

Training course MBT and project calculation

Mechanical and Biological Treatment (MBT) of Municipal Solid Waste (MSW)

Part 1 Background

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Background of MSW Treatment

- Legal background: EU Landfill Directive
... the aim of this Directive is, by way of stringent operational and technical requirements on the waste and landfills, to provide for measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment, including the greenhouse effect, ... from landfilling of waste
- Real background: German discussion from the early 1990th about a new landfill paradigm, where waste in landfills had to be treated prior to the final disposal in order to mineralize and prevent biological reactions inside. Those who wanted to avoid incineration as the main pretreatment technology designed the mechanical biological treatment as alternative treatment technology. **Technical base was the experience from the 1970th** when compost as a fertilizer was the product of MSW treatment.

Background of MSW Technology

- Mineralization of MSW by thermal treatment is state of the art for more than 130 years, first plants are known from London and Hamburg. The residues from this process (bottom ashes and flue gas ashes) were landfilled.
- Today a utilization of bottom ashes is Best Available Technique (Recycling of Fe- and NF-metals, utilization of the mineral fraction as construction material).
- Unfortunately the minerals quality in some countries does not allow recycling due to environmental (water, soil) protection goals. Landfilling bottom ashes after metal separation therefore is still state of the art in several EU Memberstates.

Background of MSW Technology

- MSW composting plants had been build in the 1970th in Germany, the Netherlands, Belgium and Austria. The processes were designed to produce a compost fertilizer from the organic fraction and a fuel with a higher calorific value, called **Refuse Derived Fuel (RDF)**.
- The compost never achieved a quality acceptable as a fertilizer due to the general function of MSW as residual waste, containing different contaminants as base for poor quality. The goal MSW-compost was cancelled late in the 1970th and the separate collection of organic waste started to be established since the early 1980th.
- Rebirth of the technology was in the 1990th now called “MBT”, using the same technology but with an adjustment first to mineralize and second to landfill the organic fraction from MSW.

MSW treatment by incineration

- Well established technology in Germany, Austria, France, Spain, Italy, Belgium, Swiss, Denmark and the Netherlands
- Establishing the technology is more and more difficult because of missing social acceptance
- Big cities with millions of inhabitants are forced to use this technology due to limited space for landfills and the huge amount of waste per time

e.g. New York: 8,960 t/d <http://nymag.com/guides/everything/trash/trash-statistics-2013-7/>

e.g. Tokyo same amount in kg/c*d

Tokyo	New York
<u>Population</u> : 12,790,000	<u>Population</u> : 8,363,710
<u>Total Area</u> : 2,187 km ² , 844.40 mi ²	<u>Total Area</u> : 1,214.4 km ² , 468.9 mi ²
<u>Density</u> : 5,847 /km ²	<u>Density</u> : 10,606/km ²



MSW treatment by incineration



? = Difficulties to establish incineration technology and get social acceptance

MSW treatment by incineration



Big sized plants with
 $> 1.000.000$ t/y
 capacities are located
 in the Netherlands,
 while long time running
 technology with small
 and medium sized
 plants (< 200.000 t/y)
 are located in France

“Waste incineration is a license to print money” By Kerstin Bendix about a study from Frost & Sullivan

Almost 100 new waste incineration plants are to be commissioned by 2012 to keep abreast with the growing capacity, declared the international consulting company Frost & Sullivan in its study "Waste incineration in Europe: great enthusiasm to invest." The boom is mainly attributable to the fact that many local authorities still see waste incineration as the only viable alternative to landfilling, despite the growing significance of recycling and biological waste treatment.

*"Traditionally, the majority of European waste incineration plants have belonged to the public sector," says John Raspin, Director for Energy & Environment at Frost & Sullivan. In 2007 there were between 200 and 250 companies on the European waste incineration market, which is relatively few compared with other segments of the waste disposal industry. **The main reason is that up to now in many parts of Western Europe municipal waste has been incinerated in large municipal plants.***

Ownership of Incineration Plants

- Increasing private public partnership doing the investment and organizing the daily operation inclusive capacity management

Country	Number of incineration plants with $\geq 50\%$ public ownership
NL	12
F	120
S, Fin, N	81
D	58
I	49

MBT Technology in Europe

- Currently more than 400 MBT plants in Europe are in operation.
- The plant capacities are varying between 30.000 t/y and 500.000 t/y.
- The biggest installation is the Dutch Wijster plant with a capacity of 820.000 t/y. It is a combination of MBT and incineration, where the biological treatment has a capacity of > 500.000 t/y.
- Public acceptance of MBT is higher than of incineration.
- Investment for MBT technology is more suitable for authorities than in case of incineration.
- Wide spectrum of technologies and process goals combined with small and medium sized plants is leading to specific applications based on local conditions.

MBT Technology in Europe (2011)

The market study “The European Market for MBT Plants” includes:

- A detailed analysis of the pros and cons, technology and costs of mechanical biological waste treatment including all political and economic trends of the European market.
- A list of 126 plants that are currently being planned or discussed.
- A precise description of the present and the future market volumes by countries, up to and including 2015, based on a transparent and comprehensible methodology.
- A description of about 330 MBT plants in Europe, including essential technical data (like capacity, manufacturer and commissioning) and contact addresses.

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Glossary: Mechanical biological treatment (MBT)



Mechanical biological treatment, abbreviated as MBT, is a process usually designed to [recover materials](#) for one or more purposes and to stabilise the organic fraction of the residual [waste](#).

The practical advantages of MBT plants are, above all, the reduction of:

- the volumes of waste;
- the organic matter content of the waste, which is sent to final [disposal \(landfill or incineration\)](#).

Another purpose of mechanical biological treatment is material splitting for further processing (e.g. preparation of solid waste fuels). Biological digestion is intended to reduce the weight, and to render inert any biologically active organic materials (typically called 'stabilised residue').

Further information

- [Best Available Techniques for the Waste Treatments Industries](#)  (European Reference Document with more information on the technique and characteristics of MBT, August 2006)
- [Eurostat's European Data Centre on Waste](#) 
- Waste framework Directive [Directive 2008/98/EC](#)  of 19 November 2008 on waste, Article 3 (17)
- Waste-specific Directives:
 - batteries: [Directive 2006/66/EC](#) 
 - end-of life vehicles: [Directive 2000/53/EC](#) 
 - packaging and packaging waste: [Directive 94/62/EC](#) 
 - waste electrical and electronic equipment: [Directive 2002/96/EC](#) 

[http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Mechanical_biological_treatment_\(MBT\)](http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Mechanical_biological_treatment_(MBT))

Rivalry between Incineration and MBT - the Estonian story

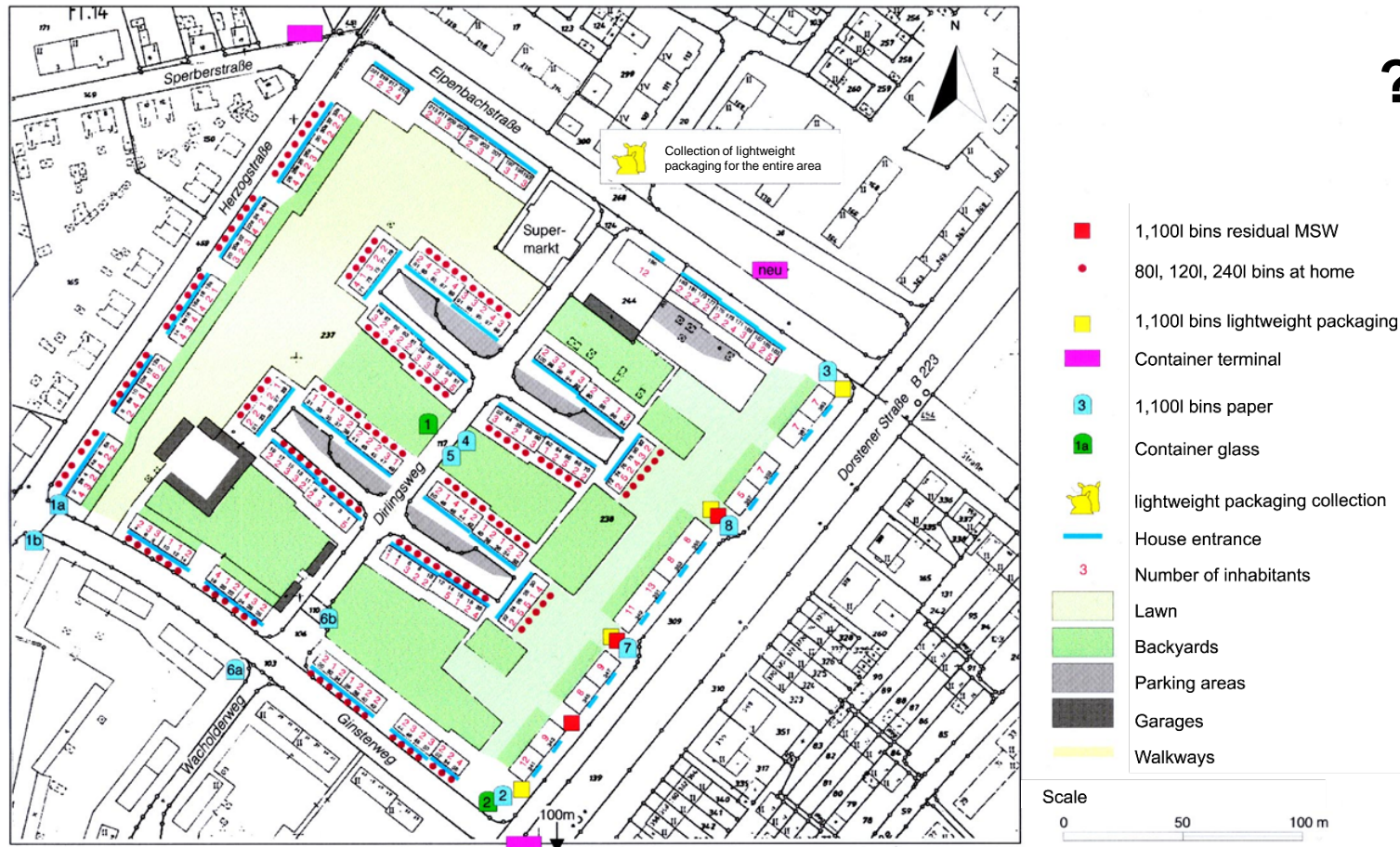
- 1 Incineration plant with a capacity of 250,000 t/y, covering ~ 90 % of the MSW treatment demand of the country
- Modern technology with highest capacity per unit;
- Competitors: 2 MBT plants with a capacity of 100,000 t/y each
- 1 MBT with biological drying technology, 1 with low tech anaerobic biological treatment
- Incineration advantages: low fees because of high revenues for heat and small amount of disposal waste
- Disadvantage of MBT: 60 €/t penalty for landfill waste

MSW and waste management

- MSW production is influenced by several waste management parameters:
- The **settling structure** with more or less commercial participation, the number of people per household, the option of garden waste, the social level and available income, ...
- Offer of daily collection volume [$l/c \cdot d$]
- Frequency of emptying waste collection bins or collecting bags, daily, weekly, monthly, on demand ...
- System of waste collection; individualized curb side collection / containers for public use
- Offer of separate collection systems for recyclables
- Payment system by tax, fees, individualized fees ...

MSW and waste management

curb side collection in urban structure (family homes) similar to rural structure



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Area 1

MSW and waste management

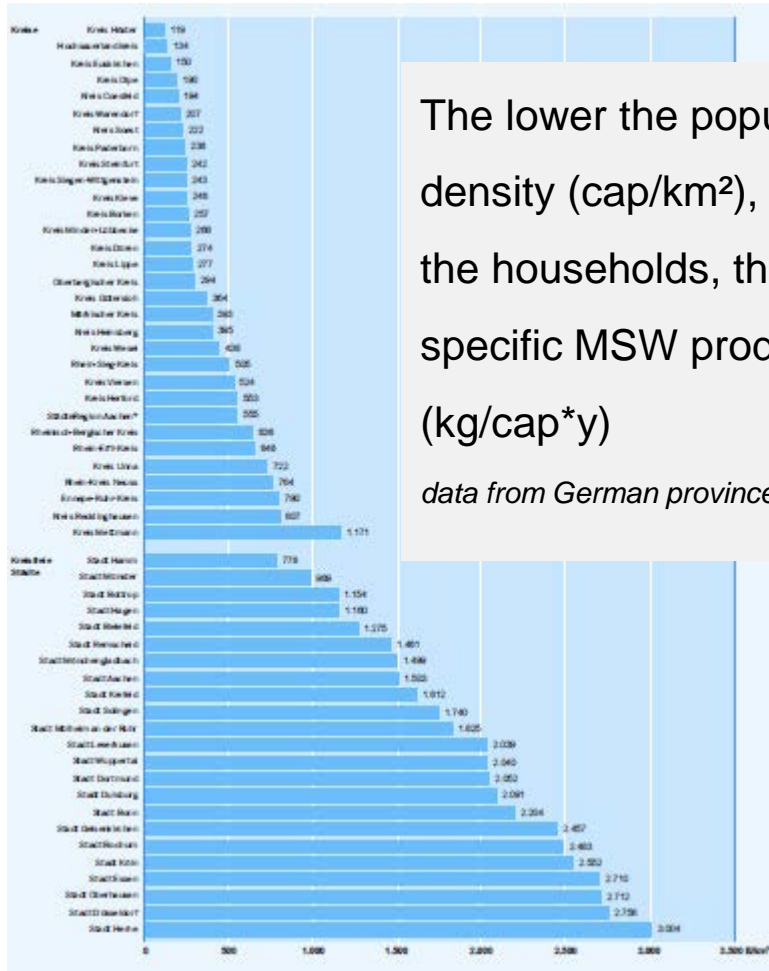
MSW collection in urban structure with waste bins in public use

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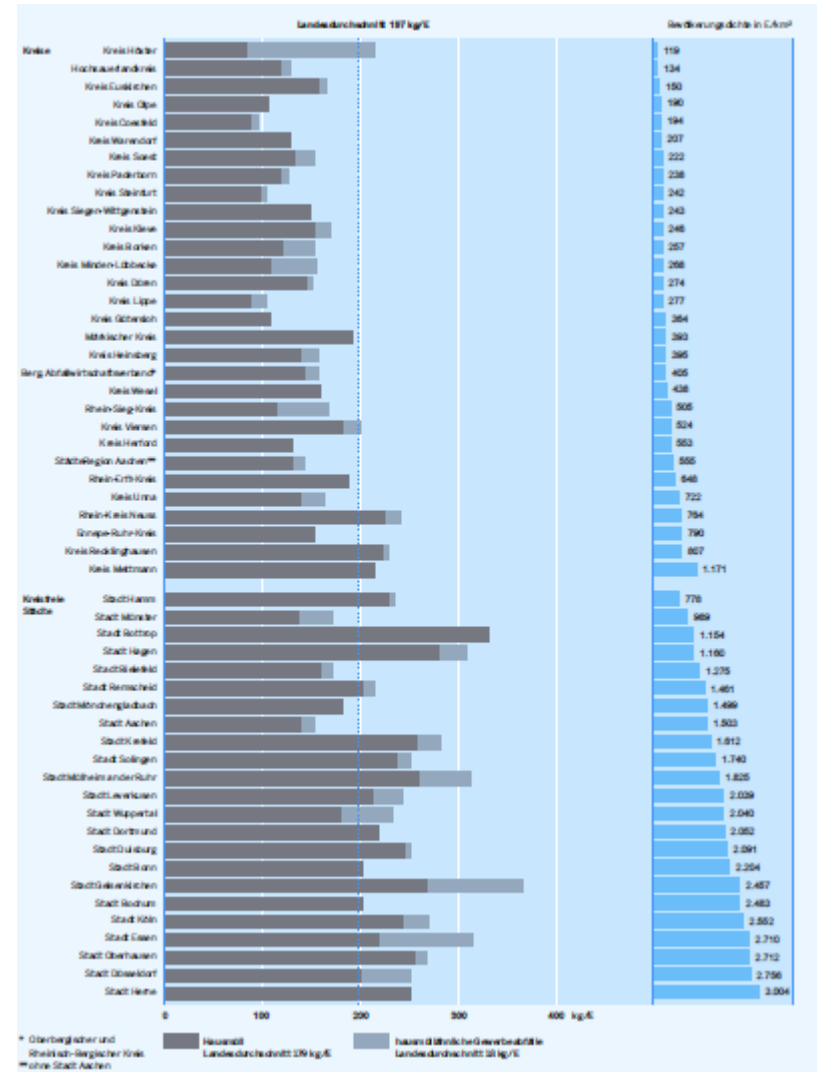
Area 2

MSW and waste management

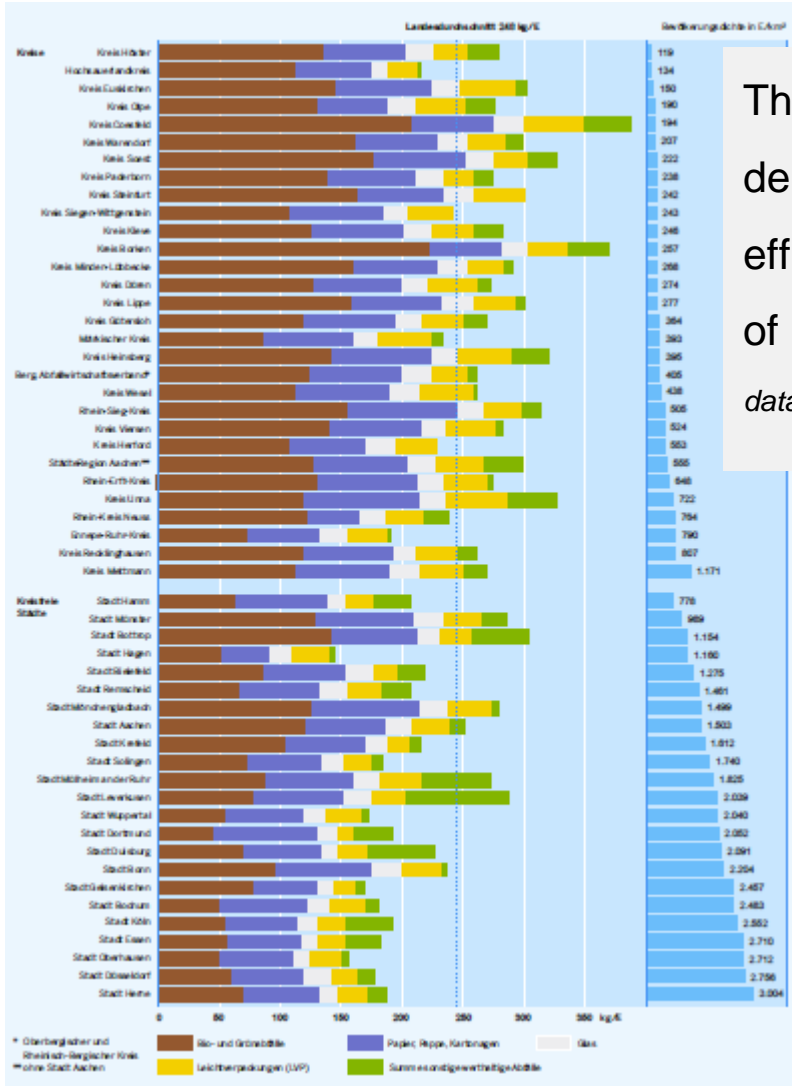


The lower the population density (cap/km²), the bigger the households, the lower the specific MSW production (kg/cap*y)
data from German province of NRW 2013

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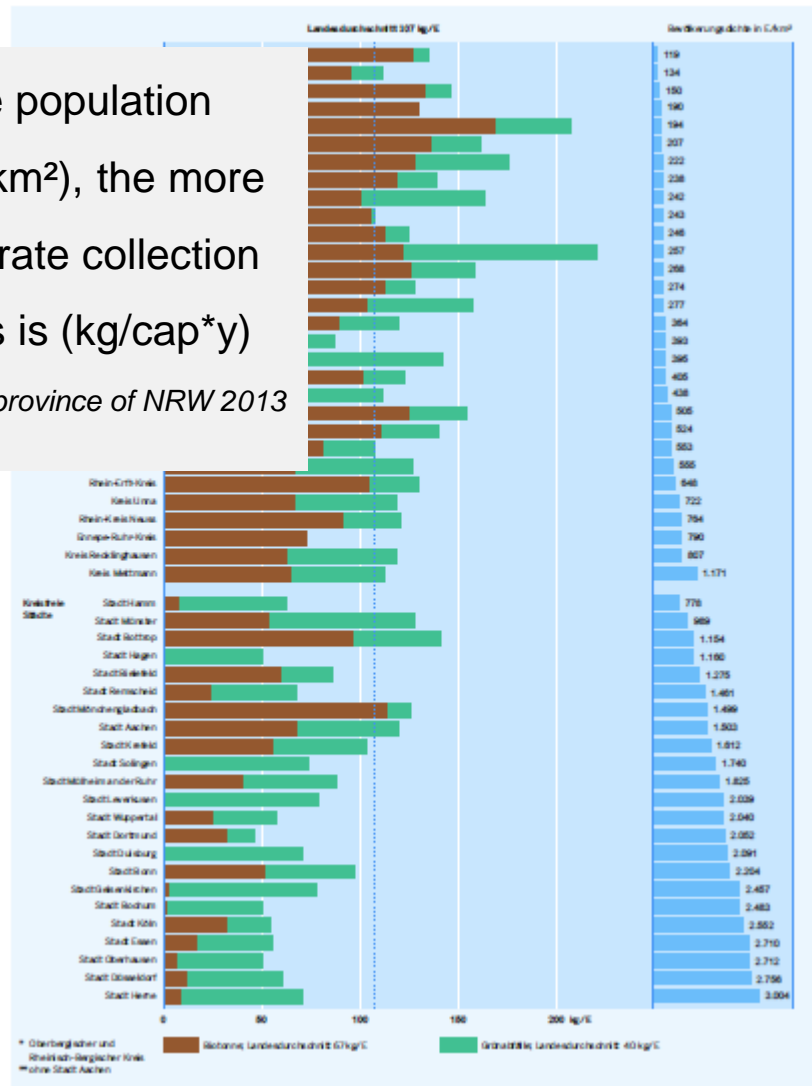


MSW and waste management



The lower the population density (cap/km²), the more efficient separate collection of recyclables is (kg/cap*y)
data from German province of NRW 2013

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MSW and waste management – collection system



Curb side collection of MSW and bulky waste from households without bins



Public collecting of MSW with containers 1.1 m³



MSW and waste management – collection system



Curb side collection of MSW with bins, sometimes inlets to reduce volume



Video collecting system I

Urban waste collection, no individual bins, obligatory separate collecting systems

Video collecting system II

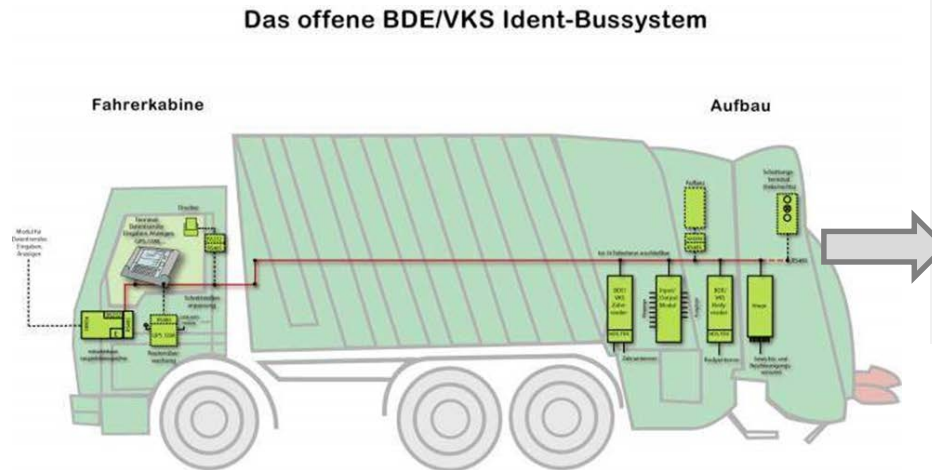
MSW and waste management – collection system



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Individualized waste collecting system, charging the number of emptying processes or the mass of waste

- Incentives for individuals to reduce waste and support separate collecting systems;
- Only suitable for rural structures with individual waste bins for each household; result of a public discussion on fair fees depending on personal waste behavior

MSW and waste management – additional systems



Typical equipment for MSW collection,
 brown = biowaste, yellow = packaging waste,
 grey = residual MSW, blue = paper & cardboards

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MSW and waste management – additional systems



Charitable paper
collection,
supported by
waste
management
industry



“Recycling Center”

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Specific MSW Production

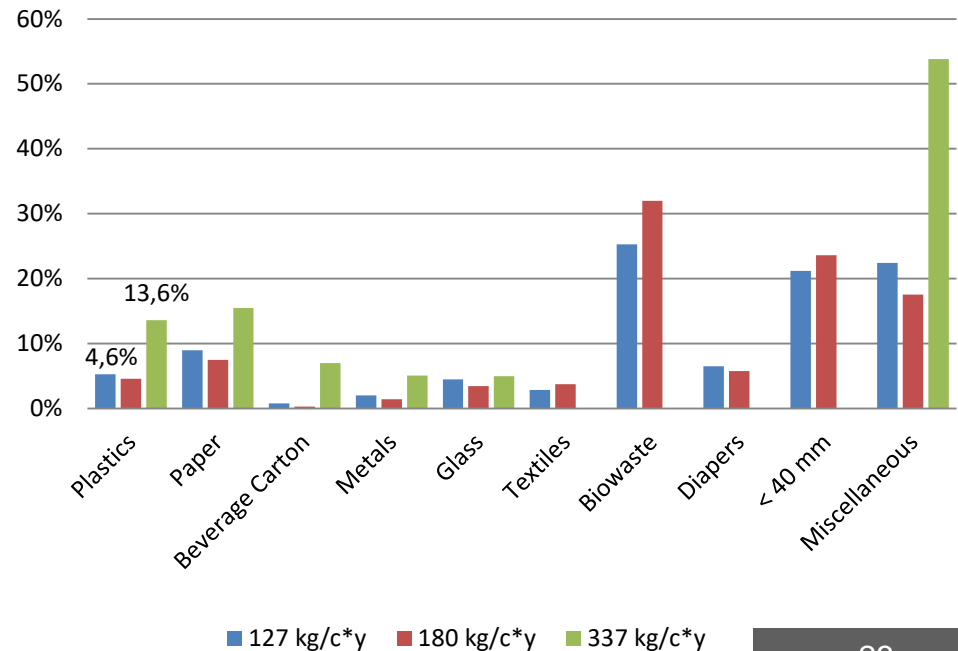
- Composition related to specific waste production and availability of additional collecting offers for recyclables

Examples:

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- a) rural settling structure, medium income level, separate collection systems obligatory for all households
- b) city with > 200.000 inhabitants, obligatory separate collection systems,
- c) big city with about 8.000 inhabitants/km², low level separate collection

MSW composition

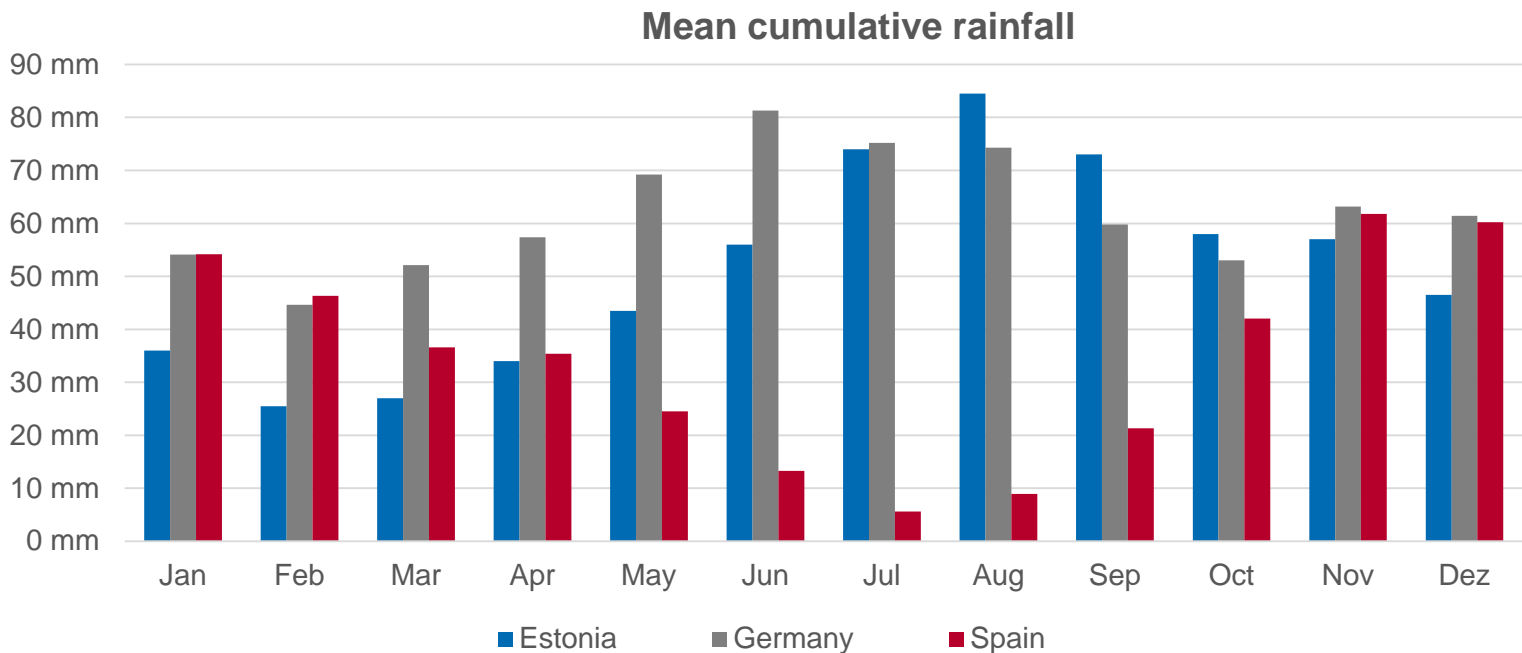
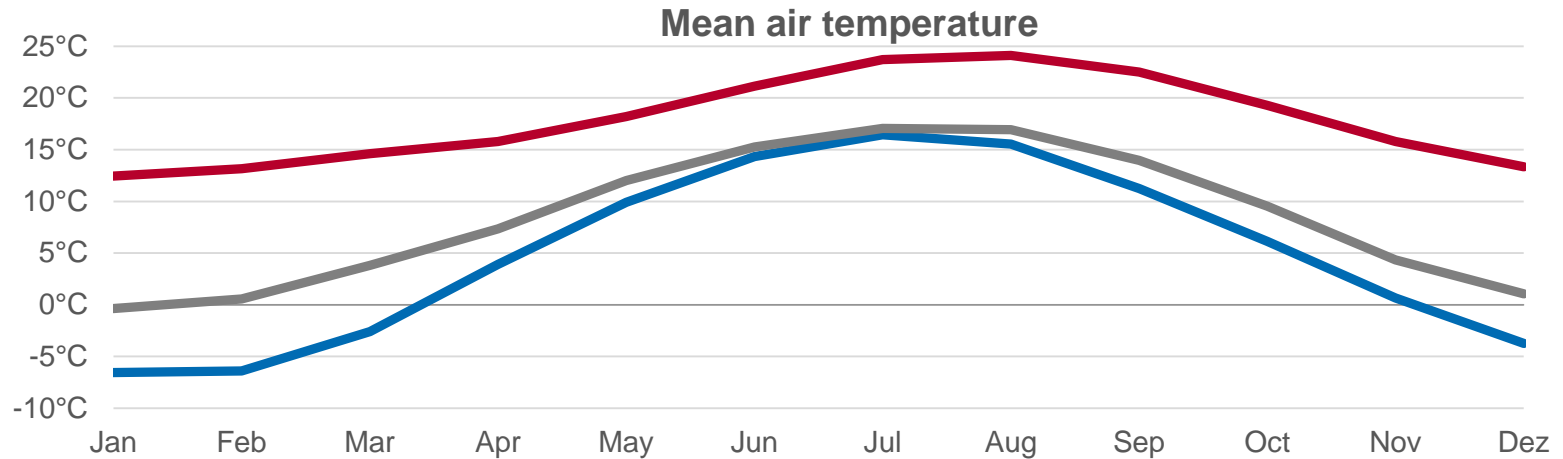


Municipal Solid Waste

- The **importance of specific waste amount** for MBT technology is based on the specific content of biodegradable waste in MSW.
- Biodegradable waste fractions originate from kitchen- and garden-waste (“biowaste”), the fine-fraction < 40 mm, paper and some other organics found in the miscellaneous fraction.
- Biowaste and the fine fraction are carrying most of the water content in MSW
- The organic content of MSW depends on the climatic conditions. During winter time or time of low temperatures both garden waste production and consumption of vegetables typically is reduced.
- During hot periods the biological process of aerobic biological degradation can start immediately in the collection system.

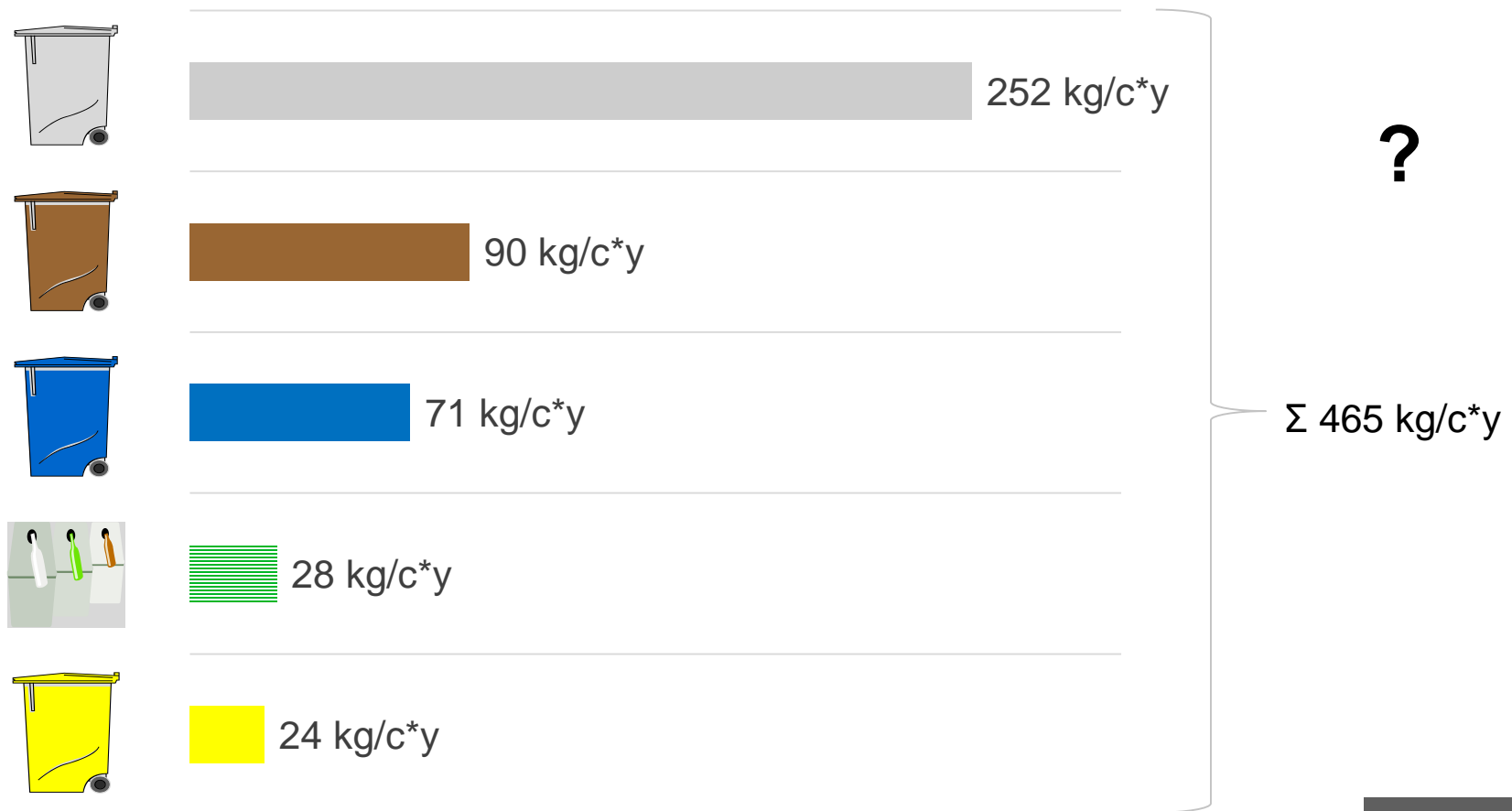
Source: <http://www.wetter.de/klima/europa-co6.html>

Municipal Solid Waste and climate

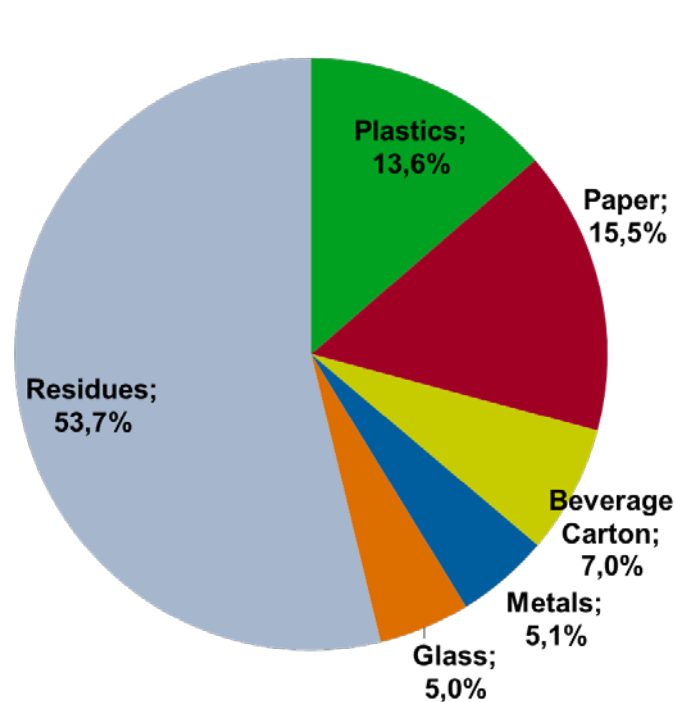


Municipal Solid Waste

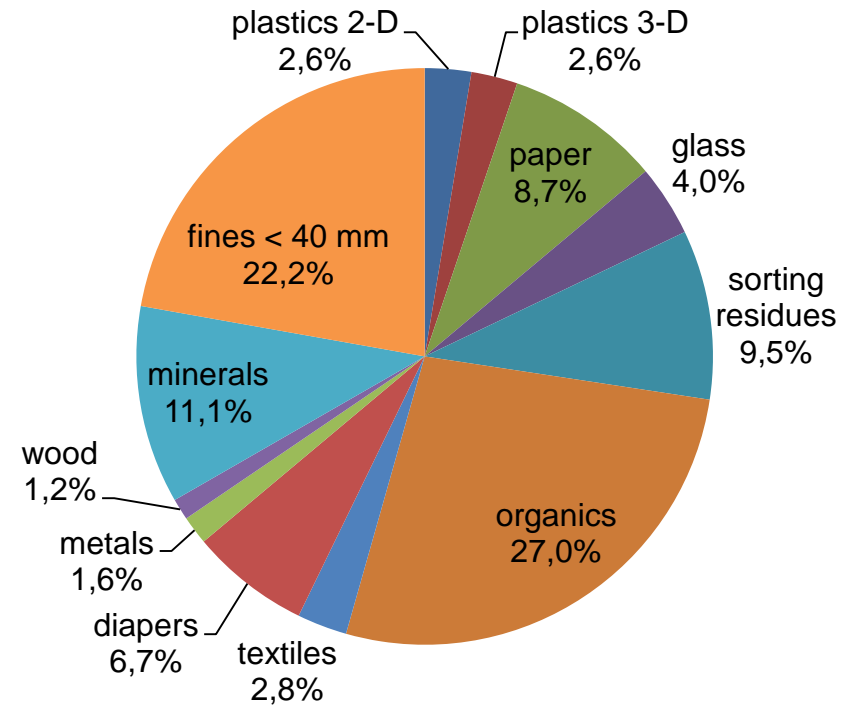
- Example of waste streams distribution in the German province of NRW without WEEE (7 kg/c*y) and hazardous waste from households (< 2 kg/c*y)



Residual MSW (grey bin) composition



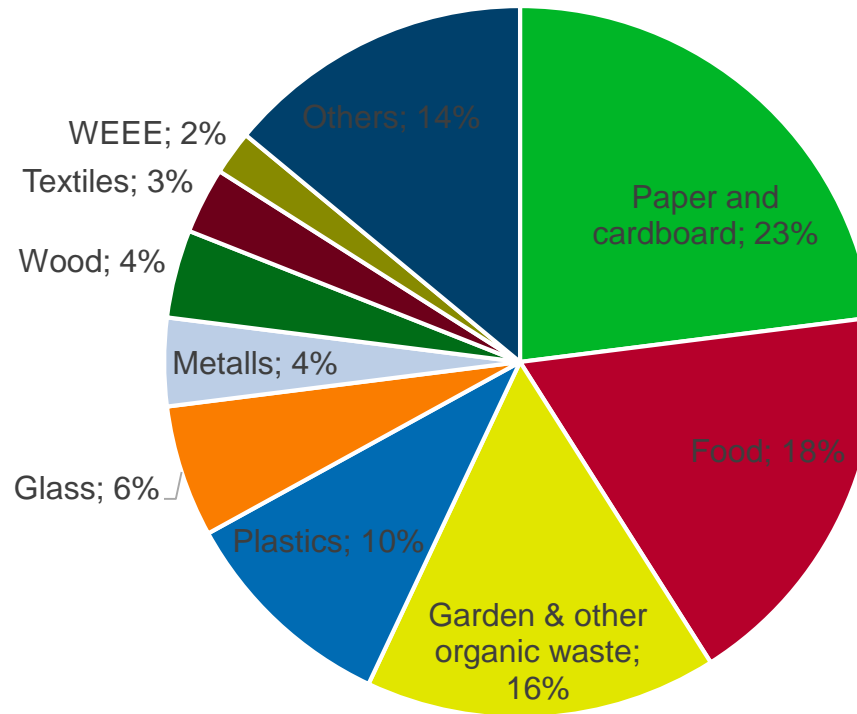
MSW from urban area (NL),
 low level collection activities for
 recyclables, > 250 kg/c*y



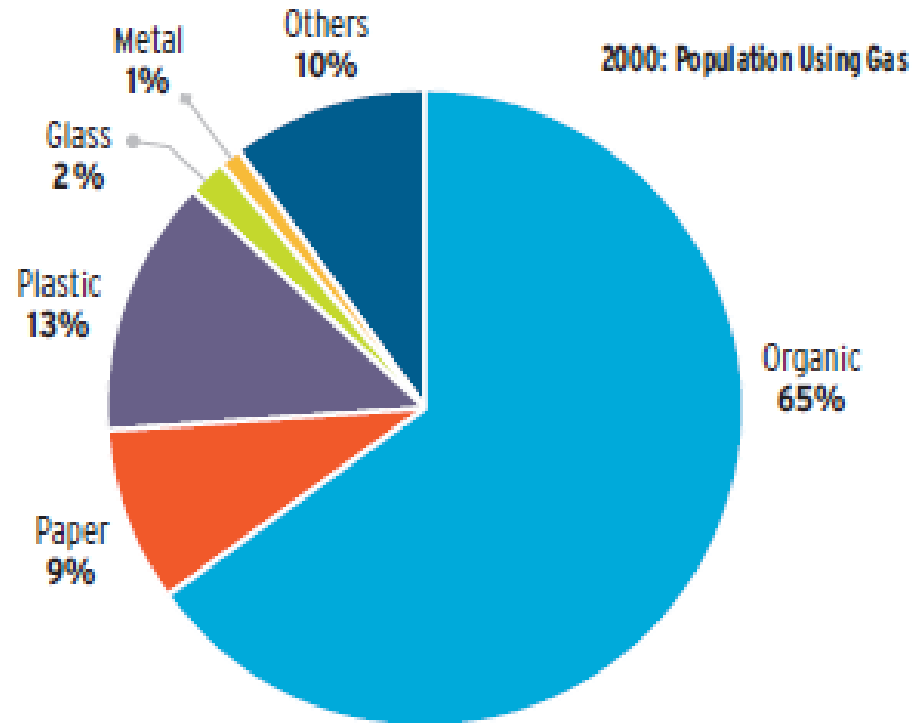
MSW from mixed structure (Hessen),
 high level collection activities for
 recyclables, Ø 158 kg/c*y

Residual MSW (grey bin) composition

UK MSW 2006



Residual MSW (grey bin) composition



MSW composition in China, households without coal consumption

<http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/Chap5.pdf>

Organic potential in MSW

- Organics useful for a biological MSW treatment are:
 - fines < 40 %, organics, paper
- Even in case of highly efficient separate collection of “biowaste” the potential of biodegradable waste is about 50 %

Composition mixed MSW

