



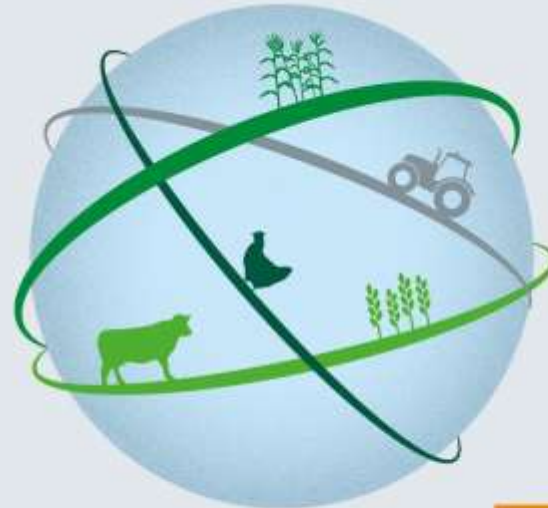
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Sustainable material and energetic use of biomass in Germany

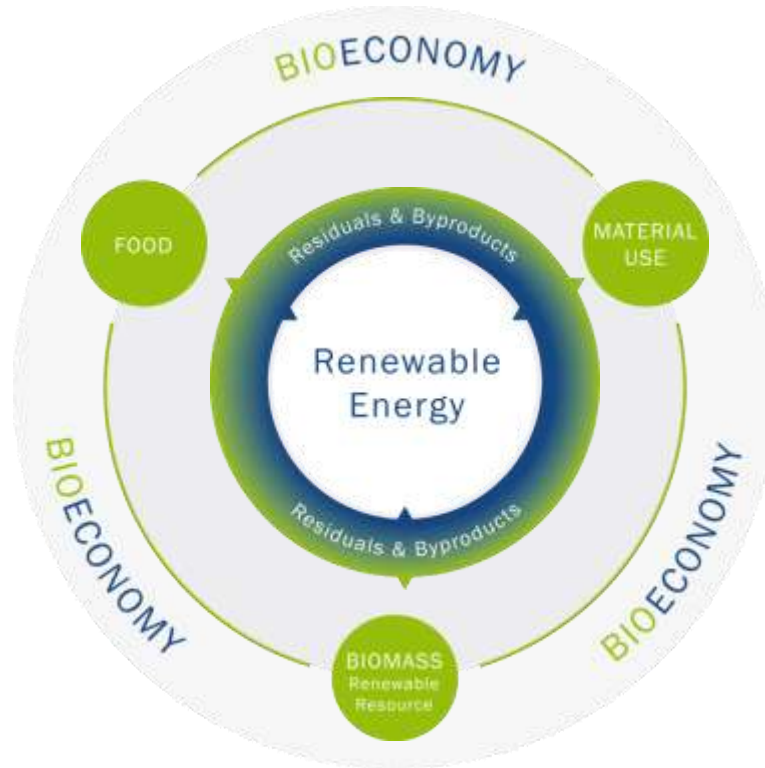
Prof. Dr. Michael Nelles
Scientific Managing Director
DBFZ Deutsches Biomasseforschungszentrum gemeinnützige
GmbH, the German Centre for Biomass Research

Expert Panel “Innovative Biomass Energy Technologies and
their policy implications”; Global Forum for Food and
Agriculture (GFFA), 17th of January 2025 in Berlin, Germany

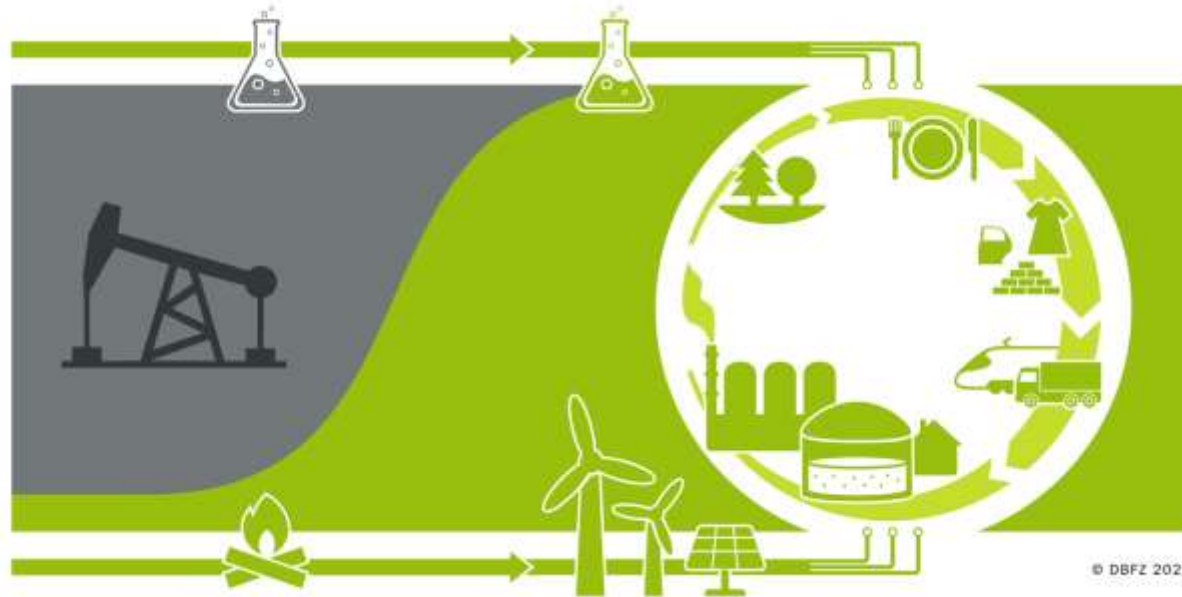


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Biomass in the ECONOMY



Climate-Neutral Society needs a 100% Renewable Energy System & a real Circular (Bio)Economy!





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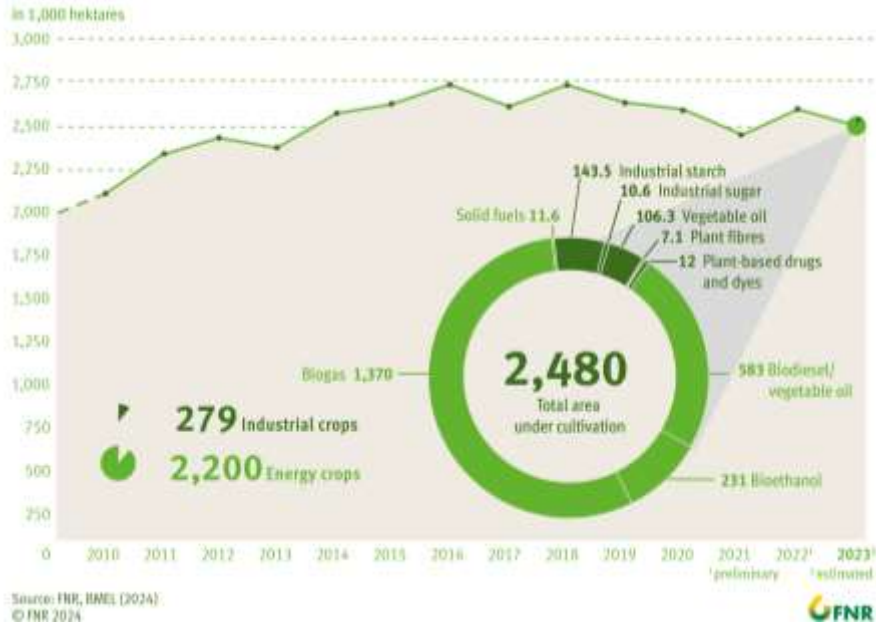
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BIOMASS AND BIOENERGY IN GERMANY

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Potentials: Renewable Resources

Agricultural area in Germany 2023



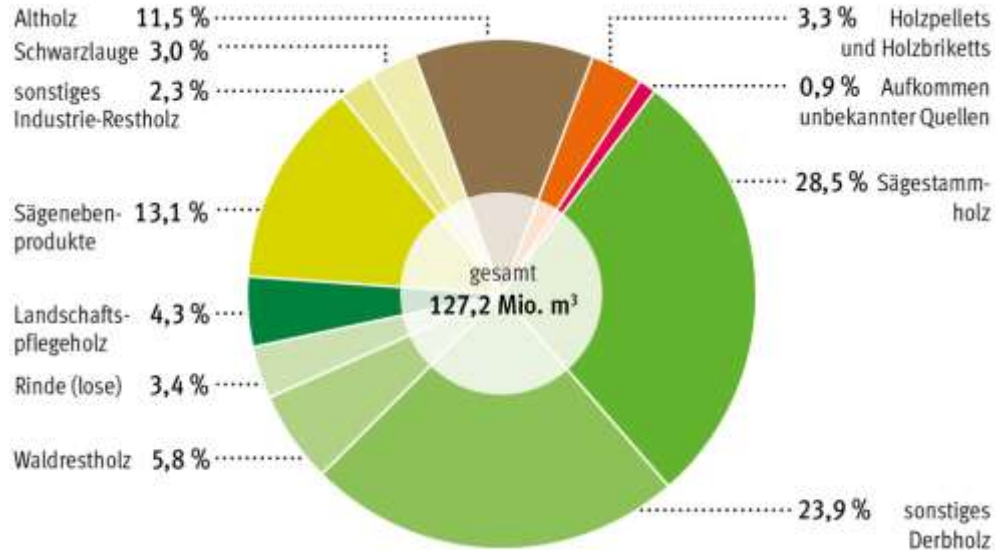
Political
framework
conditions?

89 %
Energetic use
11 %
Material use

- Agricultural area 2023: ~ 16,6 M ha
- thereof 82 % Food/feed und 15 % renewable resources

Potentials: Forests and timber industry

Amount in Germany 2016



55%
roundwood

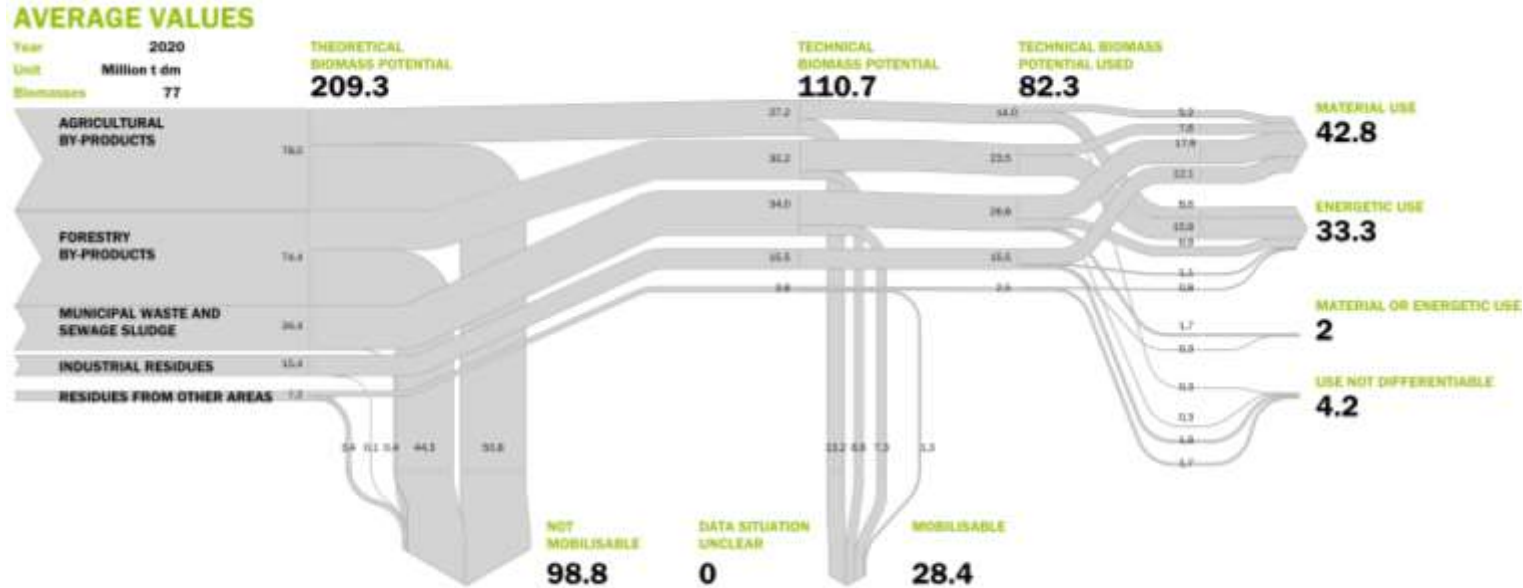
45 %
byproducts

100 %

In use
50% energy
50% material

Potentials: Biogenic wastes and residues in Germany

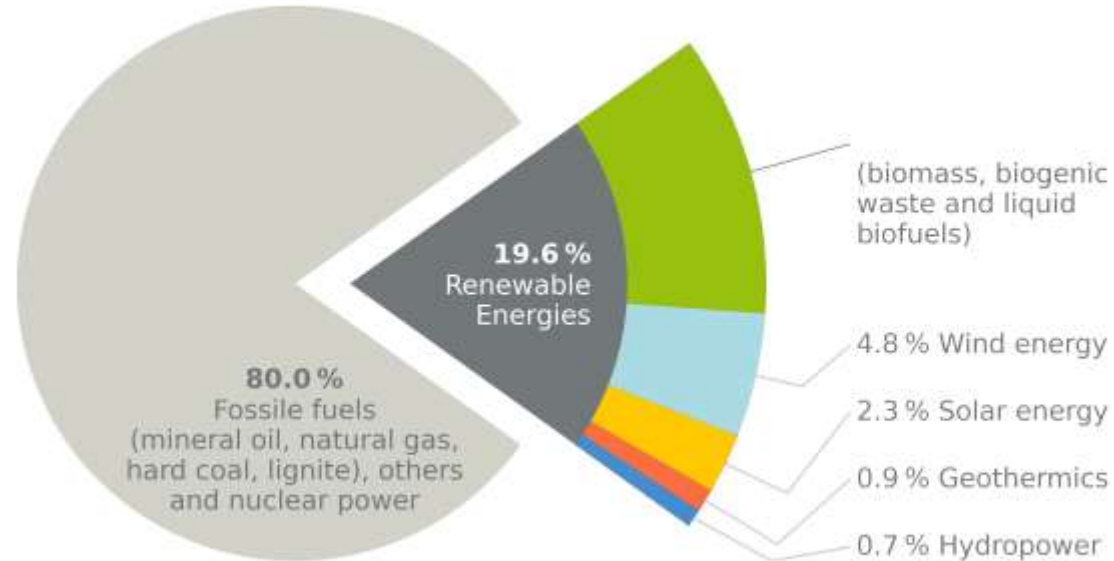
Overview



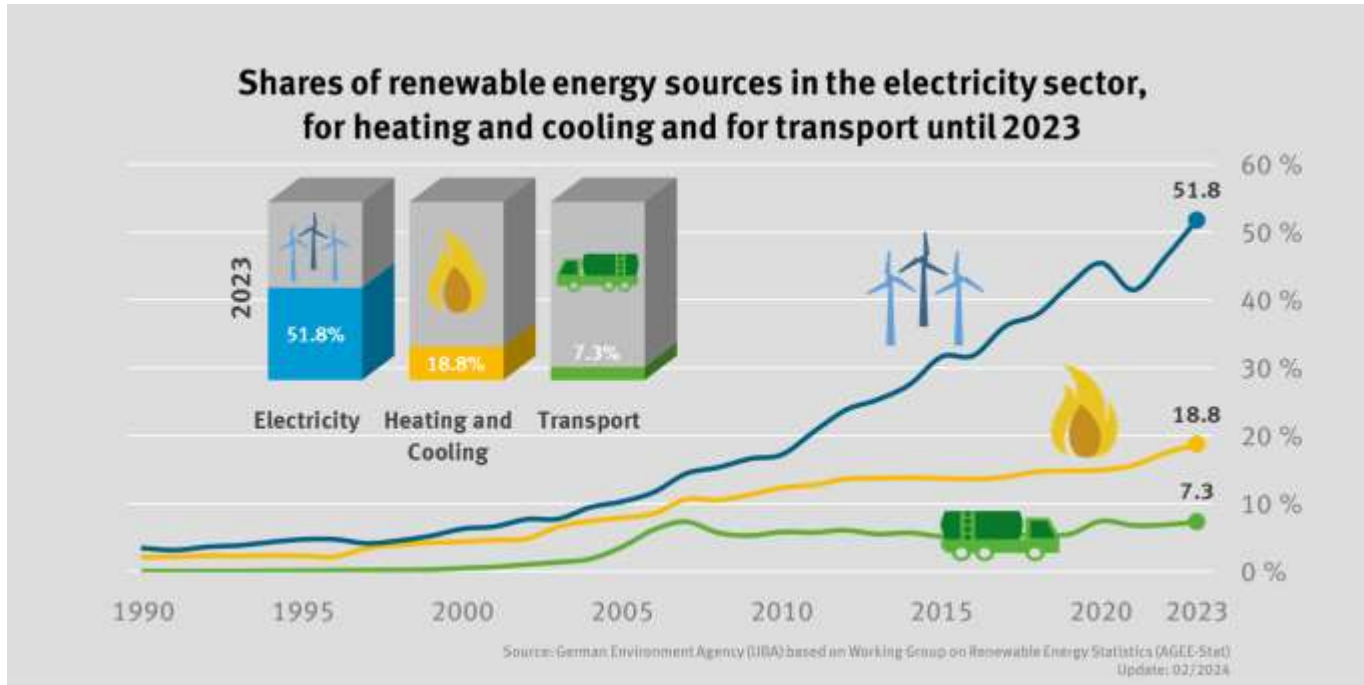
Status: 01.10.2024 (unpublished results)

Biomass in the national energy system of Germany 2023

Share of renewable energies in national primary energy consumption
(total: 10.791 PJ)

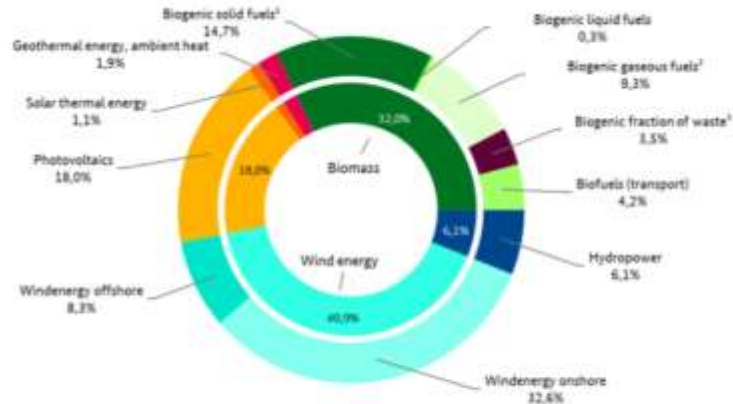


Renewable energy sources in Germany



Avoided CO₂-emissions by renewables in Germany 2022

Total: 231,9 million tons CO₂-equivalents



32% from biomass

¹ Incl. sewage sludge, without charcoal; ² biogas, biomethane, sewage gas and landfill gas; ³ biogenic fraction of waste in waste incineration plants estimated at 50%
Source: AGEE-Stat based on data of the German Environment Agency (UBA) as of February 2023



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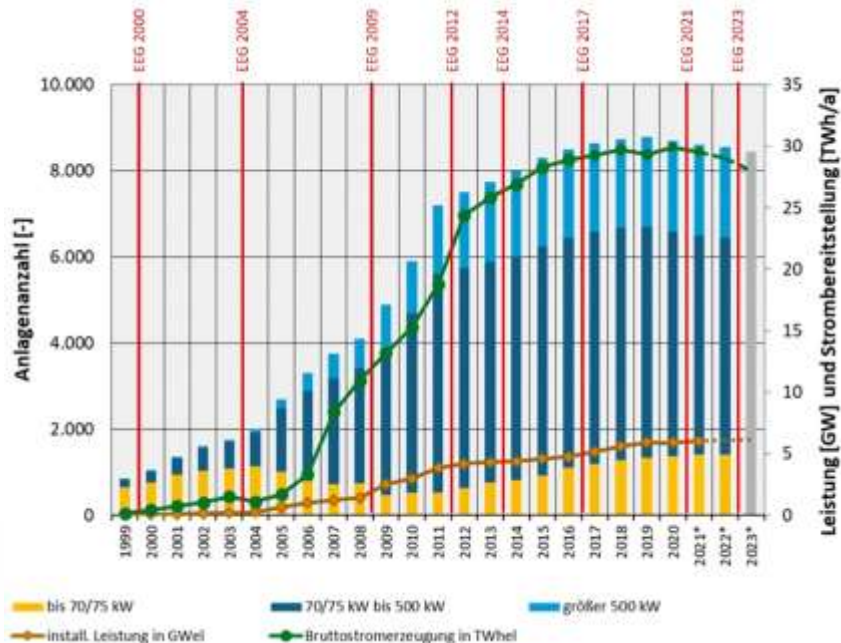
EXAMPLE: BIOGAS & BIOMETHAN IN GERMANY

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Biogas – past, present and future outlook under current conditions

Development of the biogas plant stock

Composition of the biogas plant stock



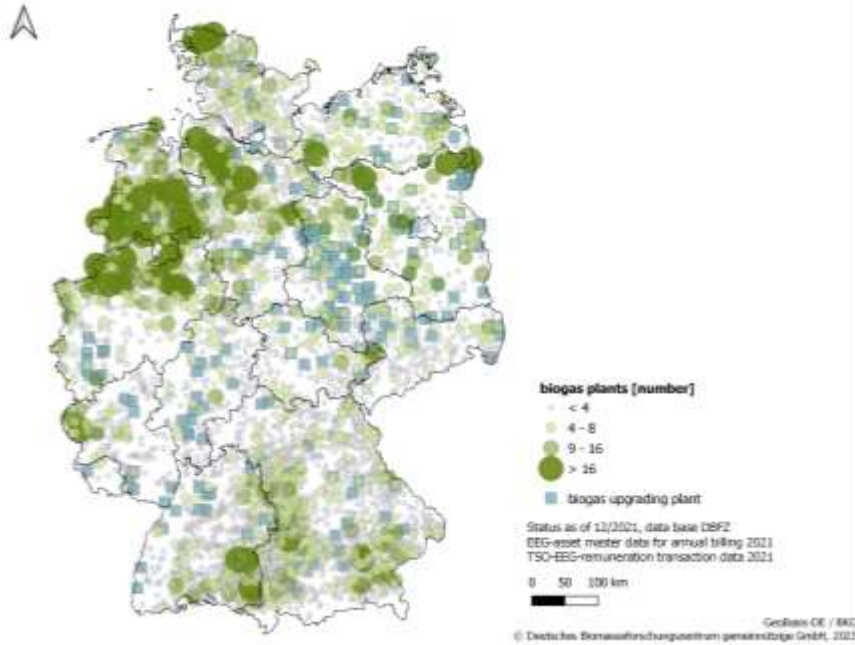
Distribution biogas plants

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	17.5³⁾
Agriculture	~8,300 ²⁾	6,224	27.2	16.9
Organic waste ³⁾	~280 ²⁾	226	1.0	0.6
Biomethane	239 (1,204)⁴⁾	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	270⁴⁾	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).

Source: DBFZ (11/2022)

Biogas – past, present and future outlook under current conditions



Biogas plants (2022*) ~ 8,750 plants
(including shutdowns)

- ~ 8,500 on-site electricity conversion of biogas
- ~243 upgrading to biomethane

Installed electrical capacity



→ 7.2 GW_e

Gross electricity production

→ 31.4 TWh_e

Heat supply

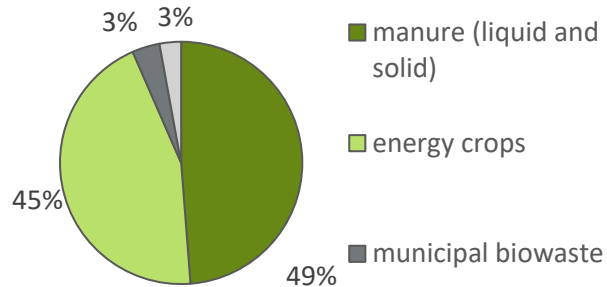


→ 18.4 TWh_{th}

Biogas – past, present and future outlook under current conditions

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

mass-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

Biogas – past, present and future outlook under current conditions

Future political framework conditions: NABIS

Utilisation hierarchy



1. Food guaranty (Food/Feed)
2. Material utilisation
3. Energy utilisation

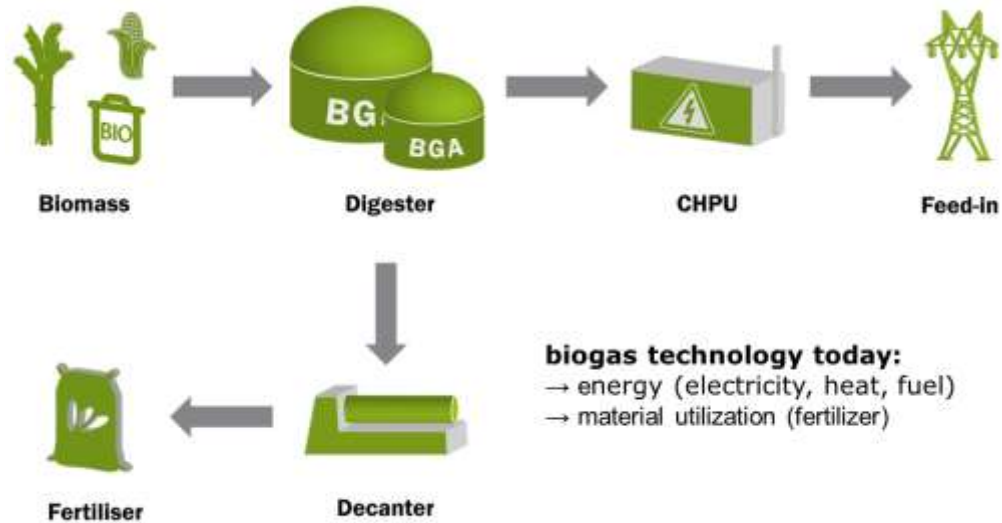
Establishment of a circular economy, multiple utilisation/Cascade and coupling utilisation

What can already be recognised with regard to input materials?

- The use of cultivated biomass to generate electricity in Germany should not be expanded further and should be gradually reduced
- In medium and long term, biomass electricity generation based on residual and waste materials is set to gain in importance

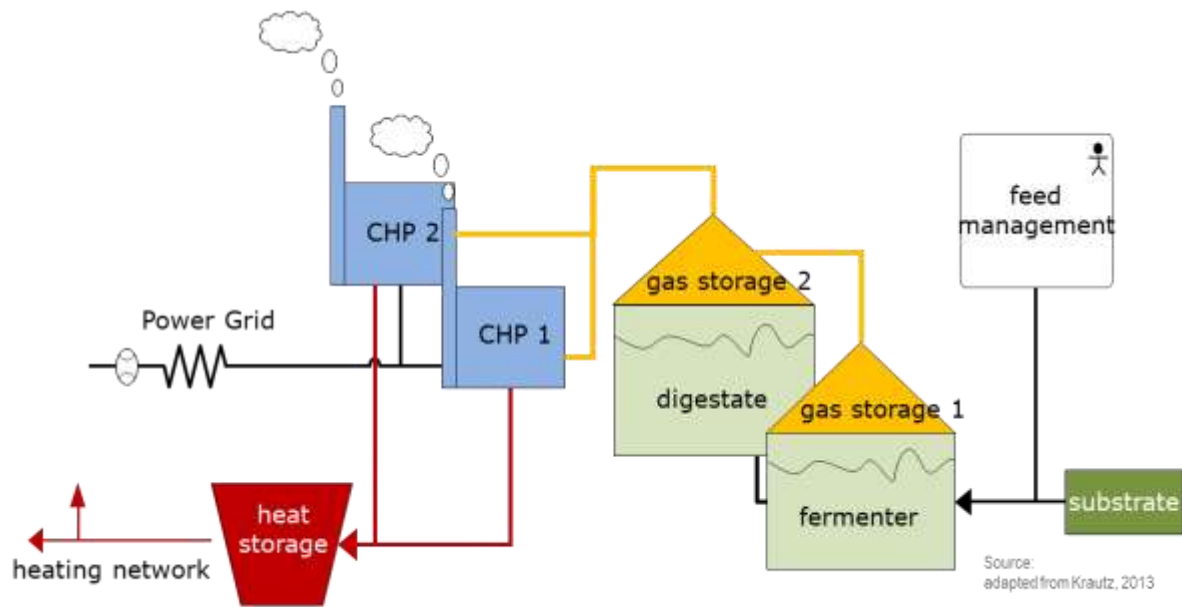


Biogas – past, present and future outlook under current conditions – current biogas concepts

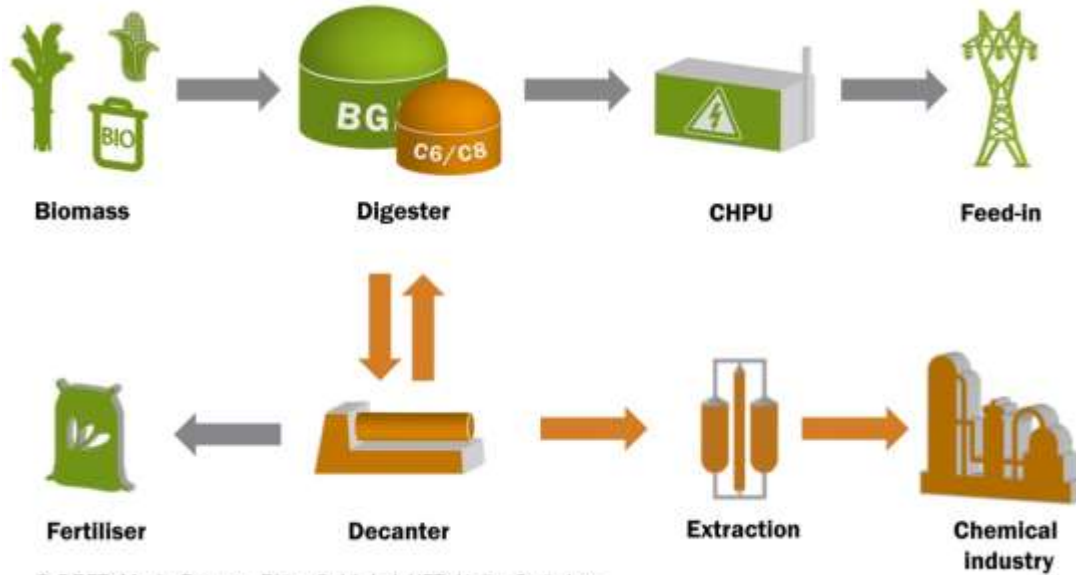


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Biogas – past, present and future outlook under current conditions – options for flexible biogas production



Biogas – past, present and future outlook under current conditions – biogas concepts in the future



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Future applications of biomethane

short/medium –term

medium/long-term

medium/long-term



Biomethane-CHP especially in urban regions with gas infrastructure

Biomethane as transportation fuel (CNG, LNG, perspective fuel cell)

Biomethane for industrial processes (process steam)



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CONCLUSION AND OUTLOOK

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Energy from biomass in Germany – conclusion and outlook

- **Climate-neutral economy and society by 2045 needs an Renewable Energy System and a well developed bio based economy with an optimal combined material and energetic use of biomass!**
- **Still more than 80% of primary energy demand** are supplied by **fossil energy sources** and bioenergy is the most important renewable energy source.
- **Sustainable biomass potential is limited** and conflicting to food and feed, material purposes and biodiversity targets.
- **Biomass resources are limited, but of great important as flexible element:**
 - link between fluctuating renewable energies
 - defossilization of transport sector and industrial sector, including negative emissions
 - Added value by providing eco-system services
 - Due to high energy prices (gas, electricity, heat) the attractiveness of bioenergy is increasing in all kind of sectors (price spread between fossil and renewable energies is decreasing)
 - Contribution to security of supply and independent energy supply with a high share of renewable energies of great importance, including energy from biomass



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