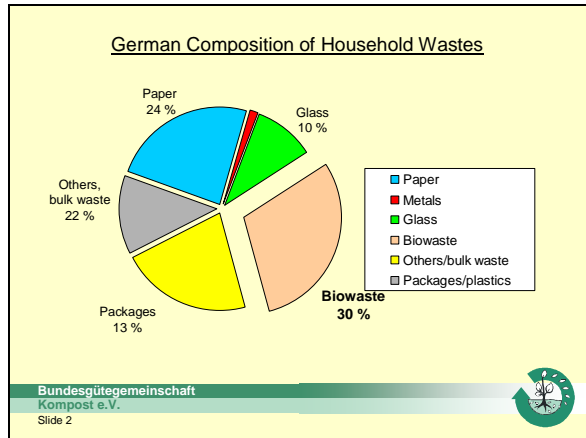


## Long-term Perspectives for Separate Collection and Recycling of Biowastes

Dr. Bertram Kehres, BGK. Köln

### 1 State of the Art of the Biowaste Recovery

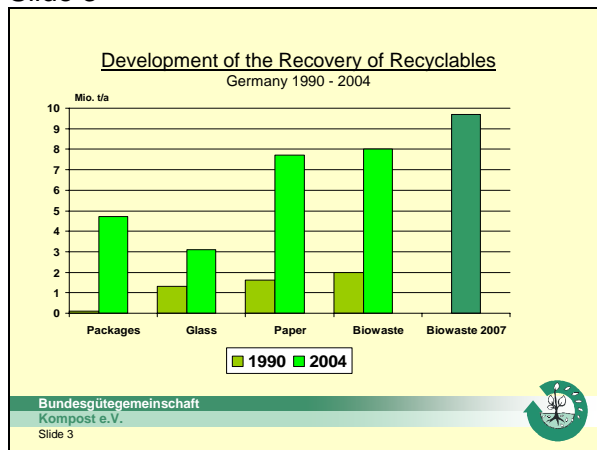
#### Slide 2



Considering the composition of the German household wastes the biodegradable biowaste shows a portion of 30%. Before this background the recovery obligation of the German Closed Loop and Waste Management Act can only be fulfilled if biowastes and the other quantitative important recyclables from household waste can be reused

During the last 10 to 15 years this has been carried out in Germany to a considerable rate. Separate collection of biowastes, paper, (light) packaging material and glass is today's standard in waste management. The transformation from the former waste disposal approach to a differentiated closed loop management can be anticipated from the increasing rates of recycling in the last years.

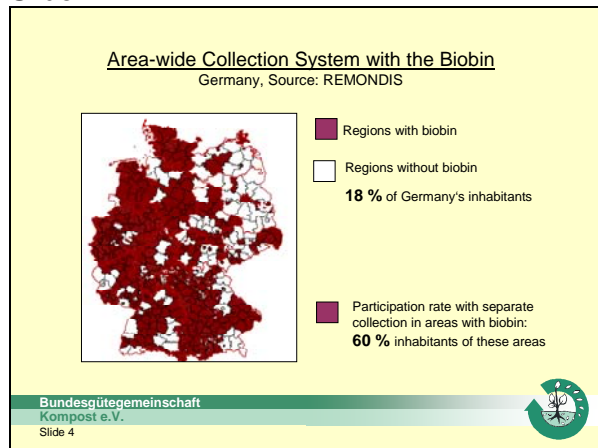
#### Slide 3



The increase in quantities between 1990 and 2004 concerning all fractions (packages, glass, paper, biowaste) is considerable. The highest increase is documented for biowastes - which means the organic portion from kitchen, garden and park waste. Here the quantities increased from 2 million t in 1990 to around 8 million t in 2004, as official statistics proved. Assessments of the German Federal Compost Quality Assurance Organisation assume that the actual amount in 2007 will rise to 9-10 million tons. In 2007 alone 6 million t of biowastes were delivered to those composting plants which connected to the German Federal Compost Quality Assurance Organisation.

Despite of a broad development of the recycling of biowastes in Germany, compared with other European countries, separate collection is not yet introduced nationwide.

Slide 4

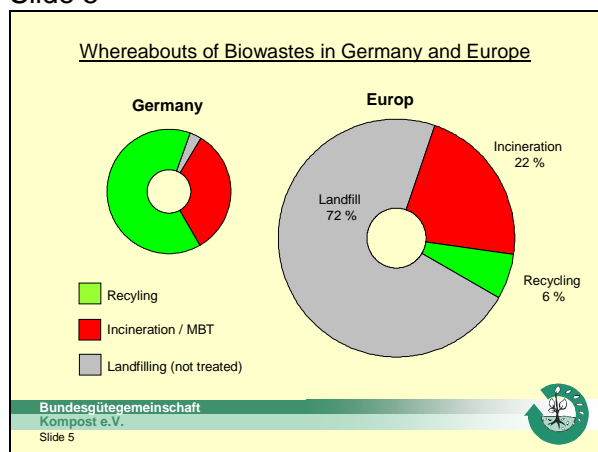


As can be seen in the graph not all of the regions respectively municipalities offer their citizens a possibility for separate collection of biowastes. Adding the regions which did not yet introduce the biobin, one comes to about 15 million inhabitants (of 82.5 million) without biowaste separate collection. This is a percentage of 18% of Germany's inhabitants. These inhabitants have to dispose of their biowastes (if not self-composting) with the residual waste bin.

Approximately 80 % of the regions/municipalities introduced the biowaste collection until now. This is without doubt a high rate. One has to consider, however, that the introduction has not completely been realised. A medium quota of households in areas connected to the biowaste collection shows about 60 % related to the inhabitants living there. Based on the total population in Germany half of the inhabitants are connected to the biobin scheme. On account of the assumption that biowastes are partly self-composted in the gardens of the citizens and not each area can be connected to separate collection, the not used potential of biowastes is estimated on 2 - 4 million t/a.

**2 Destination of Biowastes**

Slide 5



Basically three disposal ways can be differentiated when it comes to biowastes:

- The recovery of treated biowastes (see the green regional area in the figures)  
 Above all, composting and digestion is indicated here. Approximately 60-70% of the biowastes are collected separately and recycled by this way in Germany. Wooden garden and park wastes are recovered also energetically (up to ca. 25 % of the garden and park wastes).

- The incineration of not treated biowastes (red area).  
 This are all biowastes which are collected with the residual waste bin and supplied to incineration in waste incineration plants. The target of incineration is a pre-treatment prior to landfilling. An energy recovery from biowaste is hereby not focussed. Mechanical-biological waste treatment must also be allocated here, fulfilling the same purpose.
- Storage/landfilling of not treated biowastes (grey area)  
 This option is no longer allowed in Germany on account of the Technical Data Sheet for Urban Wastes (TASI) since 6/1/2005. Wastes are subject to landfilling only if they have no remarkable portion of organic matter. The small portion of landfilled biowastes refers to the intermediate storages of not treated residual wastes with portions of biowastes.

If one compares the situation in Germany with the situation in Europe, one discovers that the importance related to the quantities of the individual disposal options is very different. Corresponding figures can be learnt from a discussion paper of the Commission dated on 12/18/2003 (Draft Discussion Document for the ad hoc meeting on Biowastes and Sludge 15./16 January in Brussels).

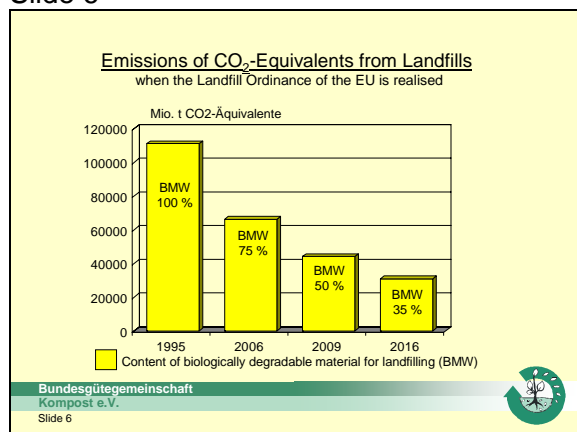
Following from this biowaste is recovered in the EU-15 countries or disposed of over the following ways on average:

- Via composting only 6 % of the biowastes are recycled.
- About 22 % are incinerated.
- 72 % of the biowastes are landfilled with the effect that considerable amounts of climate relevant gases are emitted.

### 3. Protection of climate and resources

In fact the European Union has determined a reduction of the portions of organic matter in landfills in their Landfill Ordinance. This target, however, can only be achieved if the biologically degradable components enclosed in household wastes will be incinerated or if collected separately and utilised. The realisation of the regulation in the member states is varying very much.

Slide 6

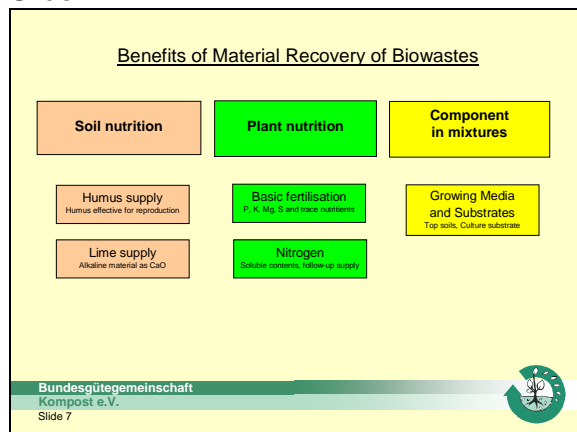


The figure illustrates by how many tons CO<sub>2</sub> equivalents the emissions from landfills will decrease, if the targets of the EU Landfill Ordinance are kept.

Compared with the year 1995 (100 %) from whereon the emissions from greenhouse gases should have been reduced by 25 % until 2006. Until 2009 half of the biowaste amounts shall be kept away from the landfill and until 2016 even 65 % should no longer be landfilled.

These targets can only be achieved if either incineration of wastes to be landfilled is developed correspondingly or separate collection and the utilisation of biowastes. The target of a lowering of the CO<sub>2</sub> reduction can be achieved with both ways. An additional material recovery can be realised only if biowastes are in fact collected separately.

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Environmental targets are not only directed on the protection of climate but also on the protection of resources and thus on the valuables contained in biowastes:

- contents of organic matter for humus application on soils
- contents of plant nutrients for fertilization
- possible substitution for peat as component of plant substrates


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Sustainability Targets  
with the Management of Biowastes

	Incineration <sup>1)</sup>	Recovery <sup>2)</sup>
Reduction of methane emissions <sup>3)</sup>	++	+
Use of plant nutrients	-	+
Generation of humus fertilisers	-	+
Substitution of peat	-	+
Generation of energy and heat	-	(+)

1) Incineration as pre-treatment prior to landfilling  
 2) Separate collection and material recycling of biowastes (composting and digestion, proportionate also energy recovery of biowastes rich in calorific values)  
 3) Reduction of methane emissions, which would arise at the landfilling of not treated urban wastes with fractions of biowastes

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The sustainability targets of the protection of climate and resources enclose both a reduction of emissions relevant to the climate and also to the protection of fossil raw material. Soil protection as basis of biomass production has to be added.

With the joint incineration of biowastes with residual wastes in waste incineration plants an effective reduction of such climate relevant gases can be achieved which would arise at the landfilling of not treated biowastes through the formation of methane. As methane is 21-fold more “climate-effective” than CO<sub>2</sub>, the incineration of residual wastes can contribute to avoid greenhouse gases from landfills to a considerable amount.

Methane emissions from landfills will be avoided by separate collection and material recycling of biowastes. This will happen only with to some extend with which they are separated from the residual waste. As separate collection never amounts to 100 %, part of the biowaste remains in the residual waste and is therefore a corresponding emission potential at landfilling. In Germany landfilling of such residual wastes without pre-treatment (usually incineration) is forbidden since mid-1995. This is not the case in other member states of the EU.


Incineration disturbs widely the material recycling potential from biowastes. A management of biowastes regarding the utilisation of plant nutrients, humus fertiliser and peat substitutes is only possible if biowastes are not incinerated, but collected separately from the residual waste.

Slide 9

Benefit Value of Biowastes: Treatment Options

Treatment Options	Compost	Digestion			Incineration
	material solid	energ./material solid	energ./material liquid	energ./thermal dry	energ./thermal dry
	Material recovery			Energy Recovery	
Humus reproduction	+++	++	+	-	-
Peat substitution	++	++	-	-	-
Nitrogen	+	+	+	-	-
Phosphorous	++	++	++	-	-
Other nutrients	++	++	++	-	-
Energy, heat	-	+	+	+(+)	++

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Both composting as well as digestion belong to material recycling. During digestion biowaste is used energetically (power and heat production). The recyclables to be utilised remain at a high rate in the digestion residues. This potential to be utilised is only lost if the digestion residues are e.g. dried and incinerated. In this case it would no longer be an energetic material utilisation but an energetic thermal utilisation, which can be totally assigned to energetic recovery.

This survey shows once more that a pure energetic recovery of biowastes excludes biowastes from material recycling. Contrary to that, digestion has the advantage that both the energetic potential and the material potential can be utilised. This makes sense if the respective biowastes are especially suitable for anaerobic treatment, e.g. are showing a relatively high gas potential.

A special report of the German Expert’s Council for Environmental Questions (SRU) in July 2007 with the topic „climate protection through biomass“ points out that in the long run material recycling of wastes

must be preferred compared to energetic/thermal recovery, because biogenic raw materials are the only substitute for fossil raw material (e.g. phosphate).

Contrary to that energy from fossil sources can be replaced with other renewable energies like the sun, wind, water and geothermy. Before this background the Waste Framework Directive of the EU prefers the material recycling of wastes rather than energy recovery.

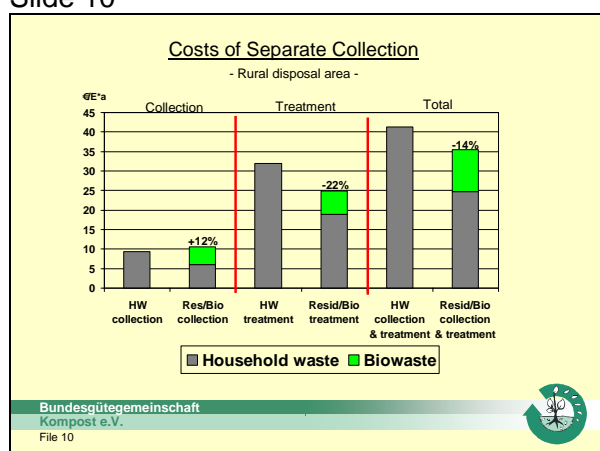
The chances of material recycling of biowastes shall be demonstrated on this basis in the following.

## 4 Perspectives of Separate Collection and Recycling of Biowastes

### 4.1 Costs of separate collection and treatment

Besides the legal frame conditions and the environmental targets costs of the recycling (collection, treatment) and the disposal are important.

Slide 10



The figure shows the comparison of costs for the following alternatives:

- Biowastes are collected together with residual wastes. The treatment of the entire waste is realised in an incineration plant, the ashes are landfilled. There exists no separate collection of biowastes. This scenario is shown by the left bars of the figure.
- The biobin is introduced and the separately collected biowastes are composted. The remaining residual wastes are incinerated. The separate collection of biowastes is carried out every 2 weeks, the residual waste collection, too. About 80 % of the citizens are connected to biowaste collection. This scenario is shown by the right bars of the figure.

Considered are the costs of the collection (left third of the figure), the costs of the treatment (composting and/or incineration, middle third of the figure).

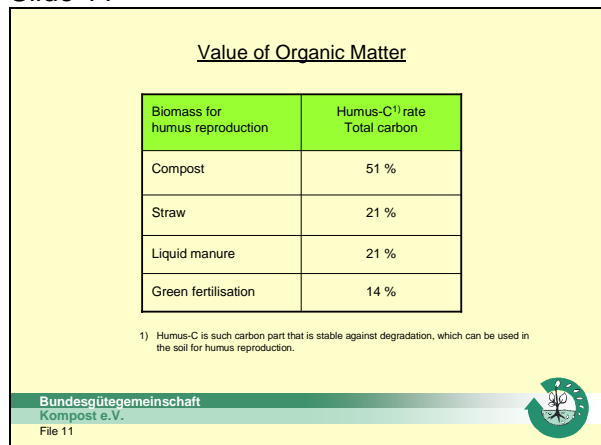
The results of the INFA-Institute, Münster are the following:

- The costs for the separate collection of biowastes show that this option is more expensive than the combined collection of biowastes together with residual waste. The additional costs are mainly caused through additional containers. The here shown example of a rural disposal area results additional costs of ca. 12 %.
- Contrary to the collection costs the costs for treatment are lower. Treatment costs for biowastes of ca. 60 €/t are assumed for composting, for the incineration including landfilling of the ashes ca. 145 €/t. The price advantage of composting leads to the fact that costs of the total treatment (i.e. composting of the biowaste and incineration of the residual waste) are by 22 % more favourable than the costs arising at incineration of the total mixed household waste (i.e. without separate collection of biowastes).
- If one summarizes the additional costs of separate collection and the cost-savings through treatment, one recapitulates that on the whole separate collection and composting of biowastes in a rural disposal area is about 14 % more favourable than the combined mixed disposal via the residual waste.

## 4.2 Biowastes as a source of humus fertiliser

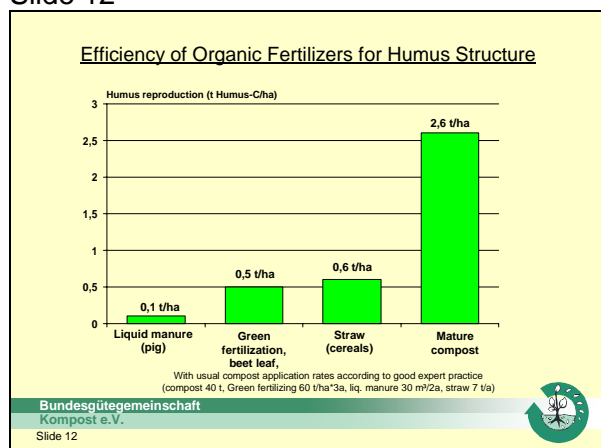
Organic matter contained in compost is comparably stable. Compost contains high portions of so-called “humus-C”. That is the portion of carbon that contributes to humus reproduction.

### Slide 11



This „humus-C“ fraction in compost accounts for 51 % of the total organic carbon and is therewith higher than in any other humus fertiliser. Compared with compost, straw and liquid manure are containing 21 % carbon resistant to degradation, and green fertilisers just 14 %. The good reputation of compost as an effective humus fertiliser and as the “the gardener’s gold” is based on this context.

### Slide 12



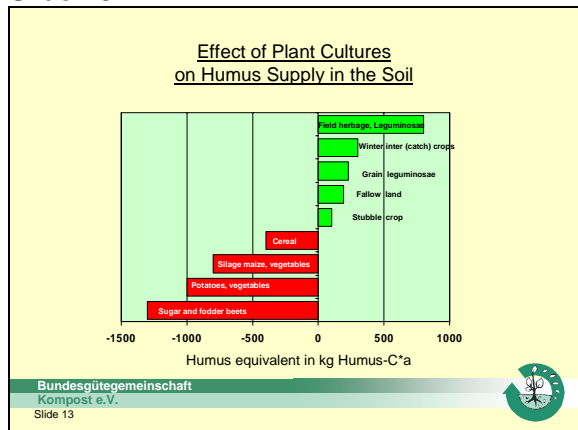
Considering the amounts of Humus-C, which are applied on areas in usual amounts according to good expert practice, the differences are becoming more evident:

- With liquid manure (from pigs) only 100 kg humus-C/ha are applied.
- Straw with 600 kg lies distinctly higher. Straw contributes to humus reproduction only if it stays on the area and is not removed for other purposes.
- Green fertilising brings a lot of organic matter into the soil. This, however, is relatively quickly decomposed. As “nutrient-humus” is this good for micro-organisms. The humus reproduction effects with ca. 500 kg humus-C/ha are relatively modest.

With compost and its high contents of organic matter resistant to degradation more than 2.500 kg Humus-C/ha are applied. The effectiveness on the humus reproduction is by factor 4 higher than with straw and by factor 20 higher than with liquid manure.

These context is not without relevance if one knows that the agricultural cultivation (arable farming without animal breeding) is often connected with considerable losses of humus-C in the soils.

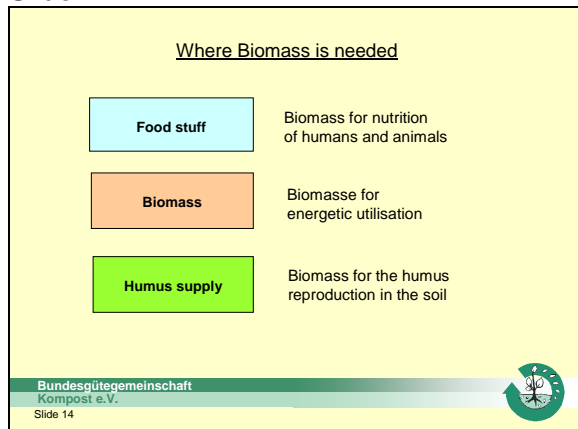
Slide 13



Those cultures which are cultivated for the production of biomass to be energetically utilised (e.g. maize, cereal silage and silage from whole plants) show deficiencies in the humus balance of -400 to 800 kg humus-C/ha and more. If these losses are not balanced with the cultivation of humus-building cultures in crop rotation or through straw fertilizing or through organic fertilisers like digestion residuals or compost, the content of organic matter in the soil will gradually decrease accompanied with a following loss of soil fertility.

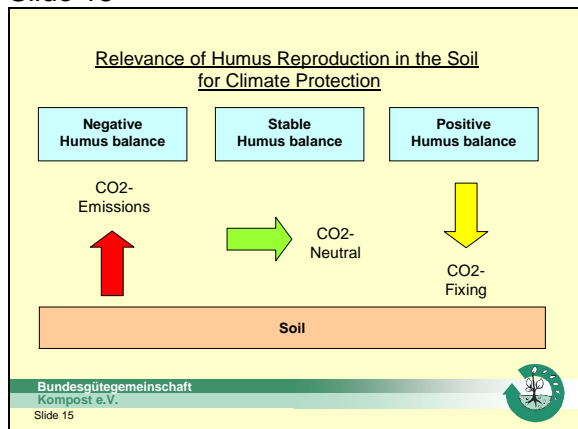
Before this background it is important to recognise the importance of biomass for the soil in the long run and the importance of a balanced humus content during biomass production.

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While it is obvious that the demand of biomass is necessary for human nutrition or for animal feeding stuff and everybody is talking about the utilisation of biomass for energy production, the fundamental demand of soils for biomass should not be ignored in the present biomass euphoria.

Slide 15



It is taken for granted that energetic utilisation of biomass is CO<sub>2</sub> neutral. But this is only the case if humus losses arising at the cultivation of biomass can be compensated. With a negative humus balance a “net-CO<sub>2</sub>-emission” arises from the soil to the amount of the balance deficit. If the balance deficit is compensated with compost the avoided emissions can be credited to the compost as CO<sub>2</sub> bonus.

Biomass utilisation is only CO<sub>2</sub>-neutral at an adequate humus balance.

At a positive humus balance the storage of carbon in soils is higher than the consumption. In this case the soil acts as “CO<sub>2</sub>-sink”. In cases where the soil shows higher humus contents or contents typical for the location the additionally fixed carbon is relatively quickly mineralised. A sustainable functioning of the soil as CO<sub>2</sub>-sink is given. A sink-function can be realised only where the humus content of the soil lies distinctly below the contents typical for the location. These cases are very rare in Germany’s agriculture, whereas they occur in landscaping more often. If compost is utilised in landscaping with the target to produce a humus content typical for the location, a CO<sub>2</sub>-sink can be assumed and the compost can be credited accordingly as CO<sub>2</sub> bonus.

### 4.3 Effectiveness of biomass management

After it was shown that the use of biomass for energy recovery is in (partial) competition to humus reproduction of the soil, the question arises which type of biomass is best suitable for which sort of utilisation and can be most effectively applied.


#### Slide 16

Suitability of Biowaste and Straw for Energetic or Material Recycling

	Biowaste	Straw
Humus-C rate in C-org. (compost / straw)	51 %	21 %
Calorific value (H <sub>v</sub> )	4 MJ/kg	14 MJ/kg
Water content	60 % FM	13 % FM
Ash content (compost / straw)	45 % DM	15 % DM

**Conclusion: Compost is the better humus fertiliser,  
 Straw the better energy carrier**  
 DM dry matter - FM fresh matter

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Composted biowastes and solid digestion residuals are especially suitable for humus reproduction with their high contents of humus-C. The predominant part of humus reproduction is presently realised in agriculture but with residues from livestock and with straw, i.e. with material possessing a distinctly lower effectiveness at humus reproduction.

Particularly straw is a material that is better suitable for energy recovery when it comes to efficiency criteria. With a calorific value of 14 MJ/kg, a water content of 13 % only, and an ash content of 15 % straw is the better energy carrier.


Biowastes with a calorific value of 4 MJ/kg only are not even applicable for incineration without additional energy supply and are recommended not for energetic recovery but for material recycling with water contents of more than 60 % and ash contents of ca. 45 %. In short: compost is the better humus fertiliser, straw the better energy carrier.

#### Slide 17

Potential of the Substitution of Straw for Humus Reproduction by Compost and Solid Digestion Residues

	Humus-C Mio. t/a	Humus-C %
Straw (remains on the field)	2.17	100 %
Biowaste compost	0.34	15.4 %
Solid digestion residues	0.13	6.0 %
Substitution potential	0.47	21.4 %

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Around 20 % of the 2.17 million tons humus-C, contained in crop straw remaining on German arable land for humus reproduction, can be substituted by compost and solid digestion residuals.


#### Slide 18

Energy Potential at the Release of Straw at Alternative Humus Reproduction with Biowastes

Energy content of the used Biowastes/Digestion Residues	48 PJ/a
Energy content of the substituted straw	<b>82 PJ/a</b>

68.6 Petajoule = 68.600 Terajoule = 68.600.000 Gigajoule = 68.600.000.000 Megajoule  
 Calorific values: straw 14 GJ/t, biowaste 4 GJ/t, 6 Mio. t straw, 4,8 Mio. t compost, 2,6 Mio. t solid digestion residues are based on ca. 12 Mio. t biowaste and digestion substrates.

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The amount of energy contained in this straw is with 82 PJ nearly twice as high as the amount in the original substrates of the utilised biowastes and digestion residues (48 PJ/a). It is obvious even before this background that biowastes must be used for humus reproduction of the soils - i.e. material recycling - and should not be incinerated.

#### 4.4 Biowastes as a source for plant nutrients

Besides the utilisation of the humus reproduction potential further arguments on behalf of a material recycling of biowastes must be claimed.

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Potential of Fertiliser Substitution

	Nutrients <sup>1)</sup> Mineral fertiliser	Nutrients <sup>2)</sup> Compost	Substitution Potential
Phosphate fertilizer	280.000 t	28.000 t	10 %
Potassium fertilizer	490.000 t	43.000 t	9 %
Lime fertilizer	2.100.000 t	175.000 t	8 %

1) Plant nutrients of amounts of mineral fertilisers sold in Germany  
 2) Plant nutrients per annum in composts from separate collection of biowastes

Nitrogen	13.500 t	540 TJ
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Plant nutrients contained in biowastes can be used only via the way of material recycling. A discussion about the fertilising value of composts and digestion residues would go too far at this moment. Therefore, just two aspects are pointed out here:

- Plant nutrients contained in biowastes can substitute to some extent mineral fertilisers (and thus mineral raw materials sources). The substitution potential for phosphate is 28.000 t respectively 10 % of the phosphate of the mineral fertilisers applied in Germany. With potassium 9 % (43.000 t) and with lime fertilisers 8 % (175.000 t) can be substituted.
- The predominant part of nitrogen is bound in the organic matter. However, it can be assumed that for plant nutrition up to 30 % of the total amount of a mineral fertiliser-equivalent can be credited. The nitrogen content in the atmosphere is satisfactorily available, but its utilisation as a fertiliser is very energy-consuming. The production of 1 kg nitrogen as fertiliser requires at least 40 MJ that corresponds to a calorific value of 1 kg oil. If 30 % of the nitrogen contained in compost can be used approximately 13.500 t nitrogen can be saved as mineral fertiliser and an energy potential of 540 TJ.

High concern must be given to phosphate. Phosphate the world-wide resources of which are available for ca. 90 years only, is of elementary importance concerning recycling and thus the protection of the few still available resources of raw materials. Contrary to the “alternative energies” plant nutrients have no “alternative nutrients”. Nutrients cannot be replaced. In the long run their “closed loop management” is inevitable. No alternatives are available.

This actual situation becomes clear if one knows that the production of biomass depends directly on the availability of water and plant nutrients. In the long run phosphate will be the limiting factor on account of its decreasing availability (besides water) for the total biomass production inclusive nutrient and feeding stuff production.

The life times for the reserves of raw material of phosphate can be compared with the life times for oil and gas. It cannot be accepted before this background that the material utilisation of organic wastes with the target of a closed loop management of phosphate has no higher significance at present.

## 4.5 Biowastes as peat substitute

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Potential of Peat Substitution

Peat consumption	ca. 10 Mio. t
Substitution potential by compost and solid digestion residues	ca. 20 - 30 % 2 Mio. t

Advantages of peat substitution:

- Saving of the fossile raw material peat available in limited quantities
- Lowering of dependency on imports
- Lowering of CO<sub>2</sub>-Emissions

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Composts and solid digestion residues are able to substitute the portion of peat in plant substrates from 20 to 40 %. For this purpose structure-containing composts from garden and park wastes are suitable. The utilisation of green wastes with a large wooden portion as peat substitute is standing in direct competition with energetic utilisation of these materials, which are financially subsidised in Germany by the Renewable Energy Law (EEG).

The domestic use of peat in Germany amounts at present to 10 million m<sup>3</sup>. More than 80 % are used in plant substrates. Assuming a peat substitution of 25 % in this range, round 2 million m<sup>3</sup> compost from garden and park wastes can be used.

Advantages of the material recycling of compost as peat substitute are:

- reduction of the dependency on imports of fossil raw materials which are only available to limited extent,
- CO<sub>2</sub>-savings, resulting from the substitution of the excavation and use of peat comprising a magnitude that can also be expected with energetic utilisation.

Regarding the effects on climate protection it is to be questioned how the specific contributions of energy recovery and material recycling can be assessed and if - besides the promotion of energetic utilisation via the EEG - a promotion of peat substitution would be purposeful if a comparable decrease target could be achieved.





Concerning this the results of a study published in these days by the University Stuttgart will be instructive.

## 5 Quality and marketing of fertilisers from biowaste


Slide 21

RAL Quality Assurance  
of the German Compost Quality Assurance Organisation

Quality assurance compost (RAL GZ 251)	418 plants
Quality assurance AS-Humus (RAL GZ 258)	13 plants
Quality assurance digestion prod. (RAL GZ 245)	62 plants
Quality assurance NawaRo-digestion prod. (RAL GZ 246)	NEW

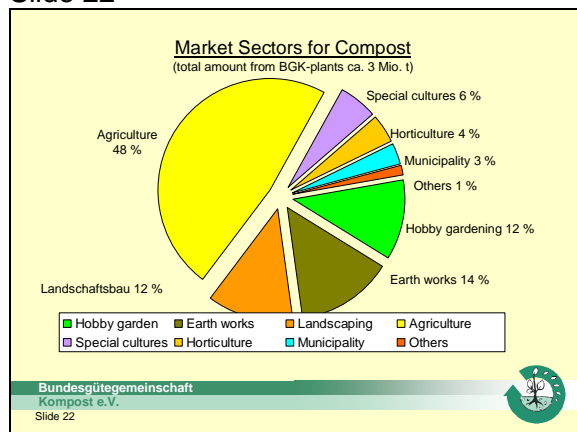





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RAL quality labels are established in Germany for the quality and quality assurance of composts and digestion residues which are awarded by the German Compost Quality Assurance Organisation BGK. Interested persons find more details on the BGK website [www.kompost.de](http://www.kompost.de). Further details shall not be made here. The Quality Assurance for digestion products will be performed in the lecture of Dr. Siebert.

Slide 22



The market sectors of compost in Germany are shown in the diagram. Besides agriculture with 45 %, landscaping with 19 %, horticulture and hobby gardening with 10 % respectively 12 % and the soil manufacturing industry with 14 % are important.

While the quantities of composts offered on the market remain static in between the demand for compost increases steadily in Germany.

In all the sales segments are composts sold with profit. Revenues outside agriculture with ca. 6 to 10 €/t and even more are higher than in agriculture (0.5 to 2€/t). The lower prices in agriculture depend on higher costs for transports and spreading compared with mineral fertilising. If these costs are considered in the calculation the price is comparable with the value of the plant nutrients contained in compost.

Slide 23

**Development of Nutrient Value of Compost**  
 2005 to 2007, Value in € per t fresh matter FM and ha

Fertiliser	2005	2007	Increase
Compost	5,30 €/t FM	8,10 €/t FM	+ 52 %
	212 €/ha	320 €/ha	
Digestion products solid	7,80 €/t FM	11,70 €/t FM	+ 51 %
	156 €/ha	235 €/ha	
Digestion products liquid	4,45 €/t FM	6,72 €/t FM	+ 48 %
	123 €/ha	181 €/ha	

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The figure shows the development of the value of plant nutrients contained in compost such as nitrogen, phosphate, potassium and lime. Considering nitrogen just the soluble portion and 5 % of the organic bound portion is calculated, i.e. round 10 % of the total content.

From 2005 to 2007 the monetary value of nutrients contained in composts and digestion products has increased by approximately 50 %. The value for compost increased from 5.30 €/t FM to 8.10 €. The value for the farmer per ha increased from 212 € on 320 €/ha. The development of values for digestion products is similar.

The value of the micro-nutrients also contained in the fertilisers and the organic matter is not considered hereby. The value for organic matter is assumed to rise distinctly in future accompanied by the increasing cultivation of renewable raw materials/energy crops and thus the demand on humus reproduction of the soil.

## 6 Summary and long-term perspective


### Slide 24

Summary: Long Term Perspectives

- Recycling of biowastes by separate collection
- Costs of separate collection and treatment in comparison
- Protection of climate and resources belong together
- Importance of material recycling of biowastes increases
- Climate relevance of material recycling is not yet considered
- Surplus in supply is replaced now by excess in demand

Separate collection and recycling of biowaste is „best option“

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The afore-mentioned aspects can be summarised as follows:

- the landfilling of not treated biowastes must be prevented on climate protection reasons. The targets of the EU Landfill Directive lead to the intended results but only on of the needed steps to go. Regarding the protection of resources biowastes must not only be kept away from the landfill but have to be supplied to material recycling as far as possible. This requires separate collection for the sake of product quality and acceptance on the market.

- Despite of separate collection considerable quantities of biowastes are still disposed off together with the residual waste in Germany. Through a more intensive separate collection further 2 to 4 million t of biowastes could be extracted from the residual waste - besides the already captured 8 million tons.
- Landfilling of untreated biowastes is widely common in the EU. Thus separate collection is not only very important regarding the protection of resources but also regarding climate protection.
- In order to support the targets of the EU Landfill Directive and the announced targets for climate and resource protection European Guidance is necessary. Best suitable here is a Biowaste Ordinance with concrete targets for separate collection and for energetic/material utilisation of biowastes. A mere product standard definition from compost in the Waste Frame Regulation is definitely not effective enough.
- The costs of separate collection are usually not higher at alternating biweekly collection than costs for a common disposal of biowastes together with residual wastes. The discussion of disposal option should consider the following aspects:
  - System decisions pro or contra separate collection are binding the decision makers usually by 10 to 20 years and more.
  - Systems of separate collection are „socio-technical“ systems, which are made to last long. The ability for a functioning needs to be accompanied not only on short-term sight, but also in the medium-termed run (e.g. awareness campaigns, public relations).
- Climate and resource protection belong together. For reasons of a sustainable management of the resources material recycling of biowastes has priority compared to energy recovery.
- The steering of the biowaste management should be carried out with regard on their actual suitability and the highest value of the individual utilisation. This means that an exclusive energetic utilisation makes sense only for biowastes with a high calorific value (e.g. > 11 MJ/kg). All of the other biowastes should be recycled via composting. Biowastes with high gas potentials should be energetically utilised via a biogas plant with a subsequent material recycling of the digestion residues.
- The importance of material recycling of biowastes will increase during the long-term perspectives regarding the following reasons:
  - On account of the increase of the biomass for energy production the demand for organic fertilisers for humus reproduction rises. Composts are especially suitable for this application purpose.
  - The closed loop management of phosphate will become a central target of a sustainable resource policy. Biowastes with a substitution potential of 10 % can contribute here noticeably.
  - Prices for fertilisers will rise like the ones for energy on account of increasing shortcomings of resources. The development has already started and will accelerate in future. The nutrients

contained in composts will become more and more competitive. Already today fertilising with secondary raw material fertilisers is more favourable than by mineral fertilising alone.

- Notwithstanding the aforementioned arguments for a sustainable resource management of biowastes the contribution and benefits of material recycling for climate protection remains by far unconsidered in the present assessments:
  - The contribution of composts and digestion residuals in order to substitute humus losses in the soil and thus to reduce CO<sub>2</sub> emissions is not considered.
  - The same can be said for the contribution of material utilisation of biowastes to substitute mineral fertilisers and peat in regard to a CO<sub>2</sub> reduction.
- Sale problems with compost are belonging to the past. The demand in the market is increasing and will gain relevance on account of the aforementioned correlations. As the recoverable potential of biowastes is limited the increasing demand will be reflected in increasing revenues. The division of the markets between agriculture and non agricultural will remain in the medium-term.

The material recycling of biowastes in the past has not developed itself without reasons to one of the most important measures of the recycling industry considering quantities. It is the “best option” for most the biowastes from separate collection of both ecological and economical considerations.

Policy promotion measures are presently focussed especially on regenerative energies. This is important and right. One must keep in mind that the frame conditions of the material recycling of biowastes and their specific benefit will not be forgotten and misleading guidance of the material stream will be avoided.