €/t	9 €/t
Disposal costs high		44 €/t
Total treatment costs low	28 €/t	43 €/t
Total treatment costs high		78 €/t

## MBT type B

- Landfill flow stream must have quality according to national landfill regulations!
- Adjustment of deposit material quality by mass distribution based on sieve cut. Better landfill quality means higher amount of waste to incinerator!
- ***Does landfill flow stream must pay landfill tax?***



## MBT type B economics

	50,000 t/y*	100,000 t/y*
Total investment MBT	12 Mio. €	21.3 Mio. €
Total treatment costs	2.0 Mio. €/y	3.37 Mio. €/y
specific treatment costs	40 €/t	34 €/t
Disposal costs	<b>28 – 44 €/t</b>	
Landfill	4 – 19 €/t	
Incineration	24 €/t	
Recyclables	0 - 1 €/t	

\* exclusive German exhaust air treatment

- Visible economy of scale effect
- Important influence of the disposal costs on total treatment costs

## MBT and SRF production

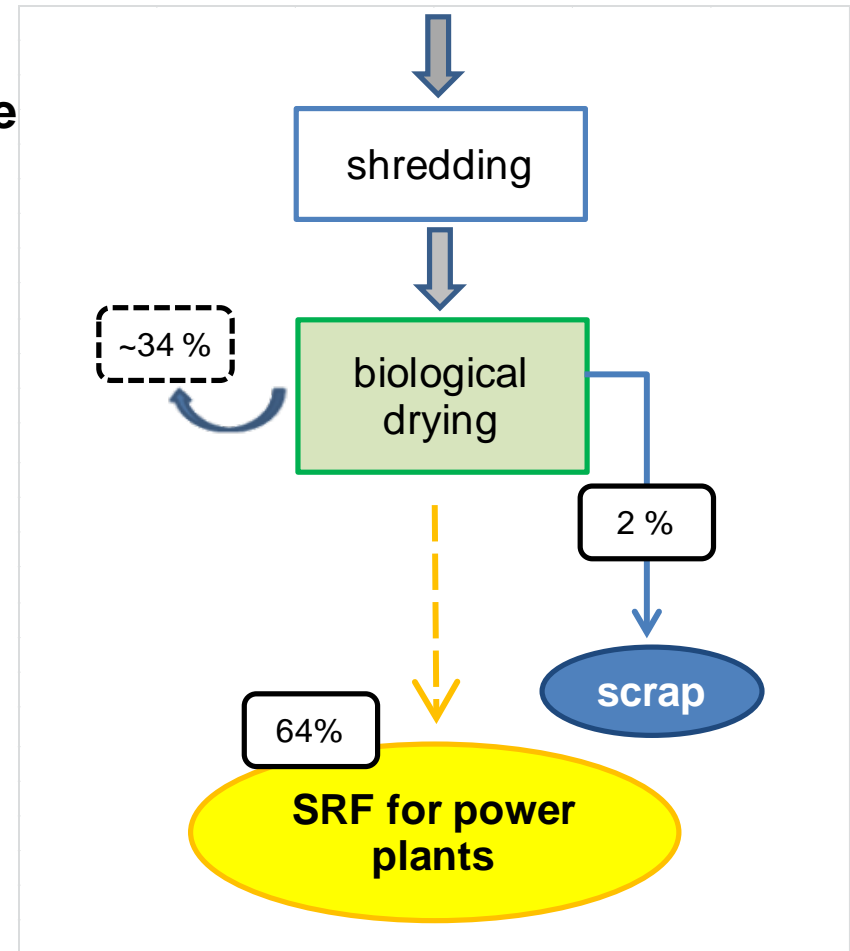
- Comparison of treatment costs regarding SRF quality

	50,000 t/y* incineration	50,000 t/y* SRF
Total investment MBT	12 Mio. €	14 Mio. €
Total treatment costs	2.0 Mio. €/y	2.6 Mio. €/y
specific treatment costs	<b>40 €/t</b>	<b>52 €/t</b>
Disposal costs	<b>28 – 44 €/t</b>	<b>0 – 44 €/t</b>
Landfill	4 – 19 €/t	4 – 19 €/t
<b>Incineration / SRF</b>	<b>24 €/t</b>	<b>- 5 – 24 €/t</b>
Recyclables	0 - 1 €/t	0 - 1 €/t

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## MBT type C

- *What are the main quality requirements for SRF?*
- Dry quality with a big share of fine fraction (~ 65 % < 60 mm!) cannot be used in all incineration systems depending on feedstock mixture!



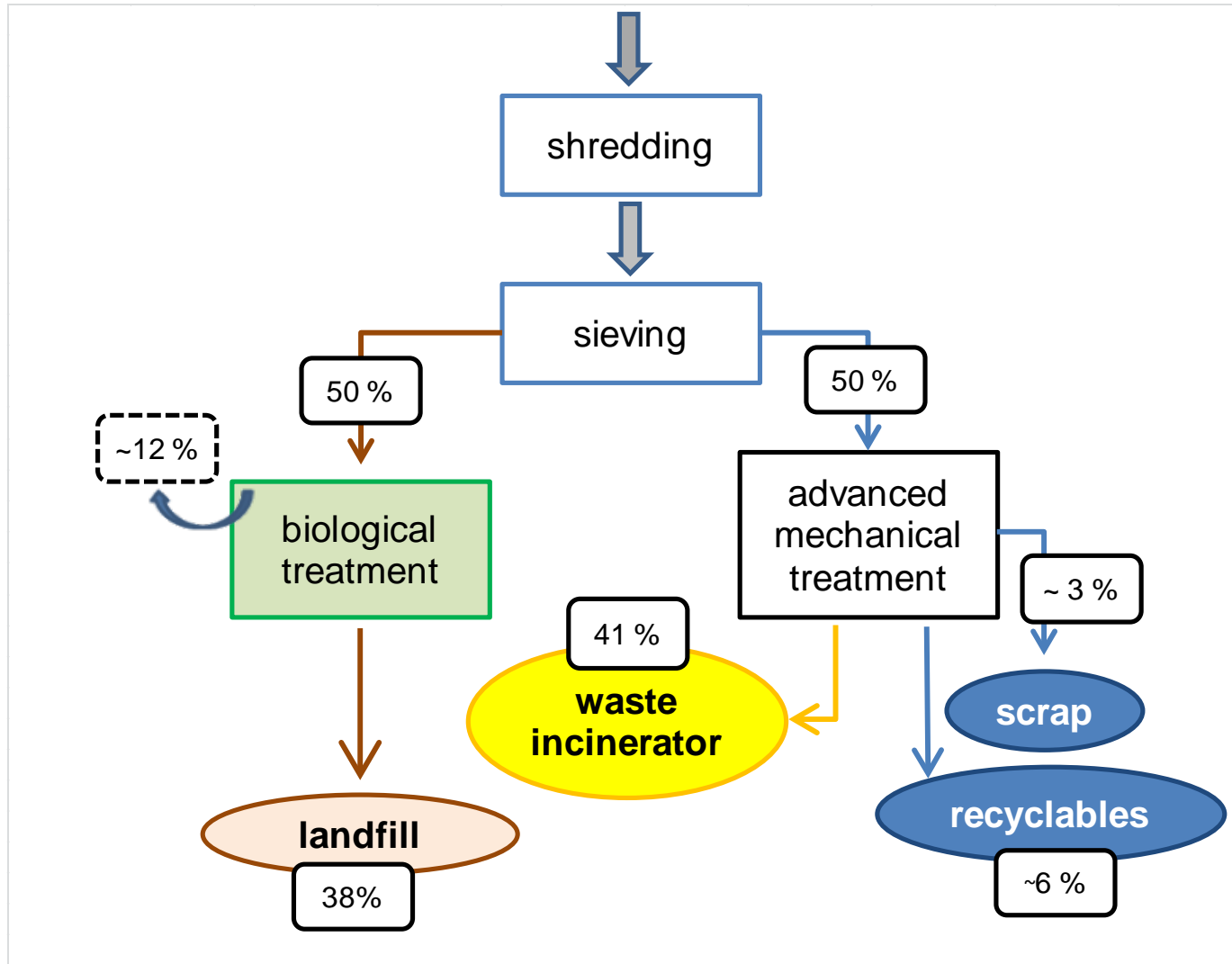
## MBT type C economics

	<b>100,000 t/y*</b>
Total investment MBT	17.2 Mio. €
Total treatment costs	3.3 Mio. €/y
specific treatment costs	33 €/t
Disposal costs	<b>0 – 32 €/t</b>
Landfill	0 €/t
SRF	0 - 32 €/t
Recyclables	0 €/t

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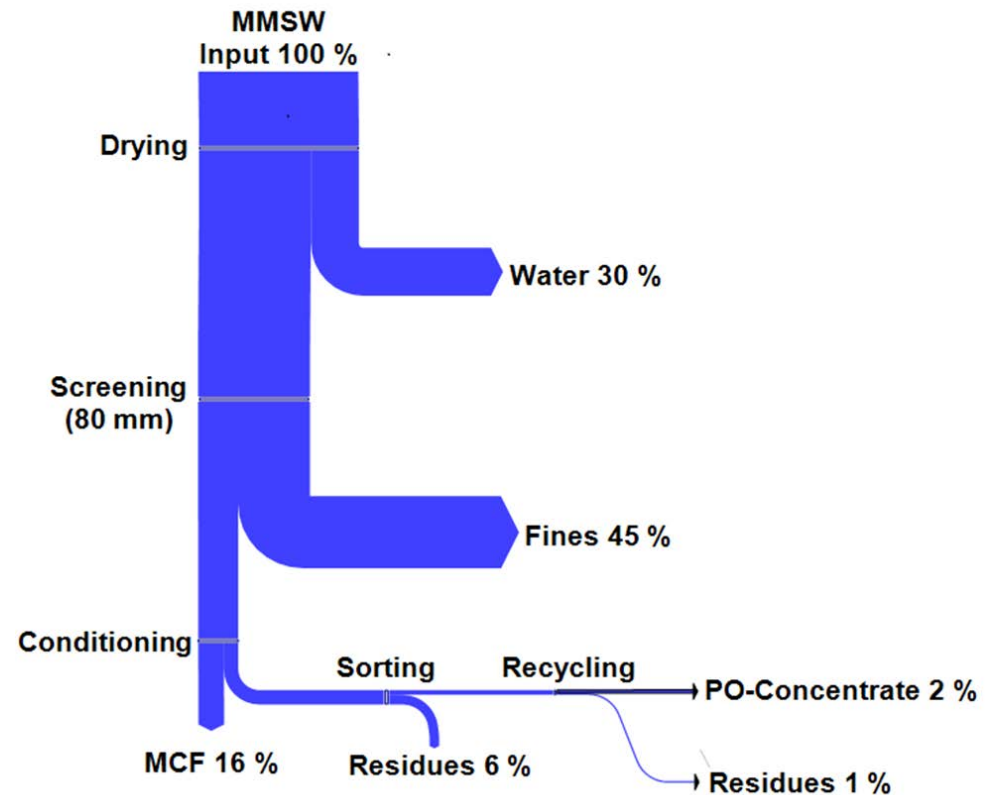


# MBT type D



## MBT type D

- **Big advantage to avoid separate collecting system for packaging waste** by sorting plastics and metals from the coarse fraction.
- **It isn't the small yield of plastics use type D but mainly the waste management solution for packaging waste!**
- *In addition beverage carton can also be sorted (example NL)*
- *The result of sorting plastics for material recycling is lower calorific value of the coarse fraction (~ 10,000 kJ/kg)*

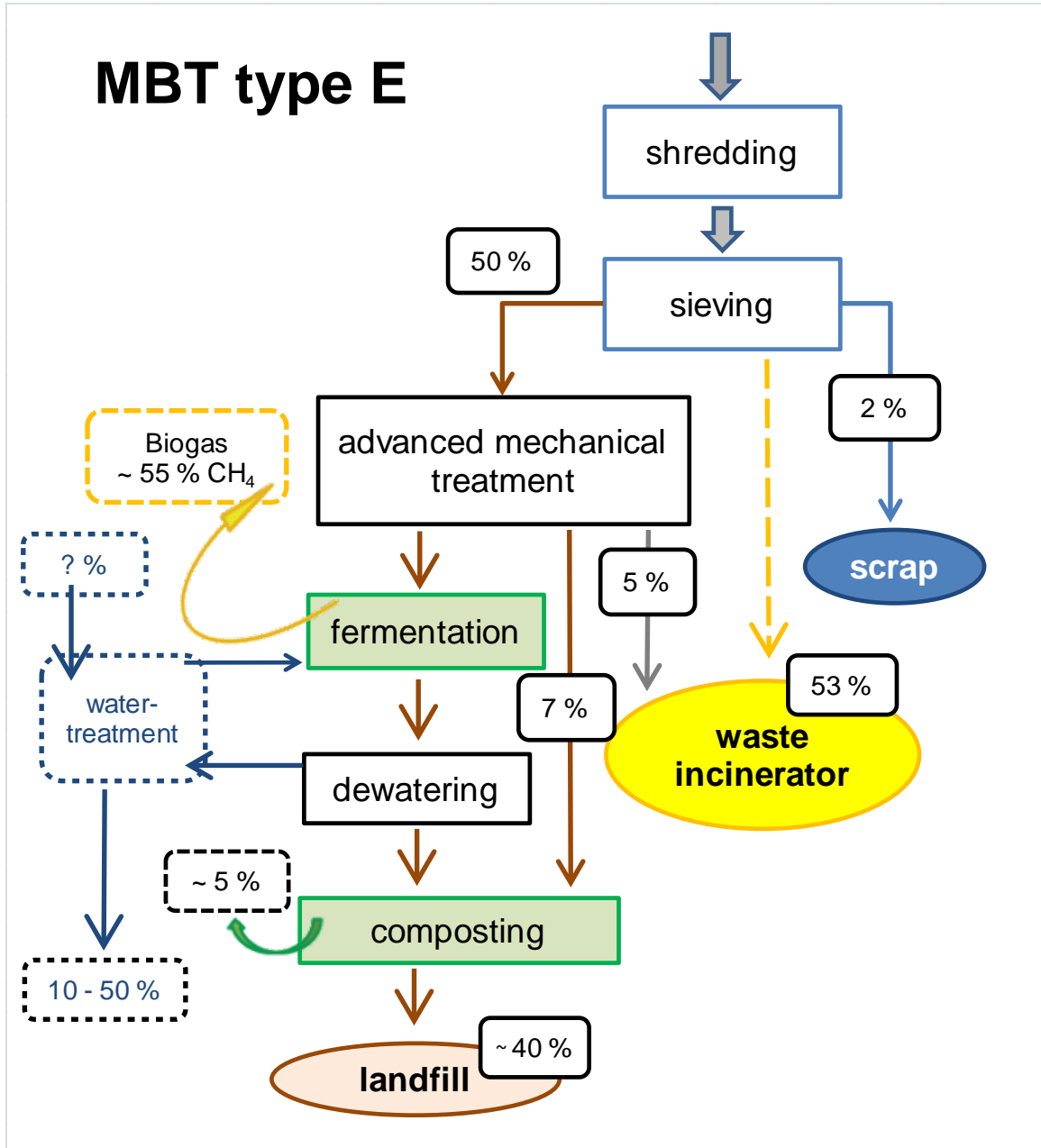


## MBT type D economics

	<b>100,000 t/y*</b>
Total investment MBT	24.7 Mio. €
Total treatment costs	4.1 Mio. €/y
specific treatment costs	41 €/t
Disposal costs	<b>24 – 41 €/t</b>
Landfill	4 - 19 €/t
incineration	21 €/t
Recyclables	0 -2 €/t

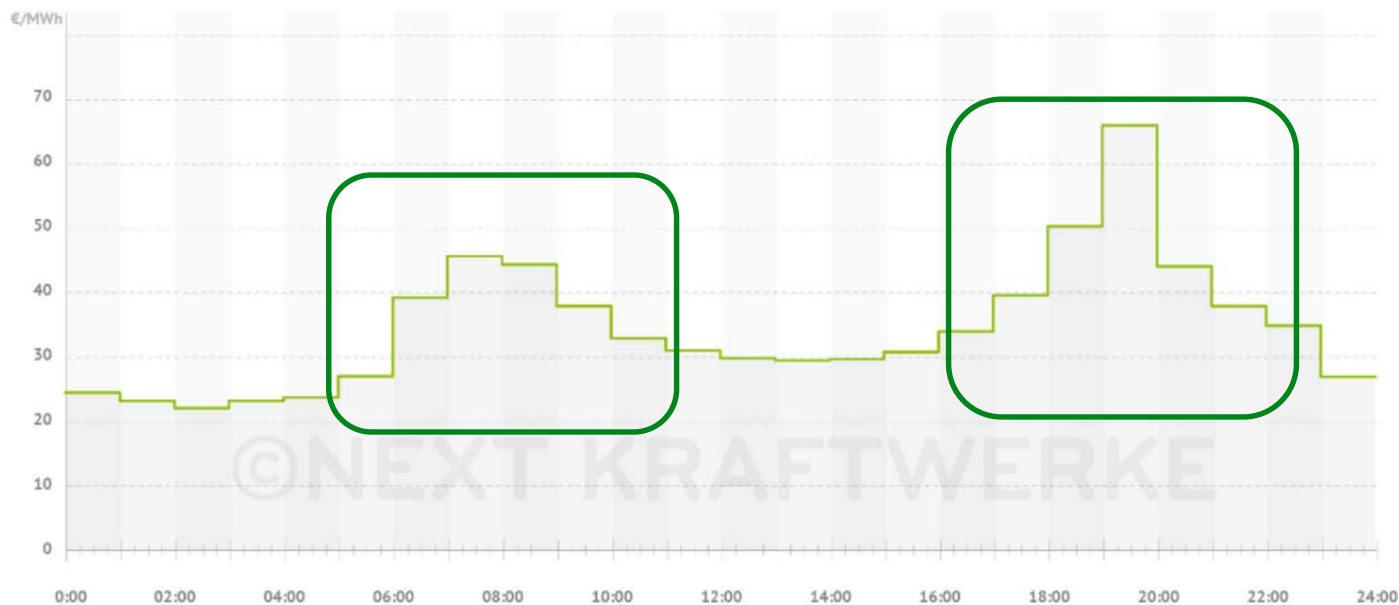
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# MBT type E



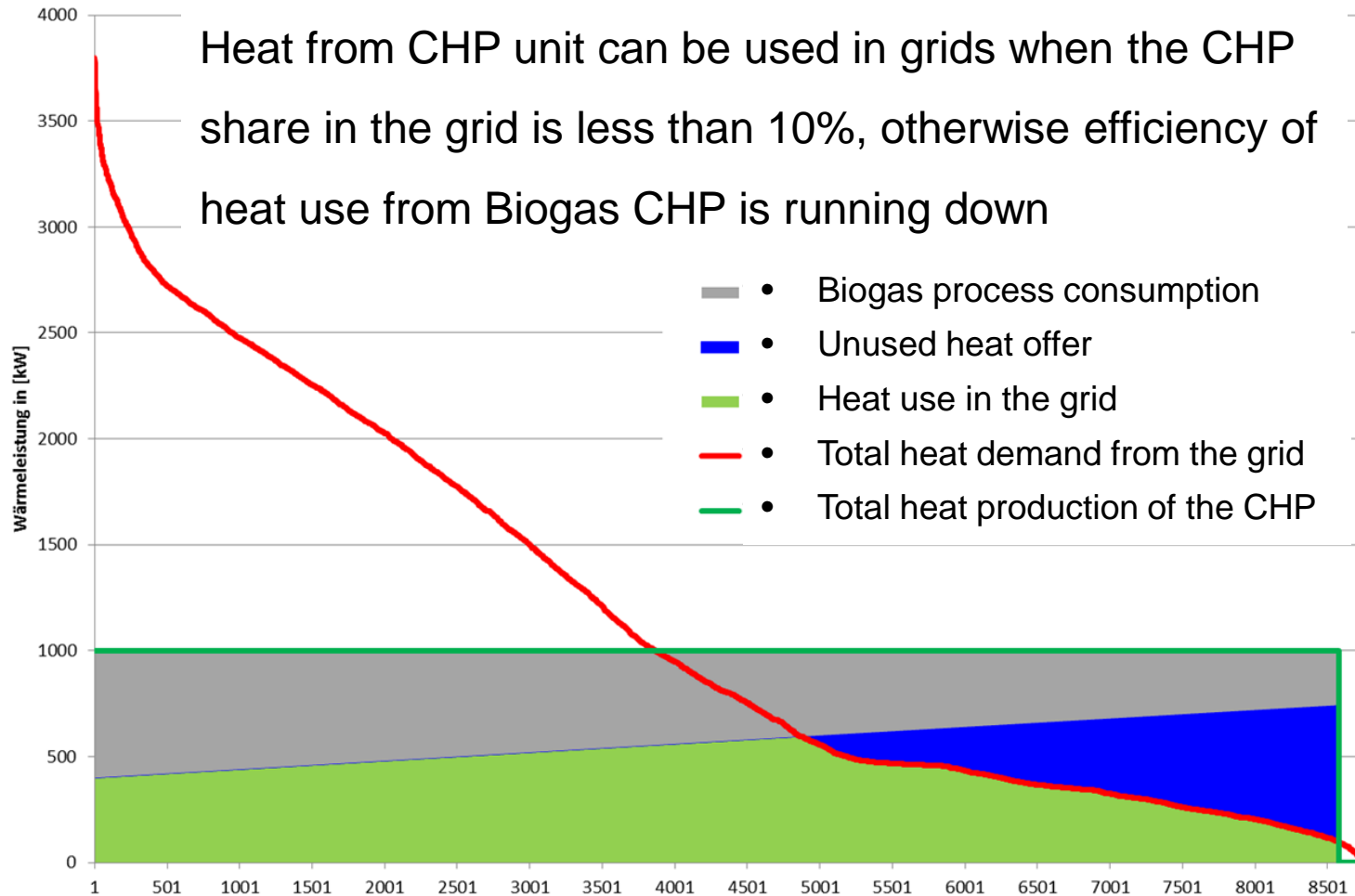
## MBT type E

- *The driver to choose type E can be the **option of renewable energy production** that can be used as controlled energy resource (**energy on demand**)*
- No continuous production of electrical energy but production when spot market (European Power Exchange EPEX Spot in Paris) announces high prices



## MBT type E

- ***Difficult to produce heat on demand!***



## MBT type E economics

	<b>100,000 t/y*</b>
Total investment MBT	31.9 Mio. €
Total treatment costs	5.0 Mio. €/y
specific treatment costs	50 €/t
Disposal costs	<b>31 - 50 €/t</b>
Landfill	4 - 20 €/t
Incineration	27 €/t
Recyclables	0 -1 €/t
Waste water disposal	1 – 3 €/t
<b>Revenues for Biogas</b>	<b>3 – 6 €/t</b>

\* exclusive German exhaust air treatment

# Economic assessment of MBT technologies

type	Capex + Opex	mass loss	landfill		incineration		SRF		metals		recyclables		total treatment costs
	€/t	%	%	€/t	%	€/t	%	€/t	%	€/t	%	€/t	€/t
<b>A</b>	34	10%	88%	8,8					2%	-0,4			<b>42</b>
<b>B</b>	34	12%	38%	3,8	48%	28,8			2%	-0,4			<b>66</b>
<b>C</b>	33	34%					64%	6,4	2%	-0,4			<b>39</b>
<b>D</b>	41	12%	38%	3,8	41%	24,6			3%	-0,6	6%	-3	<b>66</b>
<b>E</b>	50	5%	40%	4	53%	31,8			2%	-0,4			<b>85</b>

landfill	10	10	30	-10	-50	-100
incineration	60	20	40	0	-40	-75
SRF	10	30	50	10	-30	-50
metals	-20	40	60	20	-20	-40
recyclables	-50	50	70	30	-10	-30
		60	80	40	0	-20
		70	90		10	-10
		80	100		20	0

Try to find conditions with leading to different results