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# Status and prospects of treatment technology for material and energy recovery from commercial solid waste

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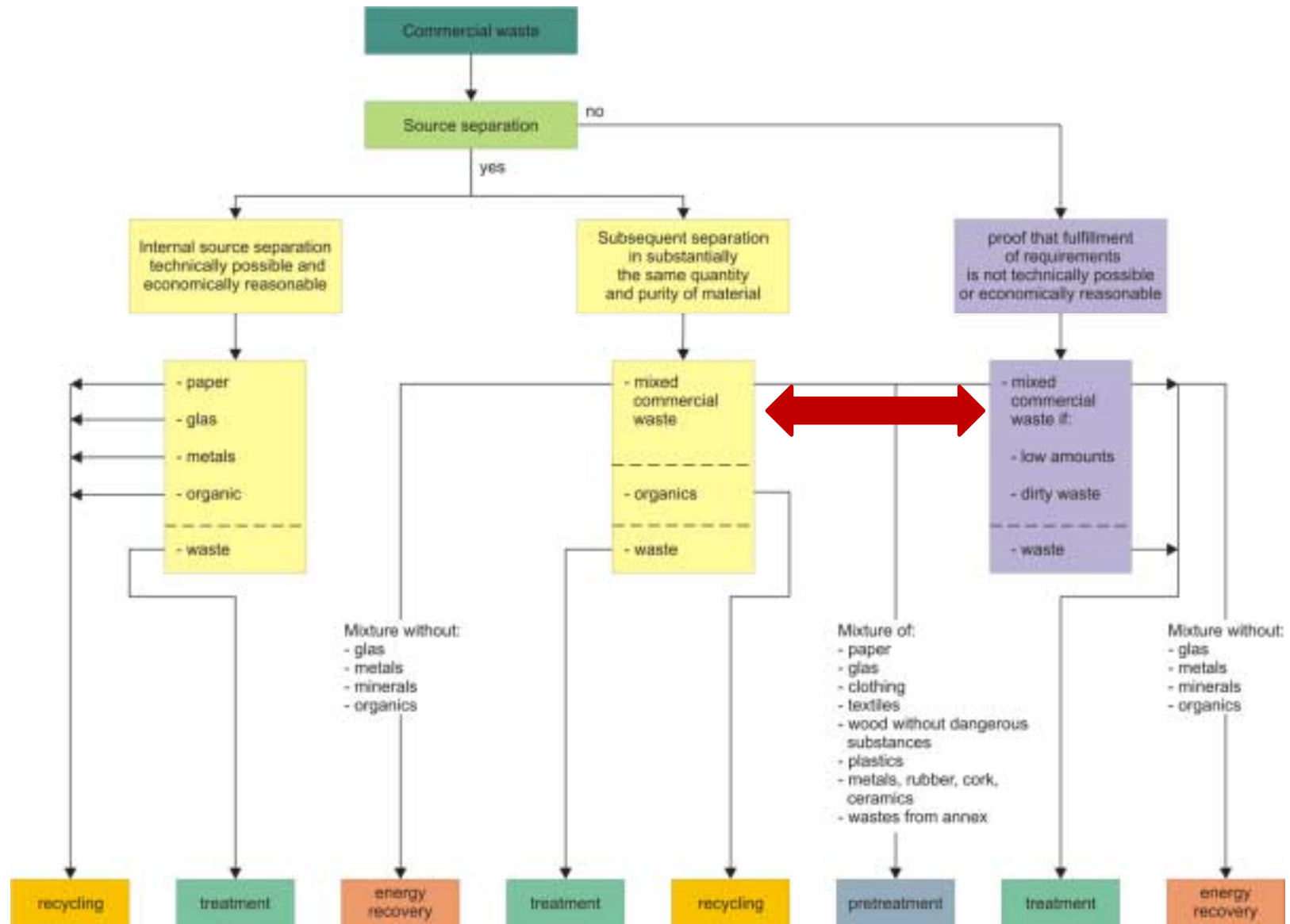
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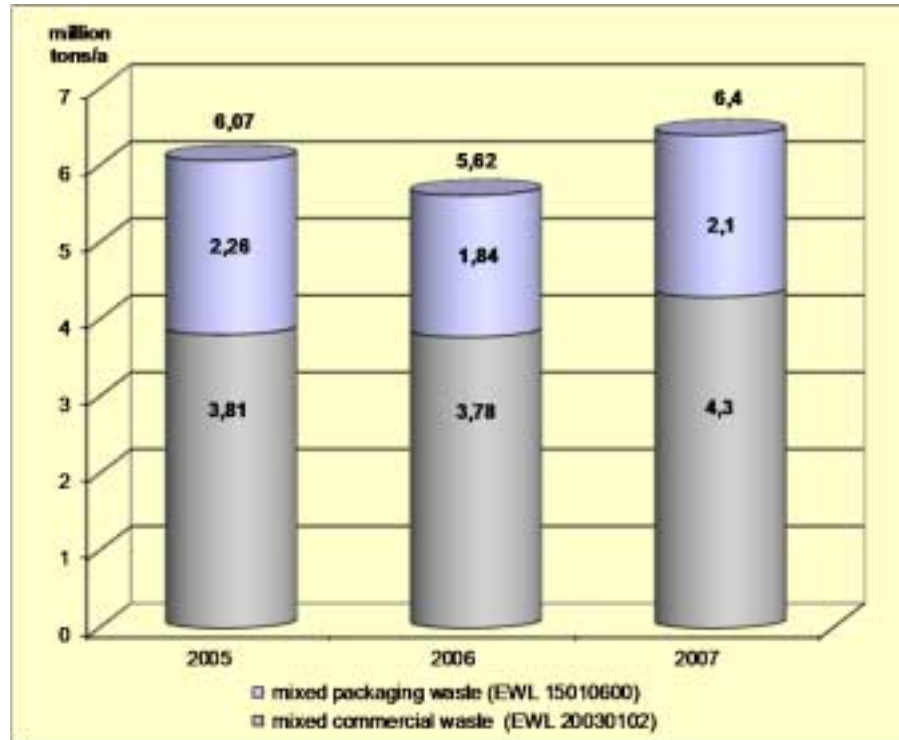


- A research project on behalf of the Federal Office for Environmental Protection aims to assess the quantity, the management and the aspects of resource preservation of commercial solid wastes.
- This contribution summarizes substantial results concerning
  - the material flow
  - the structure and efficiency of different sorting plants and
  - presents an approach to increase the material recovery by modifying the legislation

# Commercial Wastes Ordinance



# Amount of (mixed) commercial waste



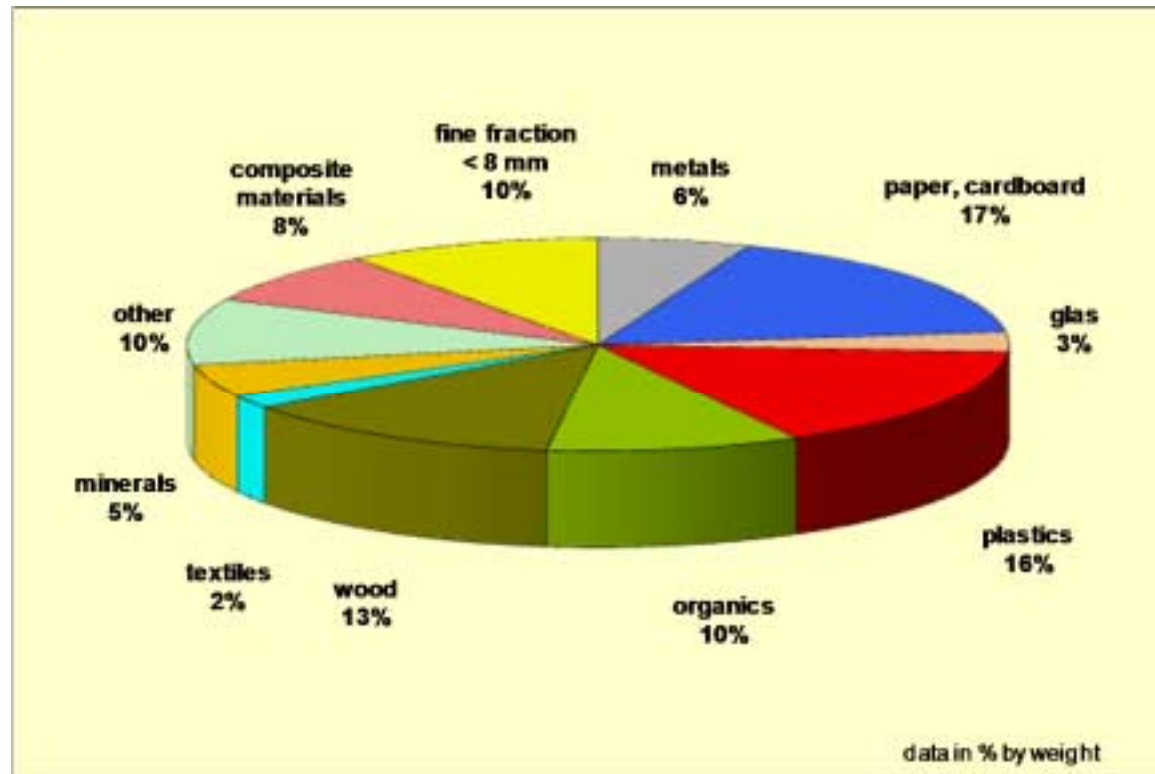
**All in all about 6.4 million tons of mixed commercial wastes accumulated in 2007.**

In 2007 about 4.331 million tons commercial wastes were treated.

Nearly half of the commercial waste was managed by public waste disposal authorities, the other part was covered by the private sector with the objective of material recycling.

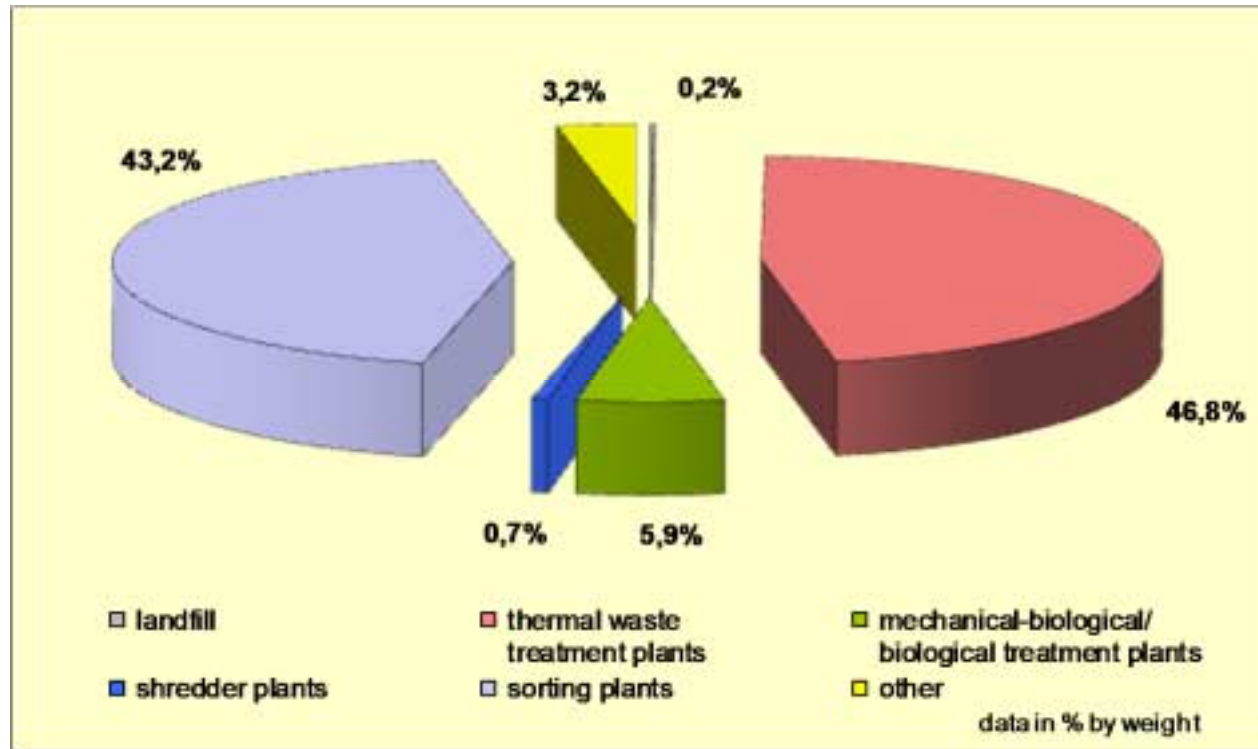
In addition businesses declared 2.1 million tons mixed commercial waste as “mixed packaging” (EWL 150106). This waste type is formally not liable to the Commercial Wastes Ordinance.

# Composition of Commercial Solid Waste



Commercial Solid Waste contains a high portion of recyclable material indicating, that not all businesses are separating recyclable fractions but dispose of those materials as conglomerate in pre-treatment plants.

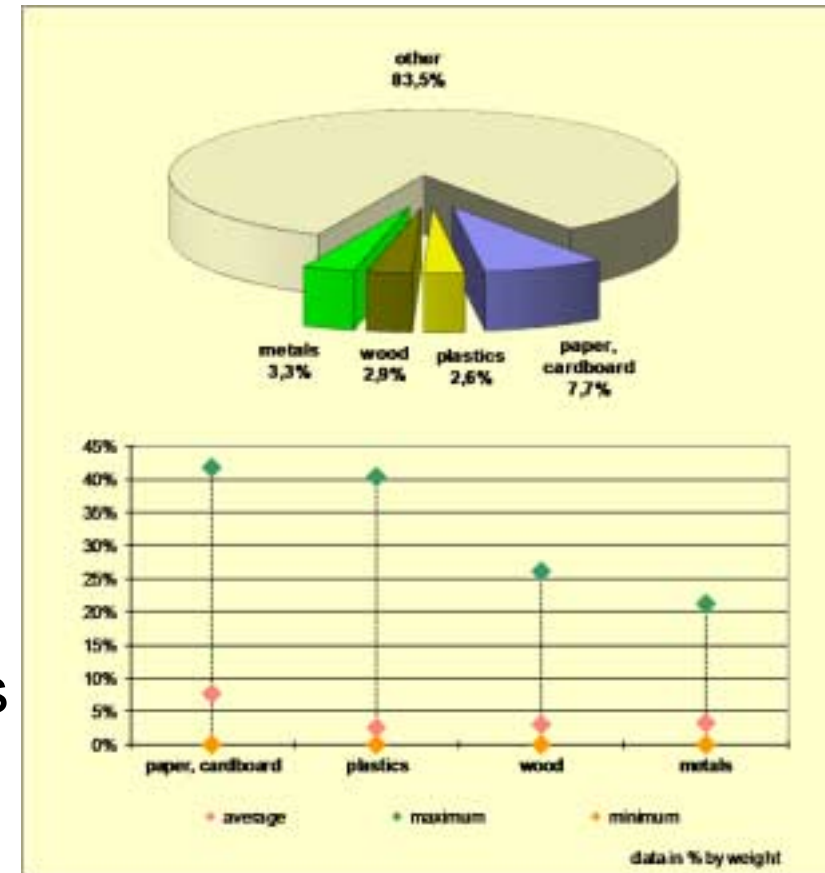
# Recycling or Waste to Energy?



Based on a total volume of app. 6.4 million tons in 2007 of both waste mixtures only 43 % by weight or respectively 2.77 million tons were fed into mechanical pre-treatment plants.

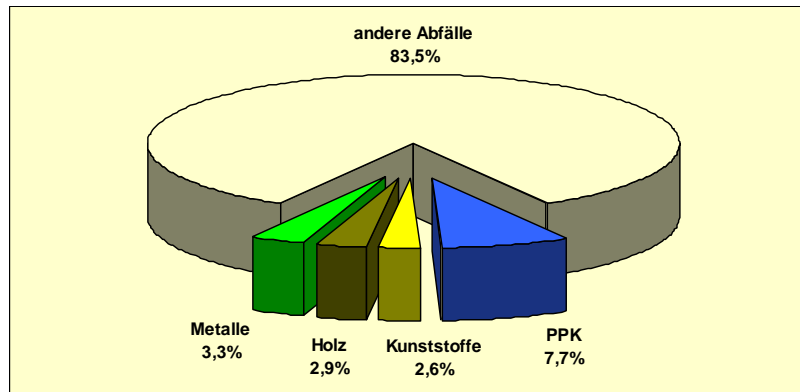
## Secondary raw materials, separated from mixed commercial waste

- According to operators data 16.5 % by weight were separated as secondary raw material – only 0.46 million tons in 2007.
- According to this mass distribution a theoretical quantity of secondary raw material of app. 1.1 million tons can be calculated, related to a total of 6.4 million tons.



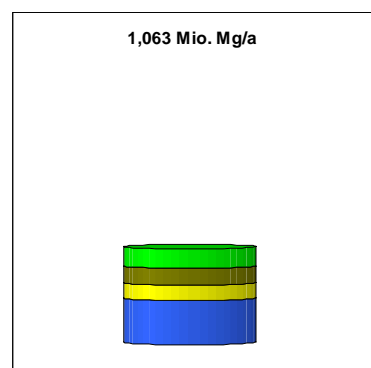
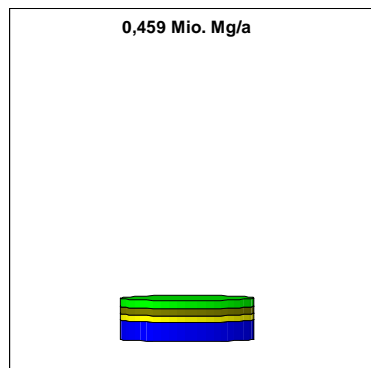
# Secondary raw material

## Situation 2007

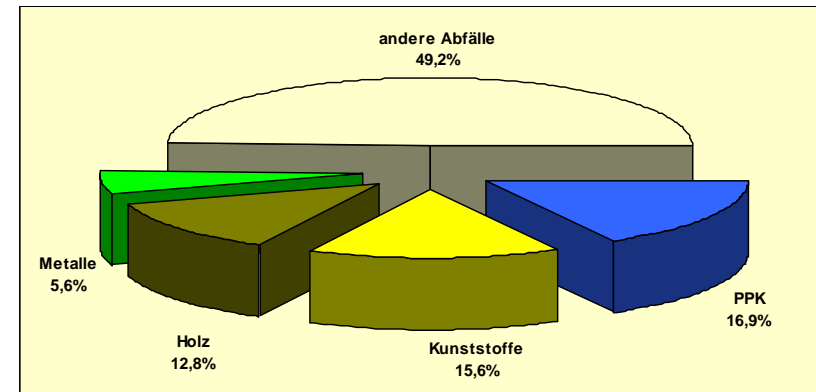


Input to pre-treatment

Total MCW

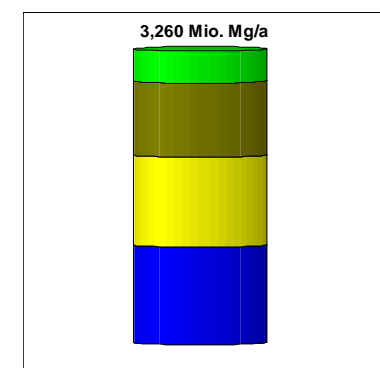
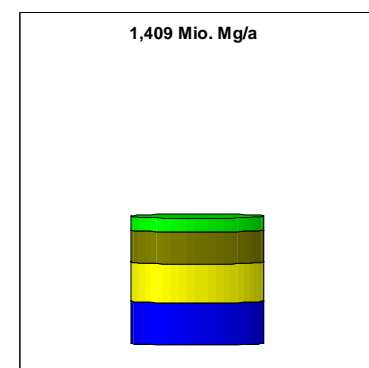


## Recycling Potential:



Input to pre-treatment

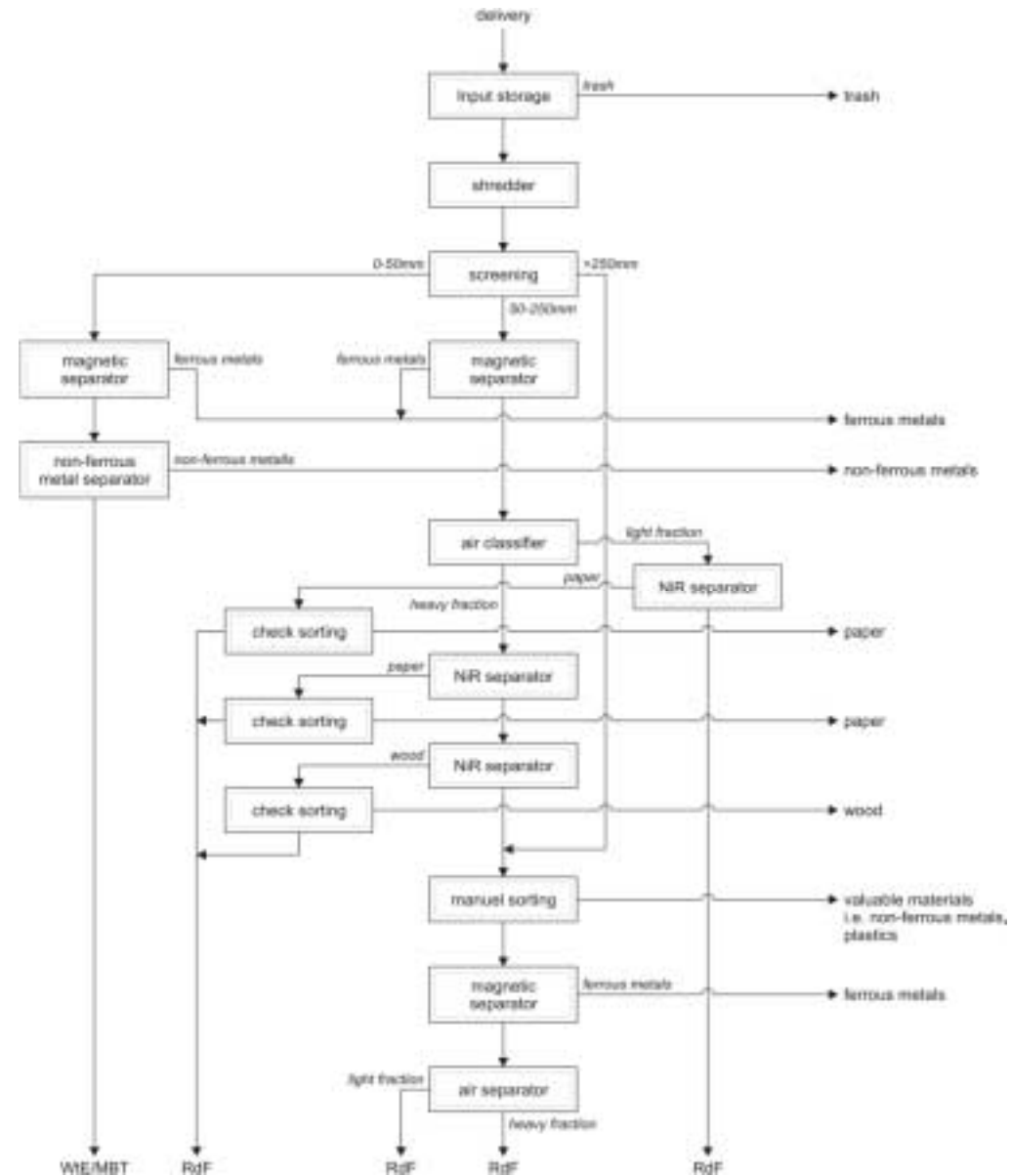
Total MCW



# Pre-treatment Plants in Germany

- Mixed commercial waste is treated in 491 facilities.
- The advances in waste treatment technology are often, if ever, realized with an extensive time delay.
- Model calculations indicate that a pre-treatment facility relies on a revenue ranging between 86 and 89 Euro/ton (as of 2010) in order to cover all its costs. Since 2009 only in single cases the prices of pre-treatment plants are competitive compared to those of incineration plants (less than 70 Euro/ton).
- In contrast to the year 2007 the majority of the pre-treatment plants currently cannot compete against the energy recovery plants.

# Pre-treatment Plants



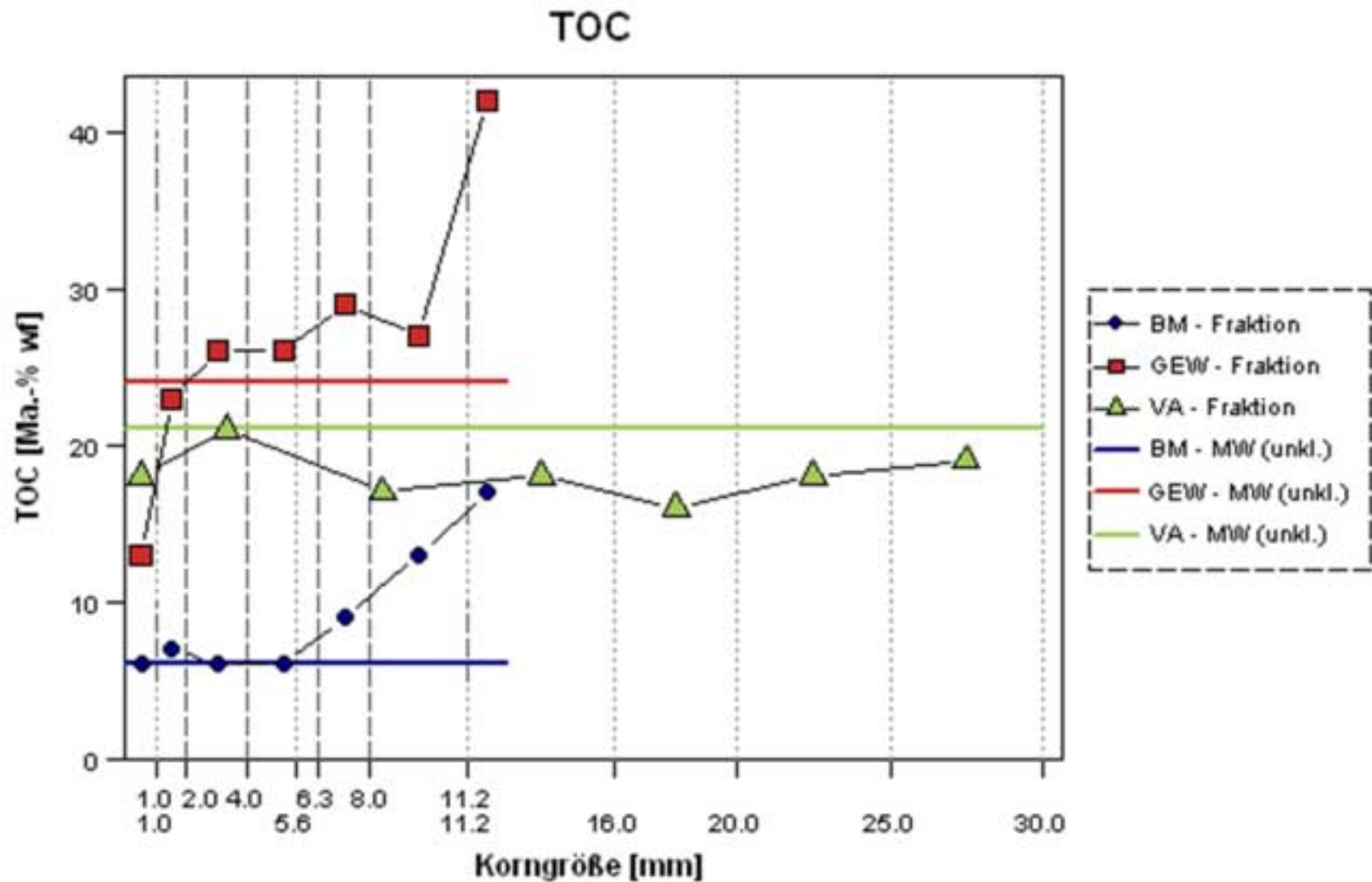
# Recovery-Quota

$$\text{recovery quota} = \frac{m_{\text{recovery}} - (m_{\text{recovery on landfill}} + m_{\text{internal recirculation}})}{m_{\text{recovery}} + m_{\text{disposal}}}$$

recovery quota  $\geq$  85 mass percent

Pre-treatment output	mass %	mass %	mass %
Secondary raw material	5	5	17
Fine fraction to landfill	15		15
Fine fraction -> recovery		15	
Refuse derived fuel (RdF)	80	80	68
Disposal (MBT/Waste to Energy)	0	0	0
Recovery quota	85	100	85

# Pre-treatment Plants: Fine Fraction



# Pre-treatment Plants: RdF



# Some Suggestions for an Efficient Use of Resources

- Mixed commercial waste **in total** shall be fed into pre-treatment plants with a technical minimum standard.
- The yield of recyclables has to be increased.
  - ↻ increase the average yield of valuable materials from 16.5 % by weight up to 30 % by weight -> 1.9 Mio. tons/year
- The material recycling for mixed plastics has to be optimized. Regarding greenhouse effect and cumulative energy consumption (CEC fossil) new utilization technologies should be developed and brought to a ready-for-use state.
- The separation of non-ferrous metals has to be optimized.
  - ↻ Up to now, assembly units for the separation of non-ferrous metals are only installed in a few sorting facilities, apparently due to investment costs.

- High-grade + low-emission refuse-derived fuel has to be generated
  - ↻ Producing 2 Mio. tons per year RDF
- The residues from waste treatment have to be utilized for energy recovery
  - ↻ The remaining waste (2.6 Mio. tons) are fed into incineration plants
- Improvement of material flow transparency
  - ↻ From a legal point of view the critically assessed use of low-priced sinks for sorting residues must be prevented. In order to accomplish that the material flows of the pre-treatment plants have to be transparent and also have to be controlled transnationally.

# Approaches for the Further Development of the Commercial Wastes Ordinance

- Already in 2004 the German Advisory Council on the Environment expressed the assessment that the Commercial Wastes Ordinance is an instrument which requires elaborate enforcement hence overstraining the waste management authorities.
- Important elements of the Commercial Wastes Ordinance are either not executed at the designated level or not executed at all.
- As both the EC Framework Directive on Waste and consequentially the draft Waste Avoidance, Recycling and Disposal Act acknowledge the priority of material recycling over energy recovery, the realization of the five-step waste hierarchy for commercial municipal waste in the Commercial Wastes Ordinance is required.

# Quality Rating for Material Recycling and Energy Recovery

- Rating quota for a high-grade and innocuous disposal of mixed commercial municipal waste

$$\text{rating quota} = \frac{m_{\text{material recycling}} \cdot Wf_{\text{material recycling}} + m_{\text{SBS}} \cdot Wf_{\text{SBS}} + m_{\text{EBS}} \cdot Wf_{\text{EBS}}}{m_{\text{output}}}$$

$$\text{rating quota} \geq 30$$

m = mass, Wf = weighting factor,

weighting factor material recycling = 100,

weighting factor RDF/SBS = 20,

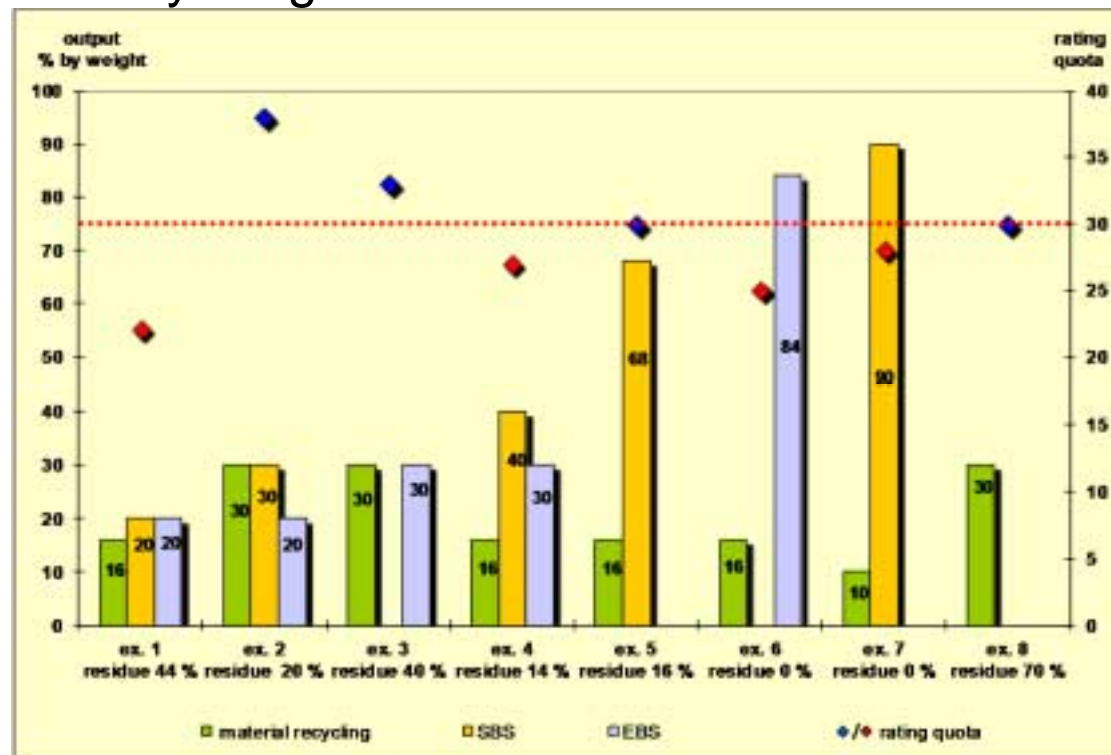
weighting factor Residues to WtE (EBS) = 10

# Quality Rating for Material Recycling and Energy Recovery

- Recyclable materials, high grade and low emission substitute fuels for incineration facilities with high combustion efficiency (SBS) and substitute fuels for energy recovery (EBS) are rated with different weighting factors (Wf) ranging from  $Wf = 100$  to  $Wf = 10$ . Waste sorting residues (EWL 191212) as well as fine fractions are rated with a zero weighting factor, hence these fractions are no objects in the rating.
- The rating will be performed for specific treatment plants. To avoid manipulation, mono-fractions that are co-treated (i.e. separately collected paper and cardboard) will have to be deducted from the output.
- The total rating quota that has to be achieved is set on a specific level to provide an incentive for material recycling and to effect the production of substitute fuels as well. A rating quota of 30 would provide these effects.

# Quality Rating for Material Recycling and Energy Recovery

- With a low portion of material recycling (16 % by weight) it is necessary to generate a high portion of substitute fuels (68 % by weight) to score a rating quota of 30 (see example 5).
- The rating quota could be achieved just by concentrating on the extraction of recyclable material fractions with an output portion of 30 % by weight.



blue = quota achieved  
red = quota missed

## Lessons learned

- Commercial Solid Waste contains a high portion of recyclable material, but:
- The majority of the pre-treatment plants in Germany currently cannot compete against the energy recovery plants.
- For an efficient use of resources the yield of recyclables has to be increased.
- The realization of the five-step waste hierarchy for commercial municipal waste in the Commercial Wastes Ordinance is required.