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BIOSOL Farm: Agriculture contribution to nutrient cycle

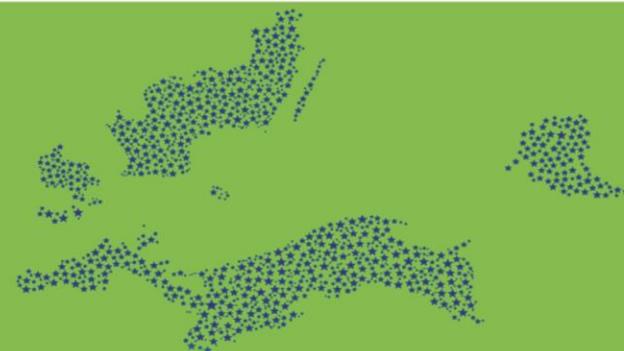


SOUTH BALTIC FARMS
AN ESSENTIAL PART OF RENEWABLE ENERGY SYSTEMS

June 9, 2025

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BIOSOLFarm – South Baltic Farms

- an essential part of renewable energy systems



SUN, WIND, BIOMASS

BIOSOLFarm project aims to create a greener, more secure, and prosperous future by empowering small farmers' and farms associations,

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Structure

1. Farmyard manure - animal manure
2. Plant-based fertilizers
3. Use of farmyard manure
4. Nutrient distribution in pig and cattle manure (slurry)
5. Obstacles for a balanced nutrient distribution
6. Objectives of biogas production
7. Changes in nutrient composition after fermentation
8. Biogas in Germany
9. Biogas in Poland
10. Biogas in Lithuania

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1. Farmyard manure - Animal manure

Slurry

Mixture of urine and feces, often diluted with water. From cattle, pigs or other farm animals

Manure (solid manure)

Solid dung with bedding (e. g. straw), Especially from cattle, horses and sheep

Liquid manure

Liquid part of manure, usually almost pure urine with few solids

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2. Plant-based fertilizers

Straw

Often used as bedding, but can also be decomposed and contribute to humus formation

Green fertilization (Cover crops)

Plants (e.g., clover, mustard) are not harvested but plowed under to improve the soil

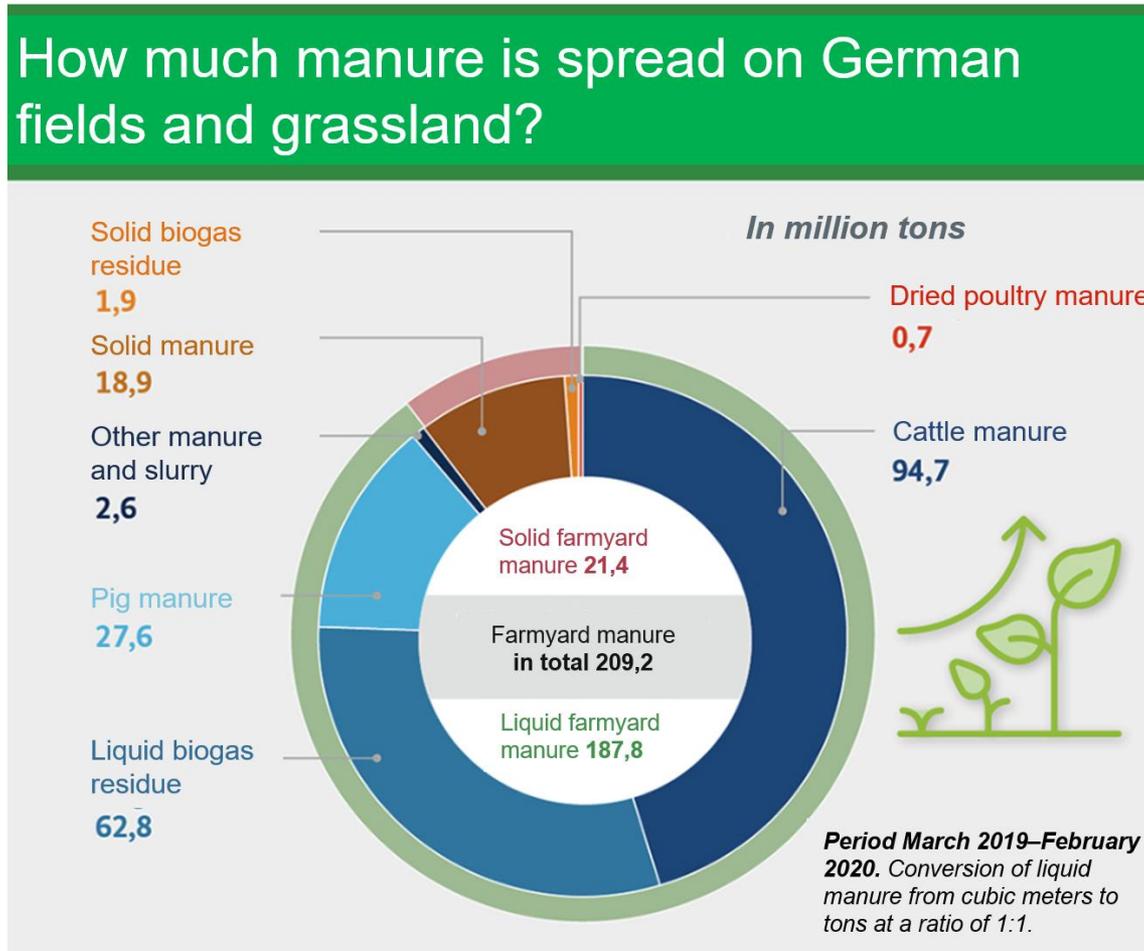
Compost

Decayed plant material, partly from by-products such as crop or vegetable waste.

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3. Use of farmyard manure



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4. Nutrient distribution in pig and cattle manure

NUTRIENTS	FATTENING PIG MANURE	DAIRY AND BEEF CATTLE MANURE
Nitrogen - Total-N -	4-7 kg/m ³	3-5 kg/m ³
of which - Ammonium-N (NH ₄)	3,5-5 kg/m ³	2-2,5 kg/m ³
Phosphate - P ₂ O ₅ -	2-4 kg/m ³	1-2 kg/m ³
Potassium - K ₂ O -	3-5 kg/m ³	4-5 kg/m ³
Magnesium - MgO -	1-2 kg/m ³	1 kg/m ³

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MEIST IM STALL, SELTEN DRAUSSEN: UNSICHTBARE TIERHALTUNG IN DEUTSCHLAND

Zentren der Nutztierhaltung, 2014 (Rinder, Schweine), 2016 (Hühner)



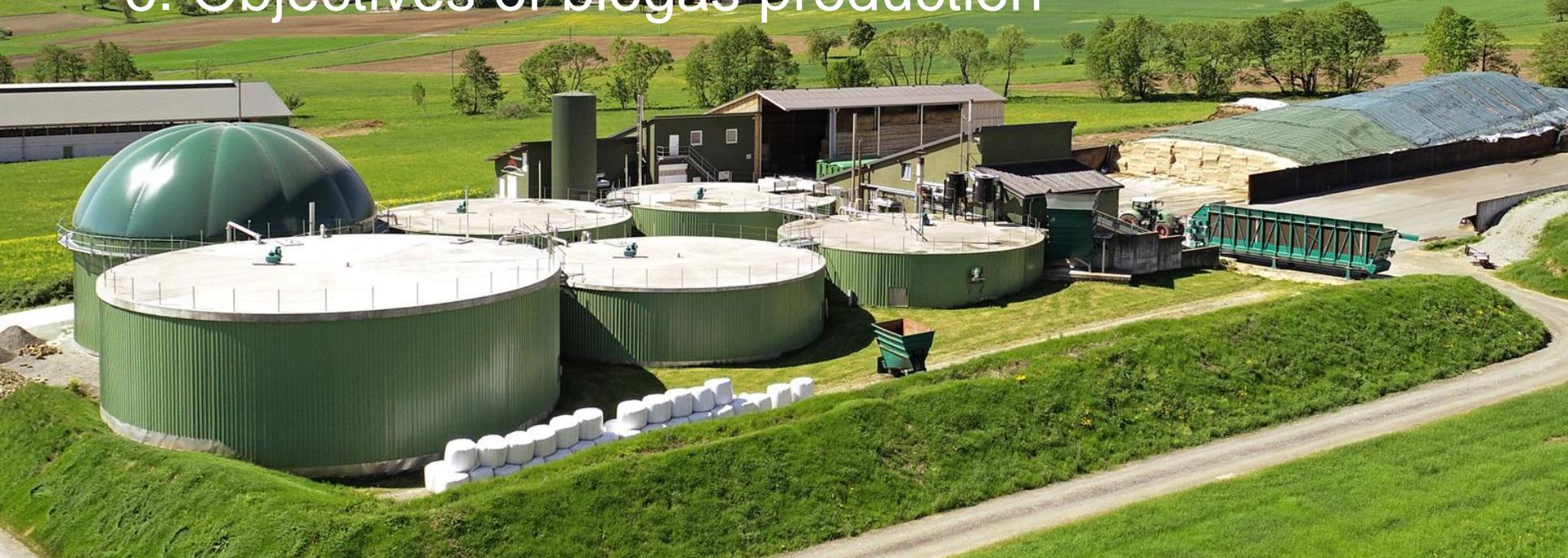
Ab 1 Rind oder 2 Schweinen pro Hektar landwirtschaftlich genutzter Fläche, ab 1 Million Hühner je Landkreis. Die tatsächliche Tierdichte kann sehr viel höher sein.

5. Obstacles for a balanced nutrient distribution

- ➔ Regional differences in the intensity of livestock farming and arable farming
- Differences in the availability of and demand for farm manure
- Balanced distribution of livestock farming and arable farming would be ideal for a balanced nutrient distribution

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6. Objectives of biogas production



1. Renewable Energy production
2. Climate protection and emission reduction
4. Contribution to energy security
5. Waste recycling and circular economy
6. High-quality fertilizer

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7. Change in nutrient composition after fermentation

Parameter	Einheit	Mixed substrate		Fermentation residue	
		Median	s (%)	Median	s (%)
TM	%	13,20	37	5,80	29
oTS	% d. TS	81,38	5	71,81	7
pH		6,89	7	7,71	3
Nt	% d. FM	0,50	30	0,43	22
NH ₄ -N	% d. Nt	42,1	37	68,9	21
C _{org.}	% d. TS	44,1	12	39,2	17
C/N		12	29	5	30
P	% d. FM	1,02	42	0,80	33
K	% d. FM	3,17	29	3,04	27
Mg	% d. FM	0,08	35	0,06	33
S	mg/kg TM	5.713	30	7.638	67
S	kg/m ³	0,56	33	0,39	34
Zn	mg/kg TM	209	107	620	115
Cu	mg/kg TM	149	252	393	92

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Nitrogen: More readily available to plants

- bound nitrogen in unfermented manure
 - The fermentation process converts some of this organic nitrogen into ammonium nitrogen (NH_4^+).
 - ▶ (NH_4^+) is immediately available to plants, similar to mineral nitrogen fertilizers.
-
- Manure: approx. 30–40% of total nitrogen immediately available to plants
 - Fermentation residue: approx. 60–80% immediately available to plants

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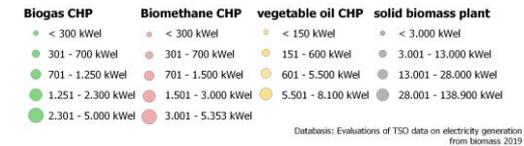
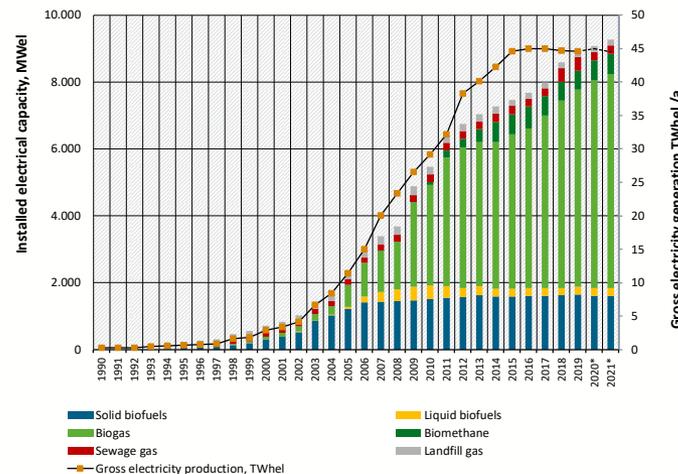
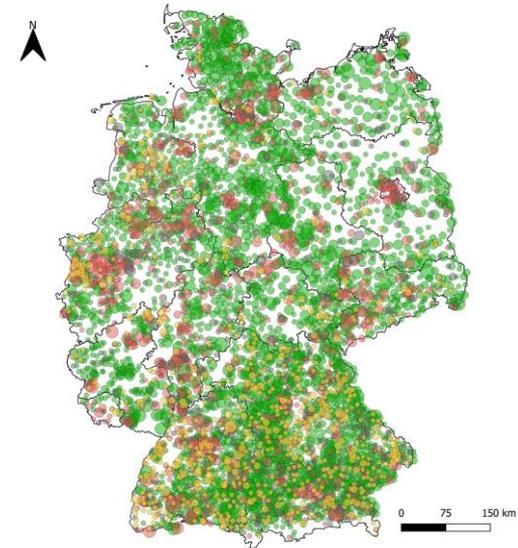
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8. Biogas in Germany

- biomass including sewage gas and landfill gas (2020): installed capacity ~ 9,3 GWel/a; electricity production ~ 45 TWhel/a
- Biogas /Biomethane CHP
- Sewage and landfill gas plants (CHP)
- Vegetable oil CHP
- Solid biomass plants



Database: Evaluations of TSO data on electricity generation from biomass 2019

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9. Biogas in Poland

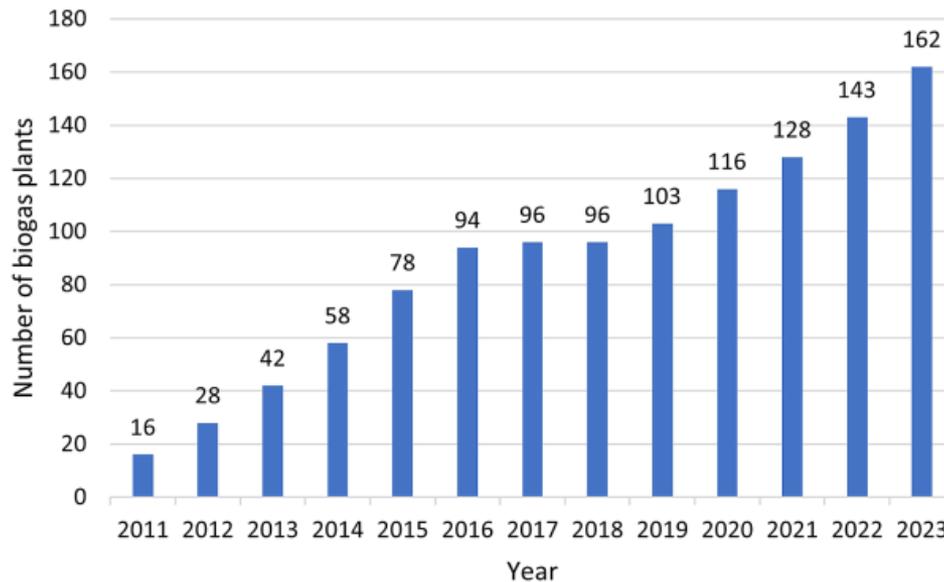


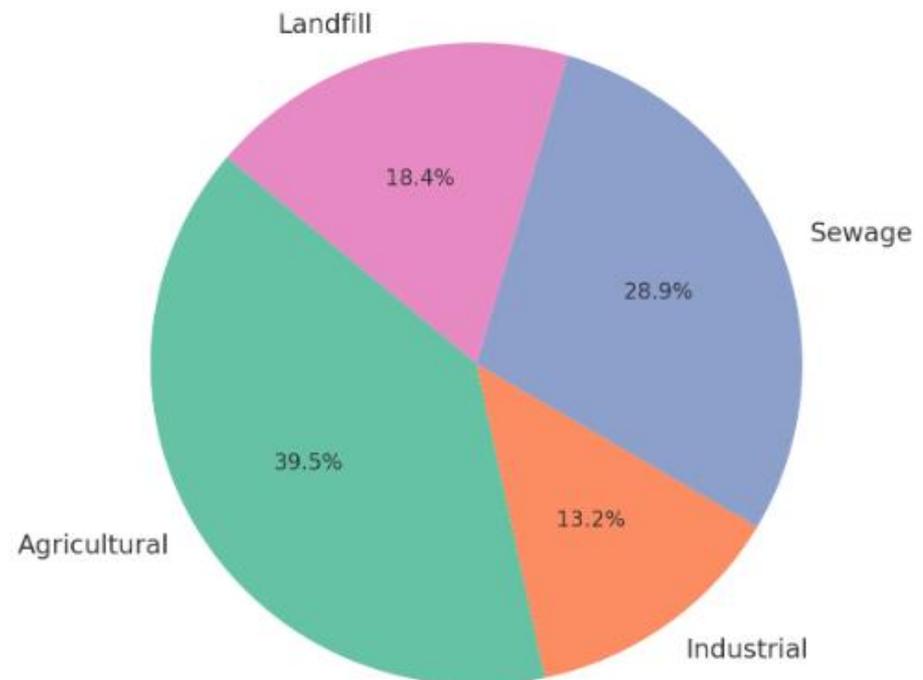
Figure 2. Number of agricultural biogas plants in Poland in 2011–2023
(The National Support Centre for Agriculture – KOWR, 2024)

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10. Biogas in Lithuania

- 41 biogas plants in total (2022)
- **15 Agricultural biogas plants**
- 11 Sewage biogas plants
- 7 Landfill biogas plants
- 5 Industrial biogas plants

Distribution of Biogas Plants (2022)
Total: 41 Plants



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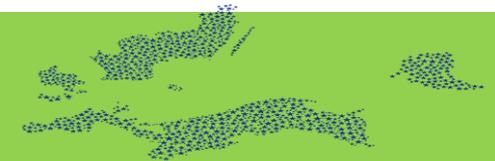
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Thank you for your attention



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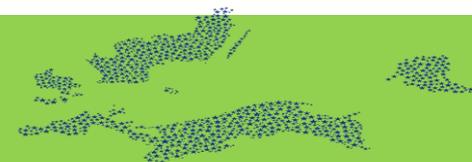
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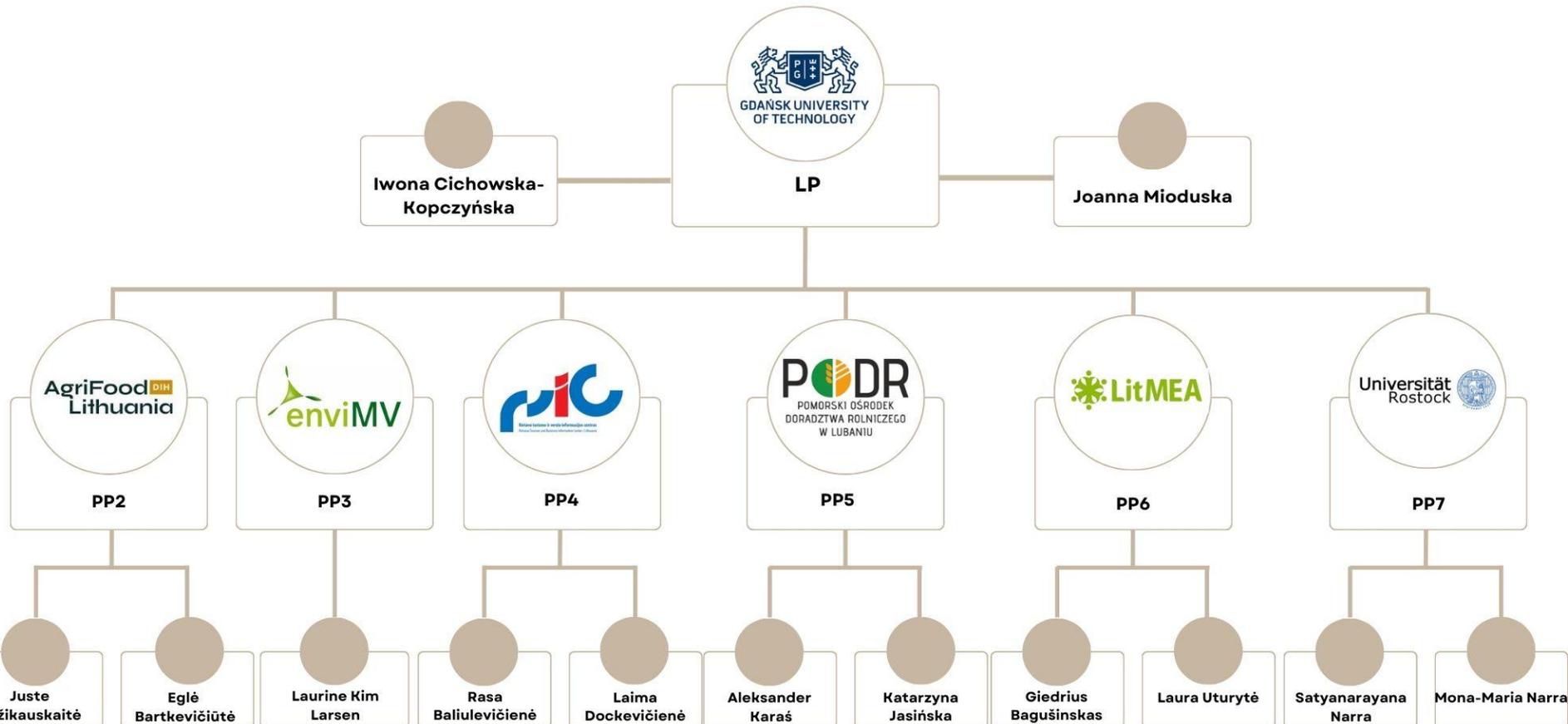
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BIOSOLFarm

South Baltic Farms - an essential part of renewable energy systems

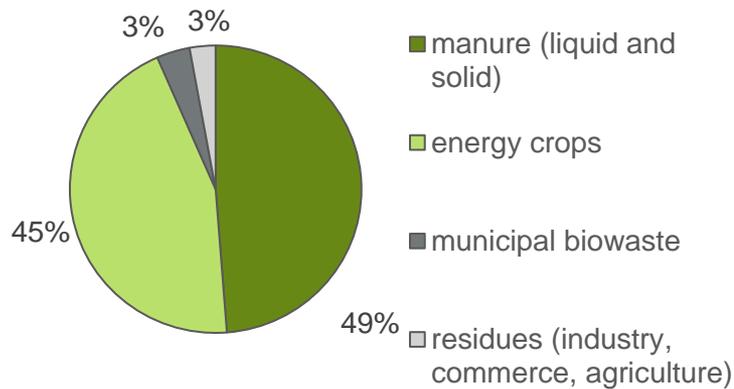
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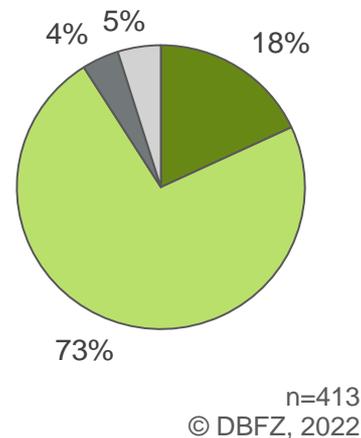
Nutrient recovery potential

In total manure and renewable resources account for more than 90 % of the biogas in Germany

mass-related



energy-related



input	amount 2021
Manure (liquid and solid)	65 Mio. t FM
Energy crops	61 Mio. t FM
Municipal biowaste	2-3 Mio. t FM
Residues (industry, commerce, agriculture)	3-4 Mio. t FM

FM fresh matter

References: Database biogas DBFZ; operators' survey 2022 (reference year 2021)

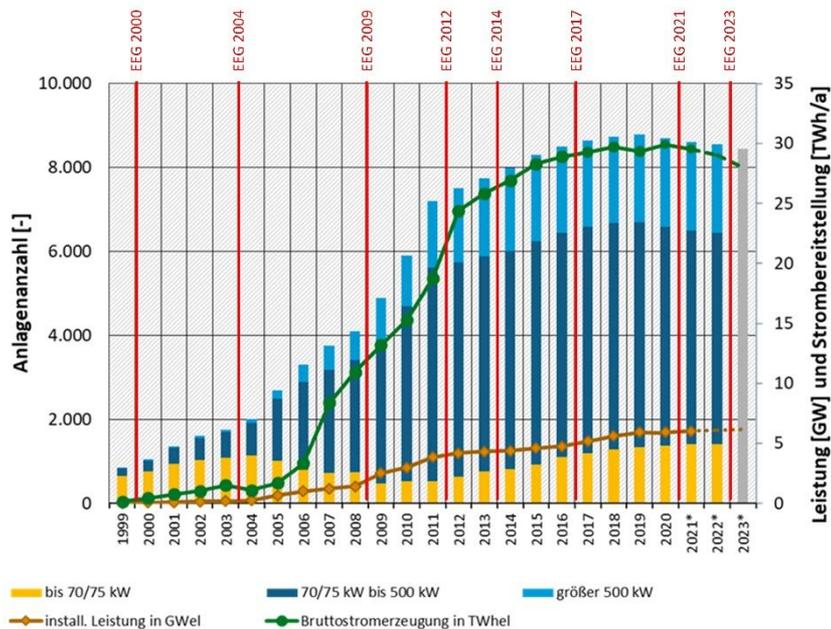
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Biogas in Germany

Development of the biogas plant stock

Composition of the biogas plant stock



Source: DBFZ (11/2022)

Distribution biogas plants

Plant type	Number of plants	Installed capacity [MW/a] ¹⁾	Electricity production ¹⁾ [TWh/a]	Heat production ¹⁾ [TWh/a]
Biogas	8,580²⁾	6,450	28.2	17.5²⁾
Agriculture	~8,300 ²⁾	6,224	27.2	16.9
Organic waste ³⁾	~280 ²⁾	226	1.0	0.6
Biomethane	239 (1,204)²⁾	654	3.1	4.8
Agriculture	188 ²⁾	514	2.4	3.8
Organic waste	51 ²⁾	140	0.7	1.0
Sewage sludge	1,271⁴⁾	374	1.6	2.4
Landfill	270⁵⁾	137	0.2	0.1
Total	10,360 (11,564)	7,615	33.1	24.8

- 1) Working Group on Renewable Energy-Statistics (AGEE-Stat) as of 02/2023 for year 2021; distribution to agriculture vs. organic waste according to DBFZ.
- 2) Estimation DBFZ. In case of Biomethane: in 2021: 239 biogas plants with upgrading technologies to provide biomethane. 1,204 Biomethane-CHP units.
- 3) Estimation DBFZ incl. biowaste plants with > 90% biowaste and co-fermentation with less than 90% biowaste ; installed capacity incl. flexible capacity
- 4) Federal Statistical Office (destatis): https://www.destatis.de/DE/Presse/Pressemitteilungen/2020/08/PD20_310_433.htm
- 5) destatis 2022: energy statistics of electricity-feeding plants in 2021 according to table-code 43312-0001. (sewage sludge CHP 457 plants, landfill CHP: 270).

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