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# Digestate as fertilizer

Application, Upgrading and Marketing



[www.biogas.org](http://www.biogas.org)

**Biogas  
can do it!**

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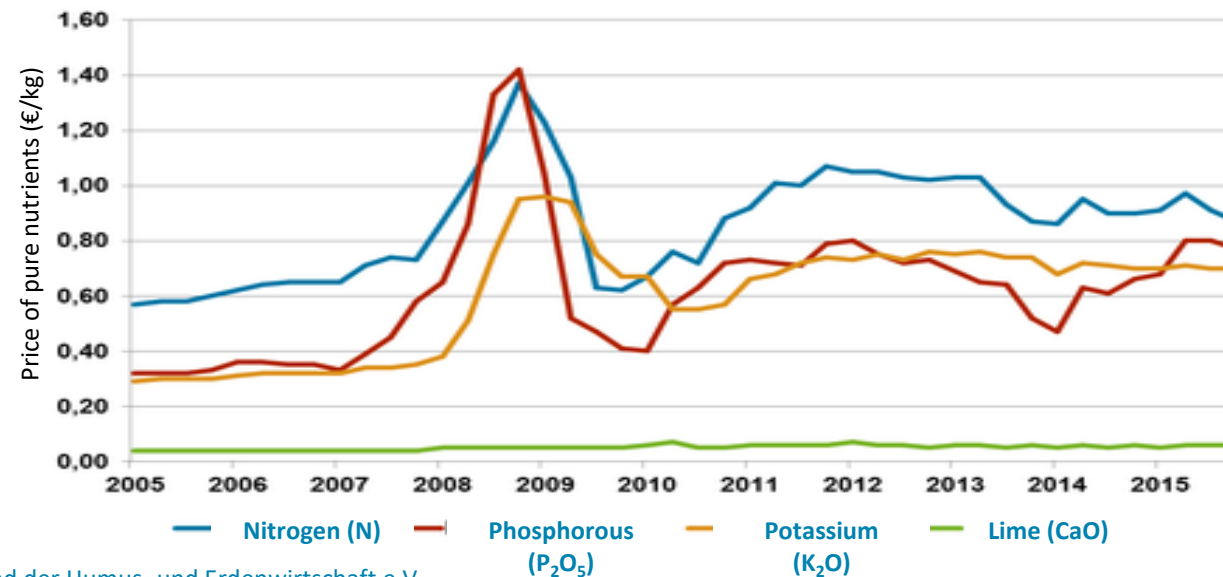
# Content of nutrients in digestate

- Approx. **82 million tons** (FM) digestate per year in Germany:
  - 0,25 % nitrogen  $\Rightarrow$  **205.000 t N**
  - 0,20 % phosphate  $\Rightarrow$  **164.000 t P<sub>2</sub>O<sub>5</sub>**
  - 0,40 % potassium oxide  $\Rightarrow$  **328.000 t K<sub>2</sub>O**
  
- Share of nutrients in the german market of anorganic fertilizer
  - ca. 11,5 % for nitrogen (1,79 Mio. t N)
  - ca. **56,5 %** for phosphate (0,29 Mio. t P<sub>2</sub>O<sub>5</sub>)
  - ca. **76,3 %** for potassium oxide (0,43 Mio t. K<sub>2</sub>O)

# Substitution of anorganic fertilizer

- Nitrogen (N): Energy demand ca. 600 kWh<sub>el</sub>/t N
- Phosphorus (P), Potassium (K), Peat: finite resource and wide transport path
- Phosphorus (P): Increasing cadmium and uran contents

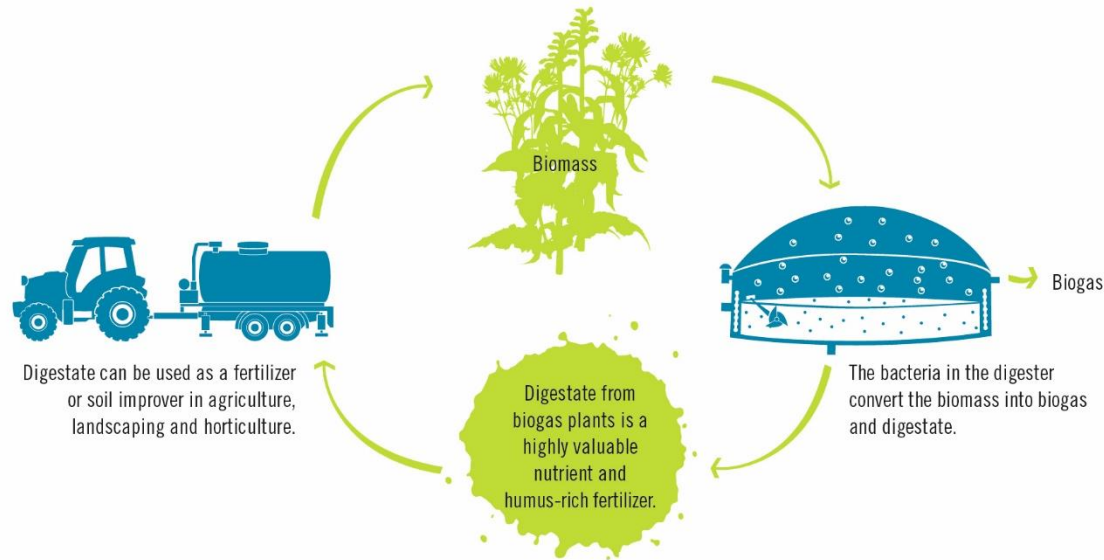
Price of the pure nutrients in mineral fertilizer



Source: Verband der Humus- und Erdenwirtschaft e.V.

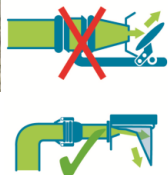
# Direct application

## Nutrient cycle



- Low content of nutrients depending on dry matter content
- For distance up to 5km profitable
- From 5km distance spreading with separate mechanization

### Wides distribution



### Drag hose



### Drag or slit-shoe



### Slurry cultivator

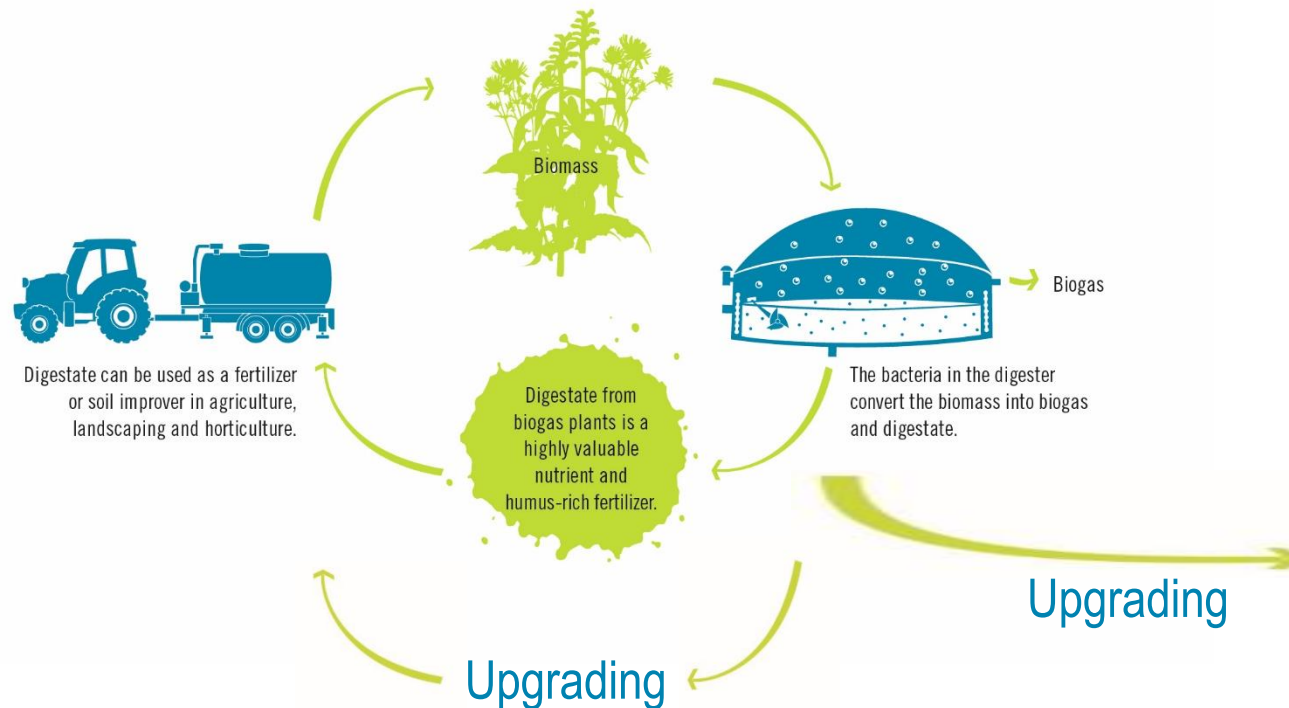


### Universal manure spreader



# Digestate upgrading

## Nutrient cycle



## Decoupling

- Fractional single nutrients
  - Industry or agriculture
- E.g. phosphate salt

→ Several processing possibilities

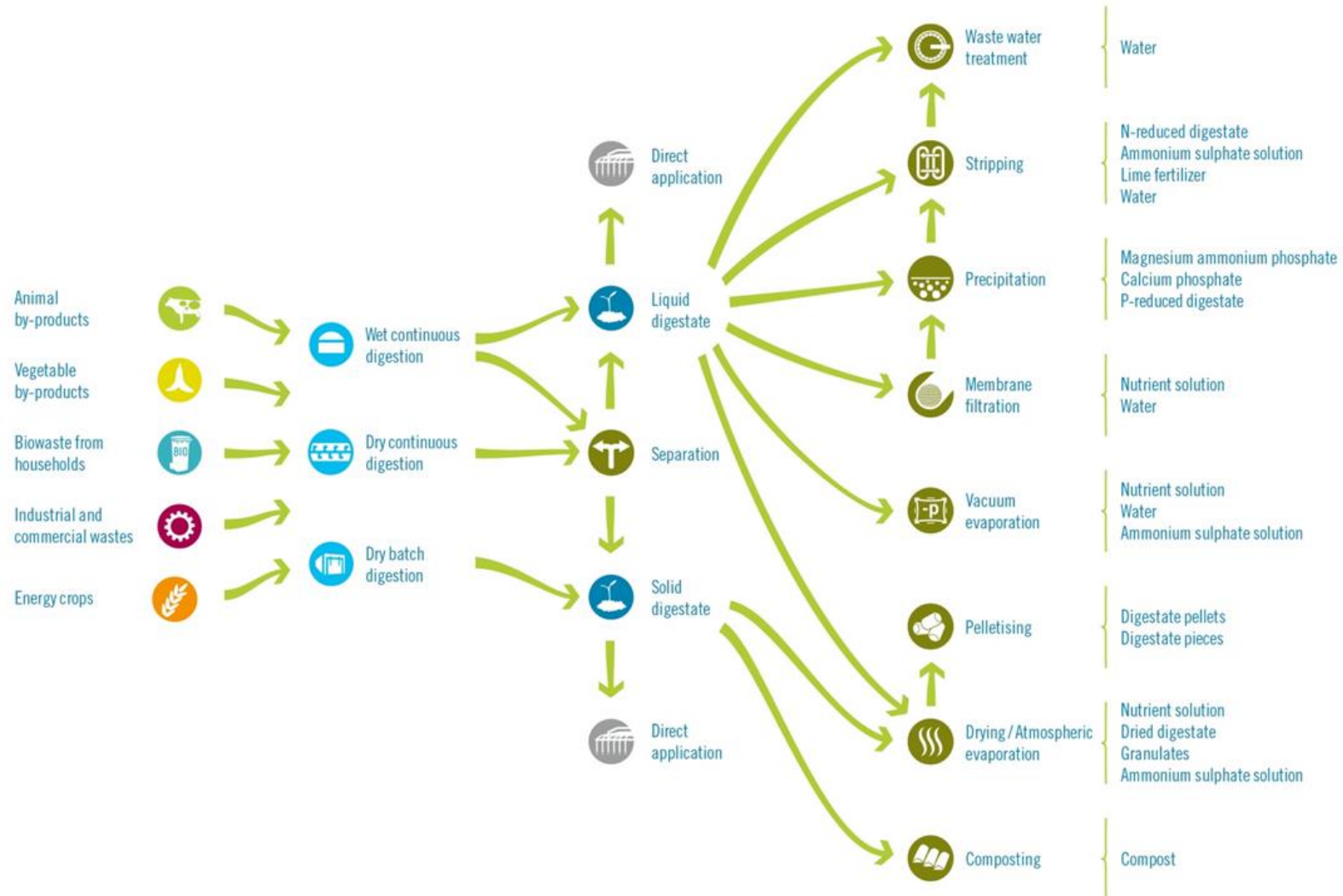
Solid liquid separation / thickening (evaporation) / drying / total upgrading

# Reasons for upgrading fertilizer

- **Reducing costs for storage, transport and application**
  - Application seasonal restricted (nutritional requirement of the plant)
  - Sufficient storage capacity during the winter
  - Reducing water content and increasing nutrient content
- **Establishing new markets**
  - Replacing growing media, potting soil, peat substitution, etc.
  - Marketing in garden center, home improvement store, retail market
  - Use for landscaping, viticulture, etc.
  - Relief of the nutrient cycle in case of land use pressure
- **Added value**
  - Producing fertilizer demand-oriented (adjust nutrient content)
  - Reducing losses of nutrient (nitrate losses), NH<sub>3</sub> emissions, animal welfare
  - Improvement of the appearance, handling



# Overview digestate upgrading



# Nutrient content of separated digestate



## Ingredients in typical digestate

Form of digestate	DM [%]	N <sub>total</sub> [kg/m <sup>3</sup> ]	NH <sub>4</sub> [kg/m <sup>3</sup> ]	NH <sub>4</sub> share [% of N <sub>total</sub> ]	P <sub>2</sub> O <sub>5</sub> [kg/m <sup>3</sup> ]	K <sub>2</sub> O [kg/m <sup>3</sup> ]
Liquid digestate	6.5	5.1	3.2	62.7	2.3	5.5
Liquid separated fraction	5.7	4.9	3.1	63.3	2.0	5.4
Solid separated fraction	24.3	5.8	2.7	46.5	5.0	5.8

Source: Data from Bavarian state research center for agriculture



# GüteGemeinschaft Gärprodukte e.V.

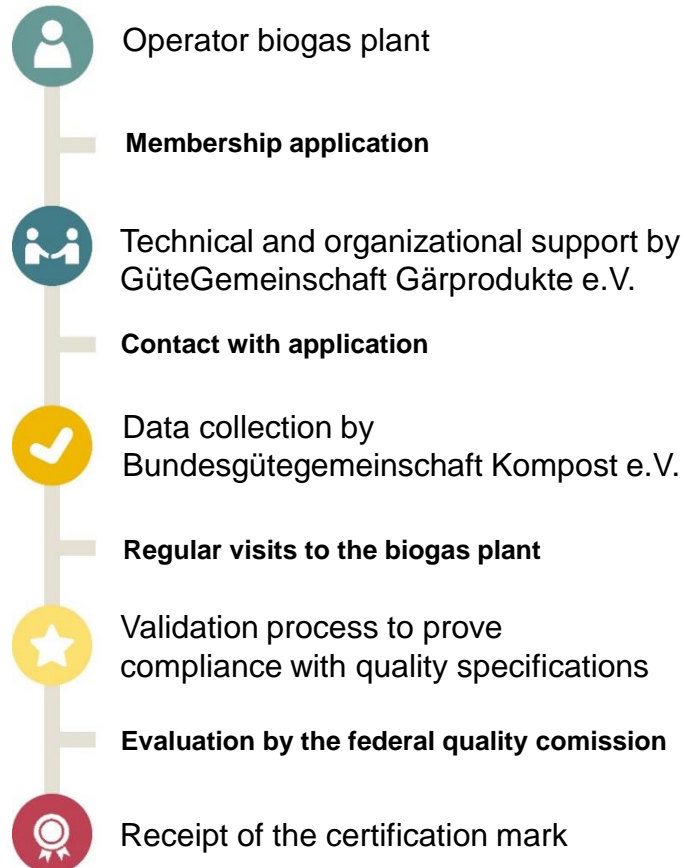


## Advantage of Quality Assurance System (QAS)

- Legal security for customers
- Increasing in acceptance
- FIBL entry possible
- Professional support e.g. Application in sensitive areas
- Exchange, specialist seminars
- Internet presence with expert informations
- Further informations: [www.gaerprodukte.de](http://www.gaerprodukte.de)



## Process of quality assurance



**RAL**  
RAL-GZ 245

### Prüfzeugnis

PZ-Nr.: 9999-1001-011

**Gärprodukt flüssig**

**RAL-Gütesicherung Gärprodukt**  
Charakteruntersuchung  
Seite 1 von 2

Anlage Musternwald  
(BGH-Nr.: 9999)

Charge: Lagerbehälter 2  
Probenahme am 07.09.2009

Rechtsbestimmungen:  Bioabfallverordnung  Düngemittelverordnung

Regelwerke:  RAL-Gütesicherung (RAL-GZ 245)  Fremdüberwachung der BGK

Die Erbringung der jeweiligen Kom. wird mit diesem Häkchen ausgedrückt.

Warendeklaration der RAL-Gütesicherung<sup>1)</sup>

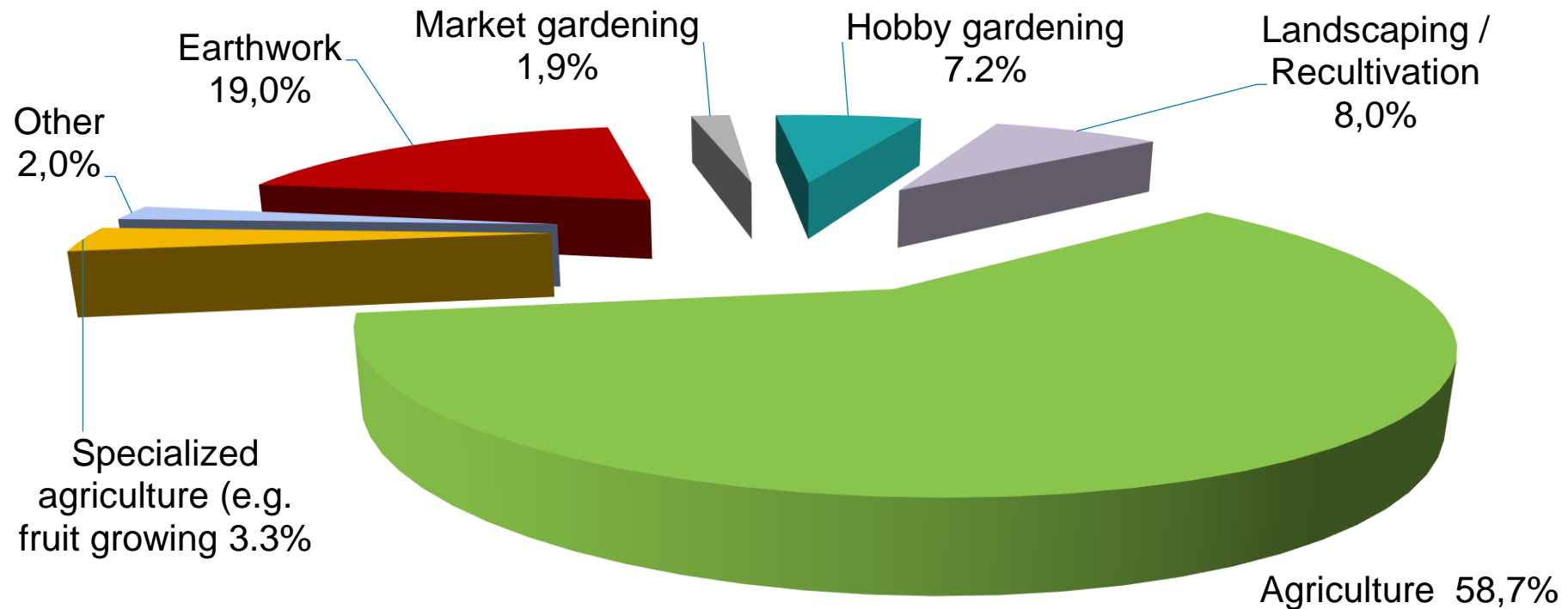
Kennzeichnung		Eigenschaften und Inhaltsstoffe	
gemäß Düngemittelverordnung		in der Frischmasse	
		kg/t	kg/m <sup>3</sup>
Organischer NPK-Dünger flüssig	Nebenbestandteile:	Stickstoff gesamt (N)	1,88 1,81
0,16-0,06-0,03	0,09 % N Ammoniumstickstoff	Stickstoff löslich (N)	0,92 0,89
unter Verwendung von organischen Abfällen, tierischen Nebenprodukten, pflanzlichen Stoffen aus der Lebens-, Genuss- und Futtermittelherstellung, pflanzlichen Stoffen aus der Landwirtschaft	0,90 % S Schwefel	Stickstoff anrechenbar (N <sup>P</sup> )	0,96 0,87
	1,43 % Organische Substanz	Phosphat gesamt (P <sub>2</sub> O <sub>5</sub> )	0,70 0,67
0,16 % N Gesamtstickstoff	Hinweise zur Lagerung:	Kaliumoxid gesamt (K <sub>2</sub> O)	0,34 0,33
0,06 % P <sub>2</sub> O <sub>5</sub> Gesamtphosphat	Lagerung nur in geeigneten und zugelassenen Behältern/Anlagen unter Berücksichtigung anderer Rechtsbestimmungen. Vor der Entnahme ausreichend Durchmischen.	Magnesiumoxid ges (MgO)	0,04 0,04
0,03 % K <sub>2</sub> O Gesamtkaliumoxid	Hinweise zur Anwendung:	Basisch wirksame Stoffe (CaO)	0,82 0,79
Nettomasse und ggf. Volumen: siehe Lieferschein	Hinweise zur sachgerechten Anwendung siehe Anlage DW. Die Empfehlungen der amtlichen Beratung sind vorrangig zu berücksichtigen. Bei einer Aufbringung auf landwirtschaftlich genutzten Flächen sind die Anwendungs- und Mengenbeschränkungen aus abfallrechtlichen Vorschriften (AbfKlärV, BioAbfV) zu beachten.	pH-Wert	8,2
Hersteller/Verkehrbringer:		Salzgehalt	8,88 g/t
Mustern Wald H		Organische Substanz	14,3 kg/t
Muster Allee 1		Humus-C	2 kg/t
04667 Musterstadt		Hygieneanforderungen eingehalten	Frei von keimfähigen Samen und ausbleibfähigen Pflanzenteilen
		Rohdichte	960 kg/m <sup>3</sup>
		Trockenmasse	1,9 %
		Düngewert <sup>2)</sup>	1,29 6kt 1,24 6kt/m <sup>3</sup>
		Humuswert <sup>3)</sup>	0,30 6kt 0,29 6kt/m <sup>3</sup>
Ausgangsstoffe:	Anwendungsvorgaben:	Stickstoff aus Wirtschaftsdüngern	0,5 kg FM
Organischer Abfall pflanzlicher Herkunft aus getrennter Sammlung aus Heingewerbe, Gülle, Pflanzliche Stoffe aus der Lebens-, Genuss- und Futtermittelherstellung, Pflanzliche Stoffe aus der Landwirtschaft.	Bei Anwendung dieses Düngemittels sind die Sperrfristen der Düngerverordnung in den Wintermonaten zu beachten. Eine Anwendung auf Dauergrünlandflächen ist nicht zulässig.	Stickstoff aus Wirtschaftsdüngern	0,5 kg FM
Fremdbestandteile: Fett und Fettsäureester		Stickstoff aus Wirtschaftsdüngern	0,5 kg FM

Das Erzeugnis unterliegt der RAL-Gütesicherung (RAL-GZ 245). Dieses Zeugnis wurde elektronisch erstellt. Es gilt ohne Unterschrift.

Bundesgütegemeinschaft Kompost e.V.  
Träger der regelmäßigen Güteüberwachung gemäß § 11 Abs. 3 BioAbfV.

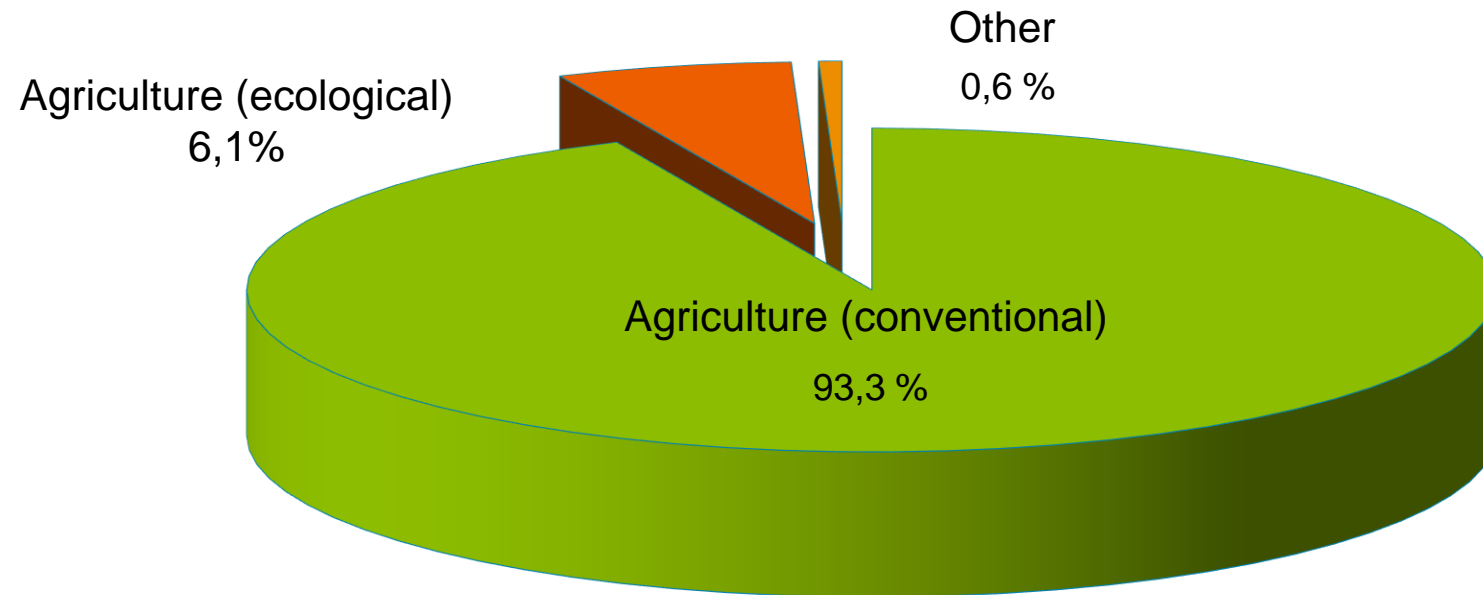
Köln, den 08.01.2010

# Marketing of compost



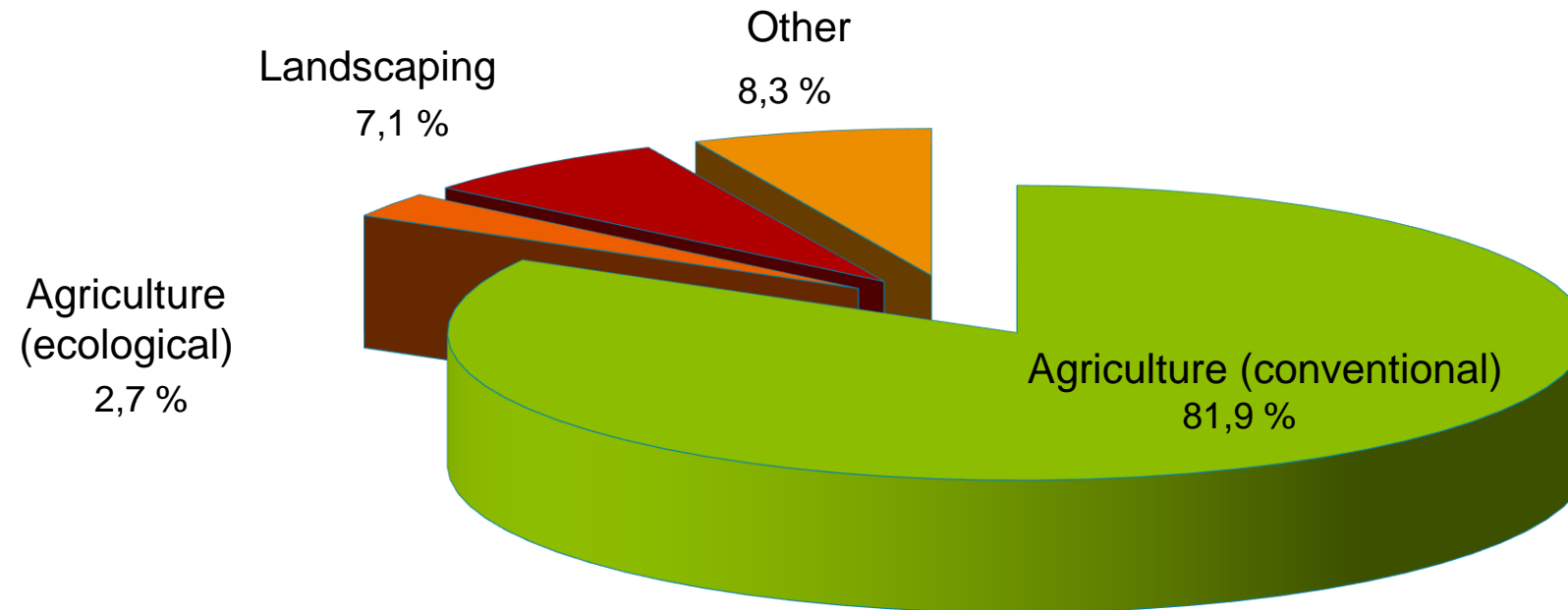
Source: Data from the Quality Assurance System, update 2016: 489 Compost plants, 6,6 Mio. t Input material

# Marketing of liquid digestate



Source: Data from the Quality Assurance System, update 2017: 163 Biogas plants, 4,25 Mio. t Input material

# Marketing of solid digestate



Source: Data from the Quality Assurance System, update 2017: 53 Biogas plants, 730.000 t Input material

# GÄRWERT-project (FKZ 22402312)

Study to decision-making behaviour of private gardeners performed by the University of Nürtingen-Geislingen, directed by Prof. Dr. Herbes in cooperation with the institute for market research - Kantar TNS

The project was funded by the financial support from the federal ministry of food and agriculture (BMEL) through the agency renewable raw material e.V. (FNR) as project sponsor for the renewable raw material funding program



Gefördert durch:



aufgrund eines Beschlusses  
des Deutschen Bundestages

# Results of the interviews

- General: high uncertainty
- Often to less information / no research before buying
- Consulting by the retailer was used, but low satisfaction
- The product name on the packaging has an recommending effect => application field (herb soil, rose fertilizer, berry fertilizer, box tree fertilizer,...)
- Differentiation between ornamental and edible plants (vegetable, fruits, berries, etc.)
- „Look and feel“ important for assessing the application
- Amazing importance of traditional rules of thumbs

## Product attributes (e.g. garden soil)

Attribute	Attribute level
Product name	All-round soil
	Potting soil
Brand name	Premium brand e.g. Compo, Neudorff,
	Middle class brands e.g. Gartenkrone, Floraself,
	Own brands of home improvement stores e.g. Obi, Toom,
Label	Bio
	Peat free
	with guano
Ressource	Renewable raw material
	Fermented residues
	Digestate from biogas plants
Price (per 40-liter-bag)	4 €
	6 €
	8 €

Source: Carsten Herbes, HfWU Nürtingen, 2019

# Willingness according to different product groups (average value in €)

Attribute	Specification	All Consumers
Soil type	Potting soil	0.39
Brand name	Premium brand	0.10
	Middle class brand	0.08
Label I	Bio	0.52
Label II	Peat free	0.46
Label III	“with Guano”	0.37
Ressource	From renewable raw material	2.21
	From fermented residues	0.74

Source: Carsten Herbes, HfWU Nürtingen, 2019



# Willingness according to different customer classes

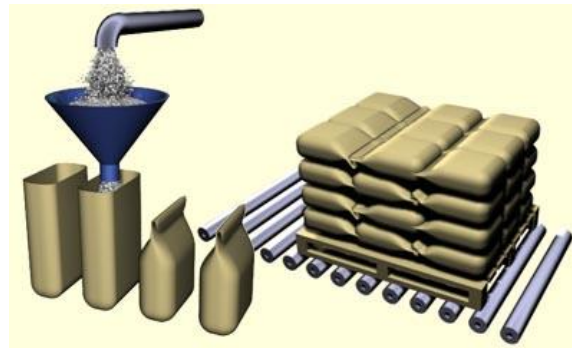
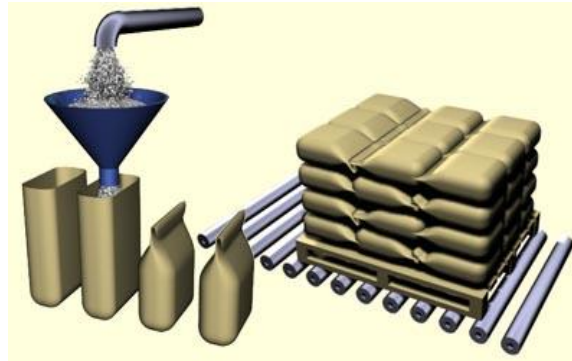
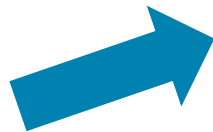
Attribute	Level	Resource sensitive premium customers	Resource sensitive customers (avoiding guano)	Label oriented middle class customers	Price sensitive customers	Multi criterion customers (guano affine)
		n=61	n=55	n=115	n=127	n=149
Soil type	Potting soil	-0.54	0.34	-4.00	-0.04	2.20
Brand name	Premium brand	2.42	-0.40	-4.00	-0.30	0.74
	Middle class brand	-0.48	-0.21	4.00	-0.11	2.08
Lable I	Bio	3.00	0.70	4.00	0.11	2.15
Label II	Peat free	3.00	0.30	4.00	-0.16	2.12
Label III	"with Guano"	-4.00	-1.28	-4.00	-0.17	4.00
Resource	From renewable raw material	4.00	3.11	-4.00	0.21	2.44
	From fermented raw material	3.83	0.93	-4.00	0.08	2.13

Source: Carsten Herbes, HfWU Nürtingen, 2019

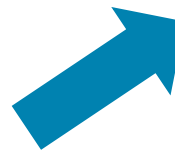
# Individual marketing



# Franchising (common brand name)



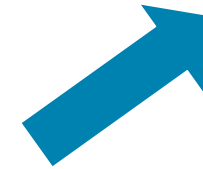
# Central fertilizer factory



Additional aggregates

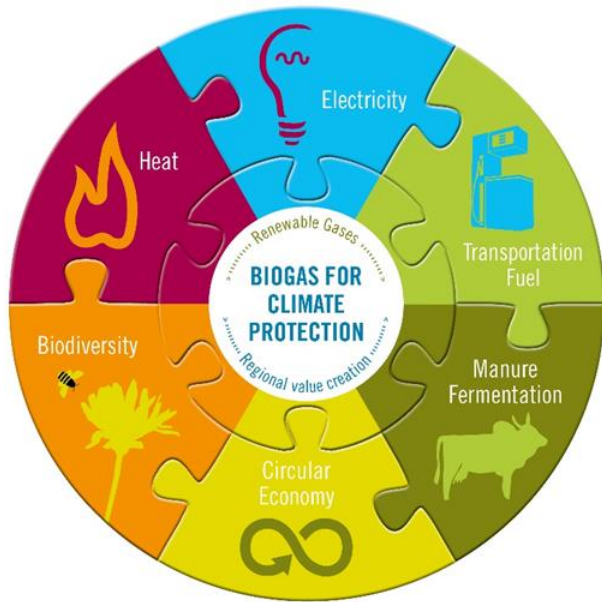


Plxmac.de 45625677



# Conclusions

- Digestate is an important product of AD, which can be used as valuable fertilizer
  - Liquid manure as input substrate is ecological and economical beneficial – emission reduction
- Interest for upgrading technologies strongly increasing
  - Legal compliance
  - Economic optimization
  - Reduction of mineral fertilizers by closing material cycles
- Upgrading technology depends on location and size of the plant
  - Heat demand
- The market has to be established
  - Different scenarios possible → raw material supplier, individual product marketing
  - Certification increases acceptance
- Considering product attributes
  - Customer demand



Thank you for your attention!



# BIOGAS Convention & Trade Fair

07.–09. Dezember 2021, Nürnberg

[www.biogas-convention.com](http://www.biogas-convention.com)