Deutsches Biomasseforschungszentrum
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The state of manure management and biogas in Germany
A recent survey of biogas plant operators (2020)

Britt Schumacher, Nadja Rensberg, Walter Stinner





Progress in Manure & Digestate 2021 – International Online Conference by IBBK, Germany, 25.-27.01.2021

Challenges in China & Germany

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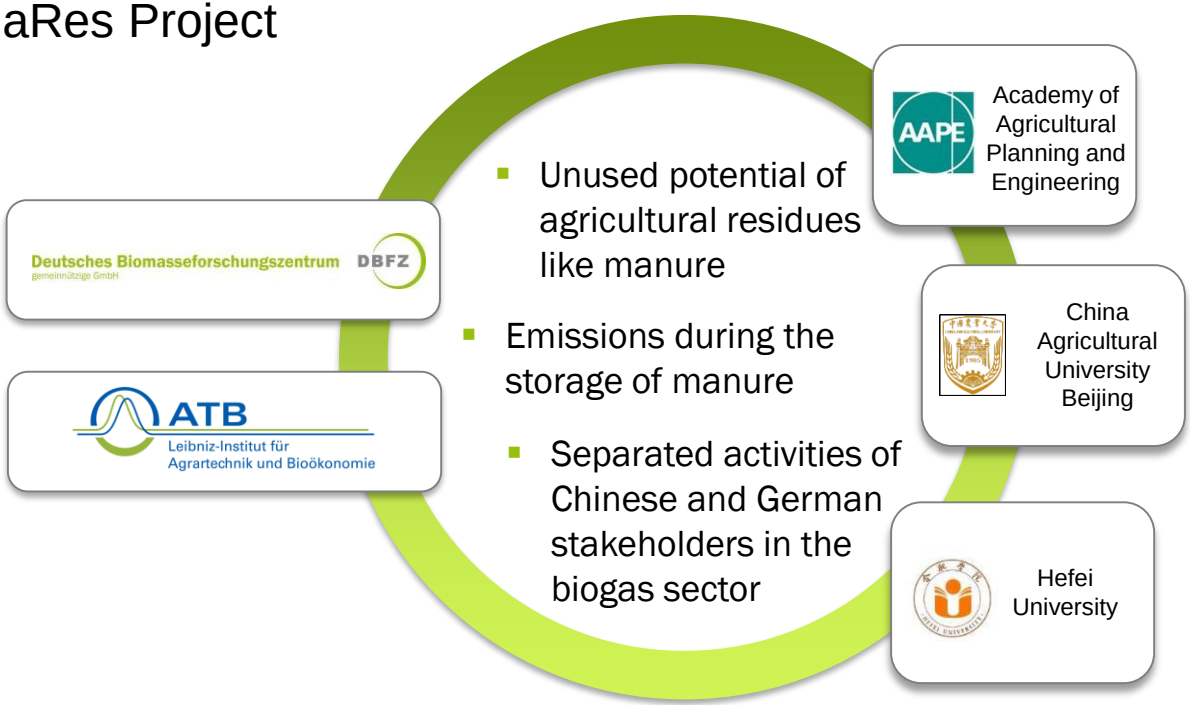
Scientists are facing challenges

➡ ChinaRes Project



ChinaRes Project

Duration: November 2017 – July 2021

Funding: Federal Ministry of Food and Agriculture

Funding code: 22025816

With support from

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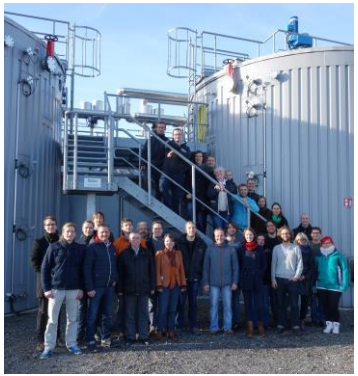
We are fostering the utilization of agricultural residues & emission reduction in the biogas sector in China & Germany via

- Identification of best-case plant concepts (barn, manure management and biogas plant)
- Identification of barriers for the energetic use of agri-residues
- Development of technical concepts for a better design and a coordinated operation of barn and biogas plant
- Comparison of results of China - Germany
- Networking activities amongst Chinese and German stakeholders



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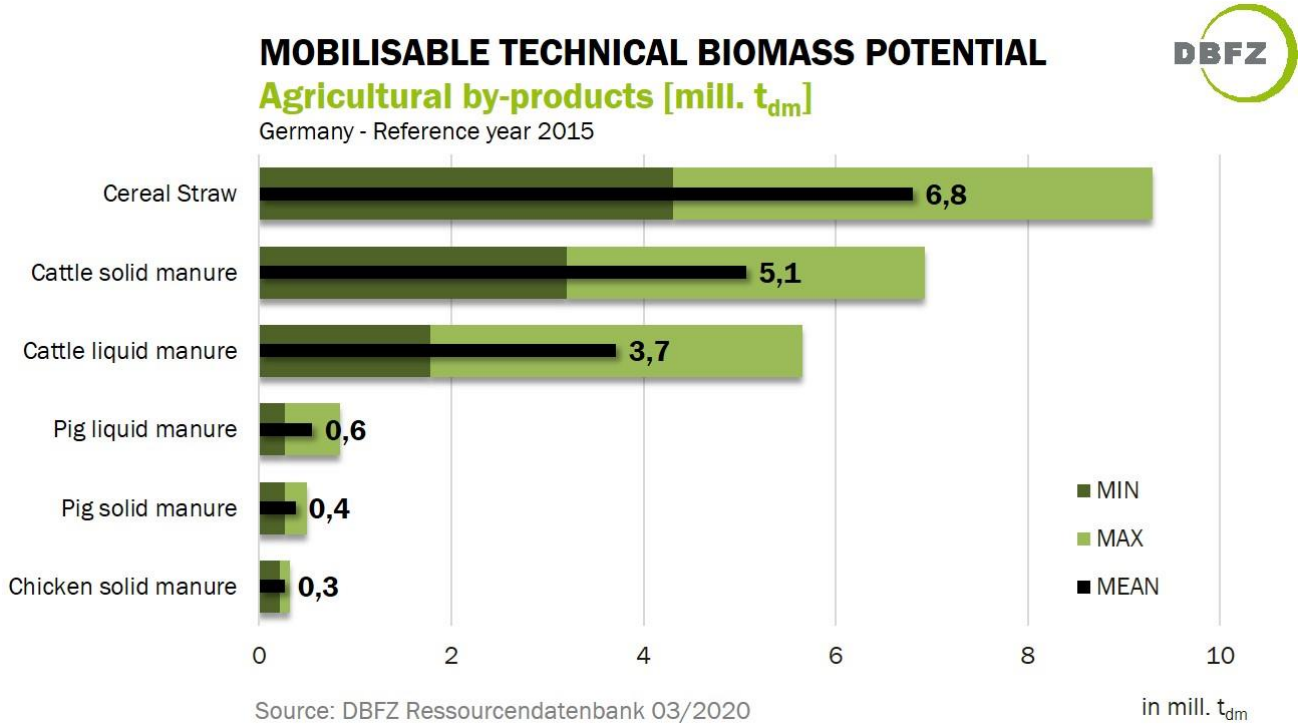
Have a look at:
https://www.dbfz.de/projektseiten/chinares/projekt

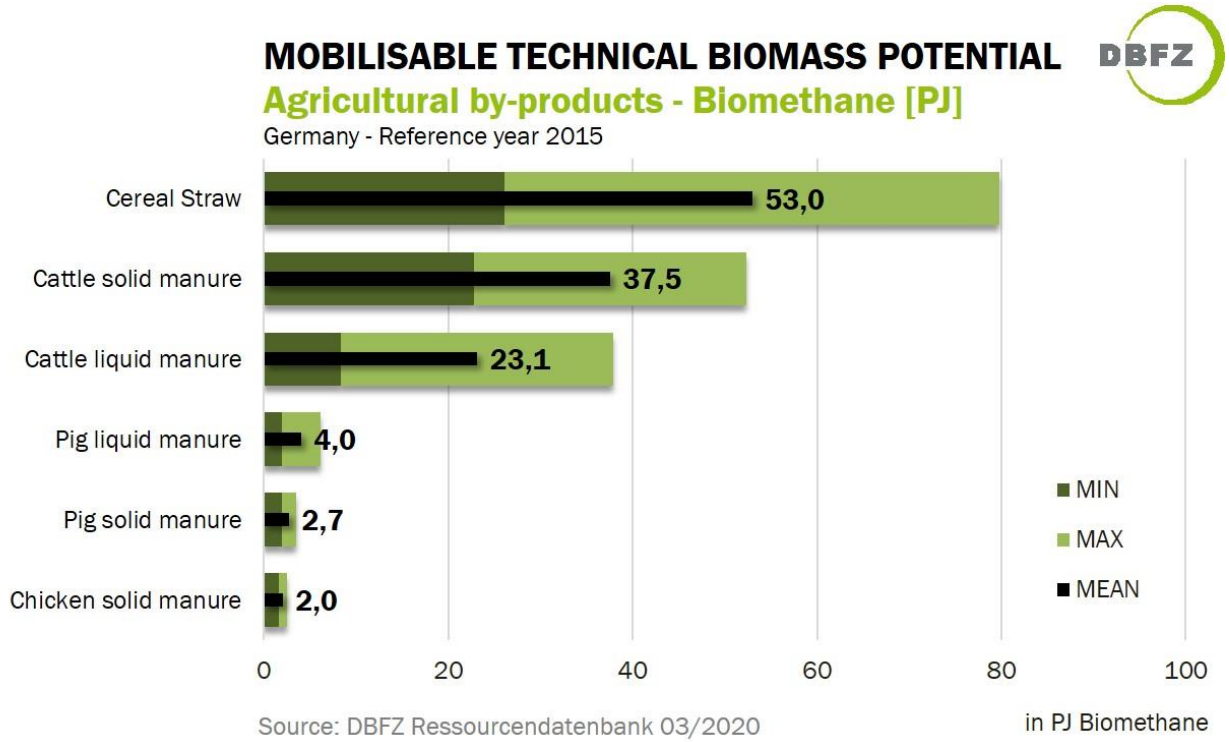
Agricultural biomass potential in Germany
Top 6

Mobilisable technical biomass potential in Germany (mass-related)



DBFZ, Krause & Brosowski 2020

Mobilisable technical biomass potential in Germany (energy-related)

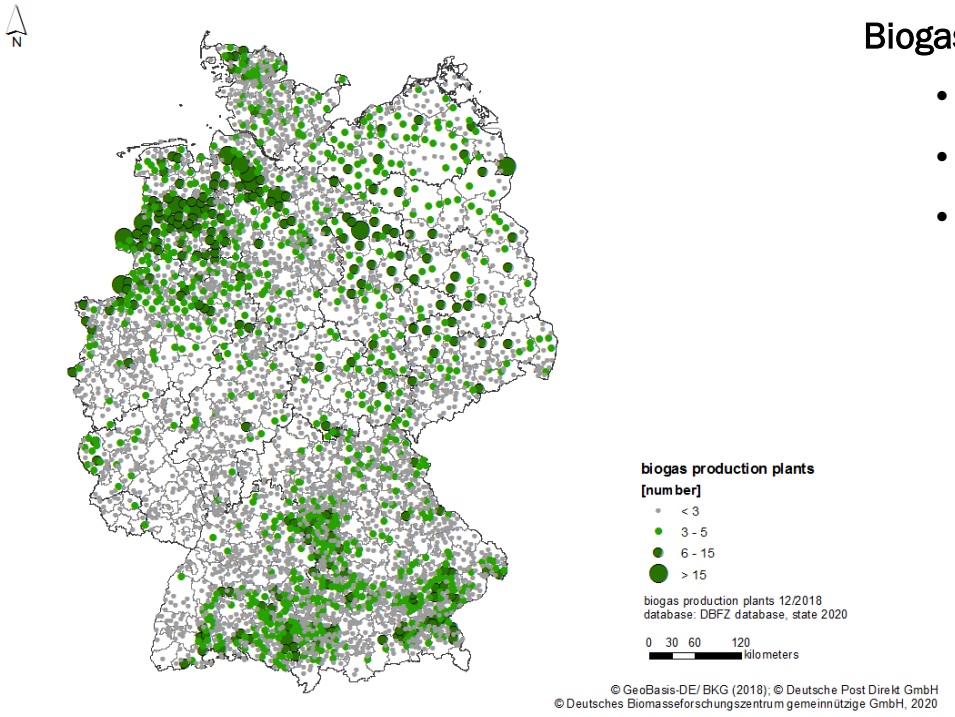


DBFZ, Krause & Brosowski 2020

DBFZ biogas database & DBFZ biogas plant operator surveys 2020

Basic data (reference year 2019)

Biogas plants in Germany (2019)



© DBFZ, biogas database, state 6/2020

Biogas plants (2019): ~9,100 plants

- ~ 8,900 on-site electricity conversion of biogas
- ~200 upgrading to biomethane
- focus on northwest and southern Germany

Installed electrical capacity

→ 5.9 GW_{el}

Gross electricity production

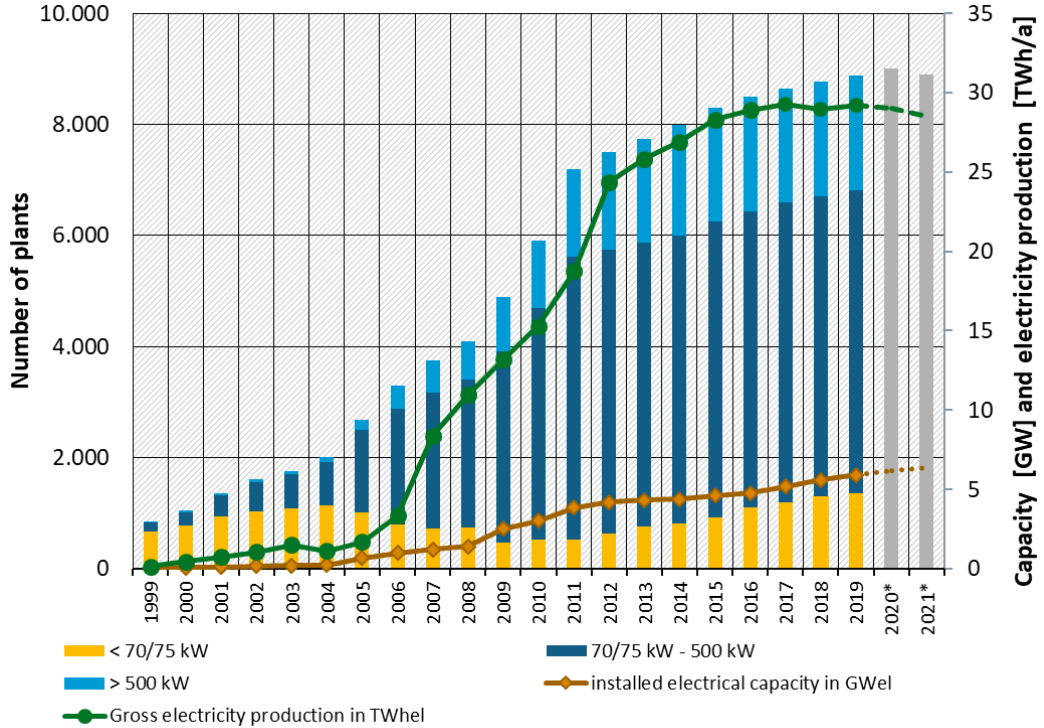
→ 31.9 TWh_{el}

Heat supply

→ 19.3 TWh_{th}

Development of biogas plants

Installed capacity and number of plants



- no significant increase since 2012
- **Predominant: capacity expansion of existing plants** (motivated by flexibility supplement/premium)
- New construction limited to manure-based small-scale biogas plants (< 75 kW_{el}) and few other plants for biowaste digestion

Database: BNetzA, AGEE-Stat, database DBFZ, small scale manure based biogas plants uo to 75 kWel from 2012 shwon in category „70/75kW“; installed electric capacity and electricity generation according to AGEE-Stat (BMWI 2020), *estimation DBFZ, DBFZ 5/2020.

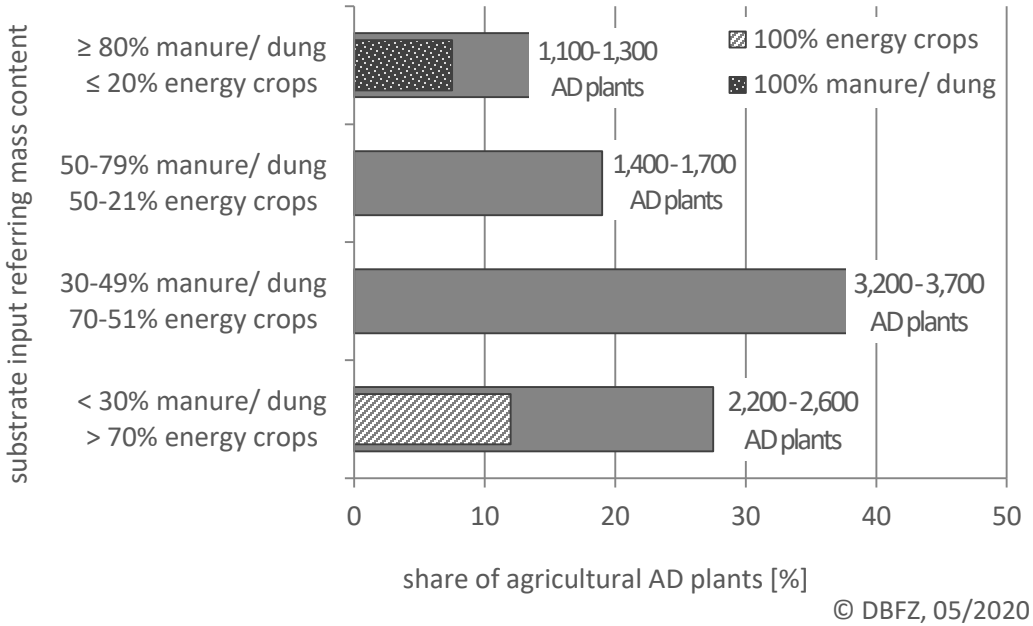
Biogas production according to substrate input and type

Type of biogas production plant (on-site electricity generation)	Number of plants 2019	Number of plants 2020*
Agricultural biogas plants	approx. 8,550	8,600
thereof smale scale manure based biogas plants (≤ 75 kW)	880	925
AD plants based on organic waste/manure/ energy crops (share of organic waste < 90 %, mass based)	approx. 200	approx. 200
Biowaste plants (share of organic waste ≥ 90 %, mass based)	137	138
Biogas production plants in total	approx. 8,900	approx. 8,950

DBFZ biogas database 10/2020, * estimation

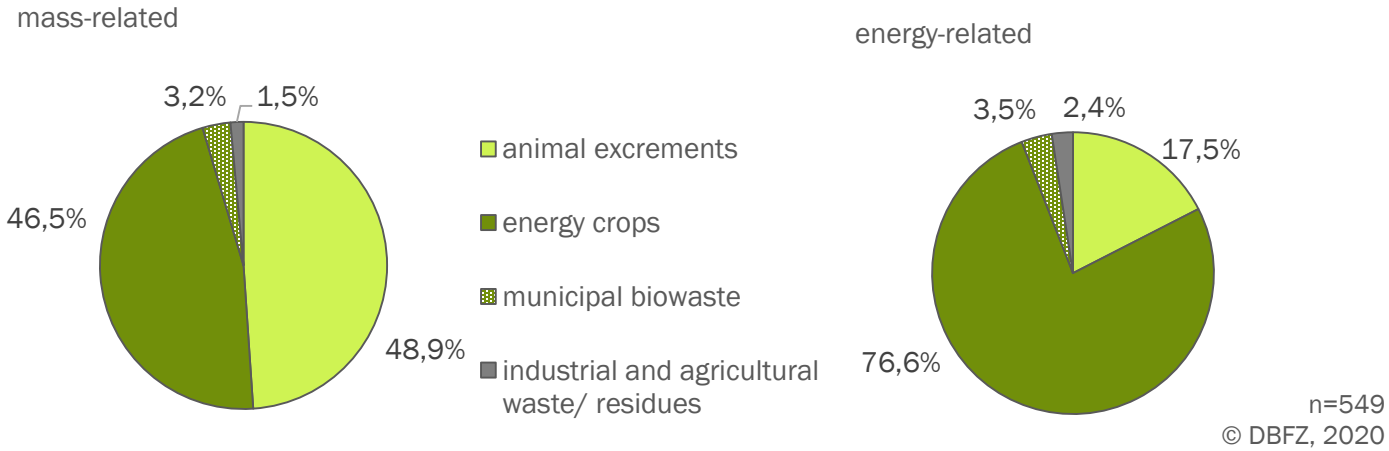
Agricultural biogas plants and feedstock

- Very different proportions of animal excrement in the substrate input for biogas production
- About 5,800 plants with a share of > 30% animal excrements
- Biogas plants with share of 51-70% energy crops at substrate input dominate agricultural biogas plants
- In recent years, the construction of new biogas plants has almost been exclusively based on small liquid manure plants



DBFZ biogas database 5/2020, DBFZ plant operator surveys

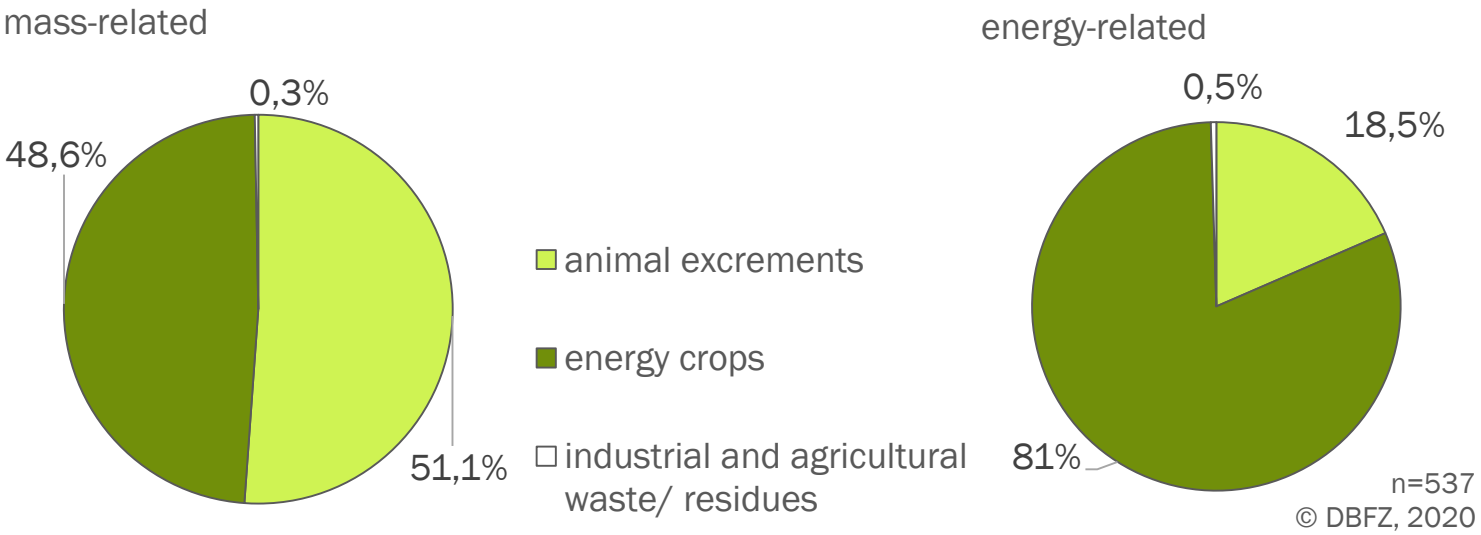
Substrate input of biogas production
(On-site power generation)



- Animal excrements and renewable raw materials account for around 95% of the substrate input for biogas production (based on the quantities used)

DBFZ plant operator survey 2020, reference year 2019

Substrate input agricultural biogas plants
(On-site power generation)

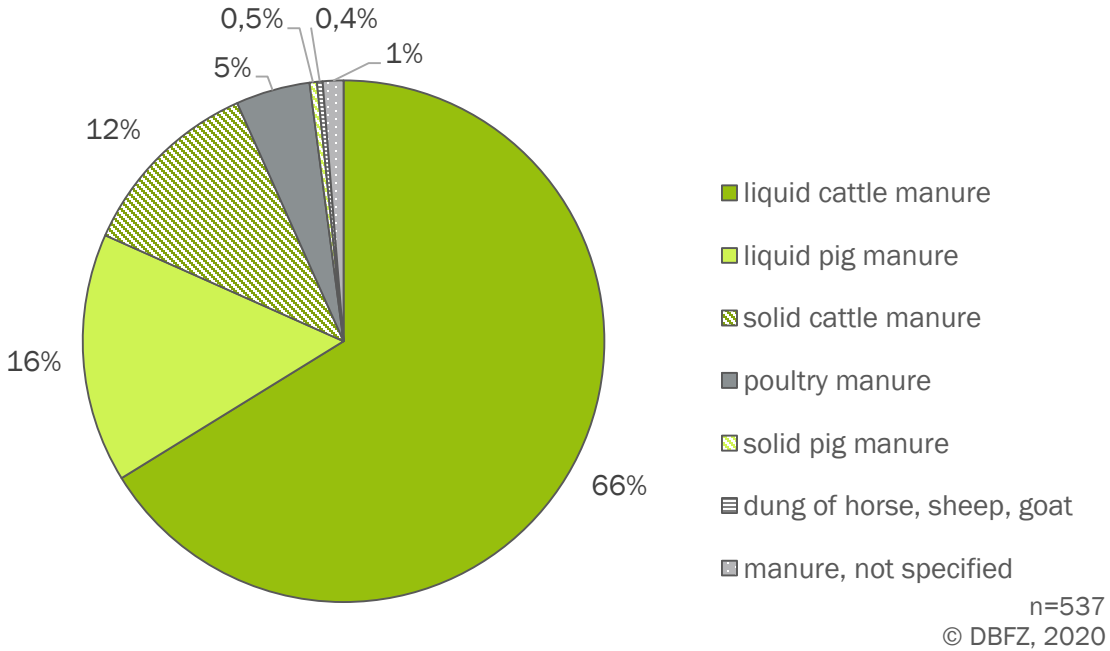


DBFZ plant operator survey 2020, reference year 2019

Utilisation of manure in agricultural biogas plants

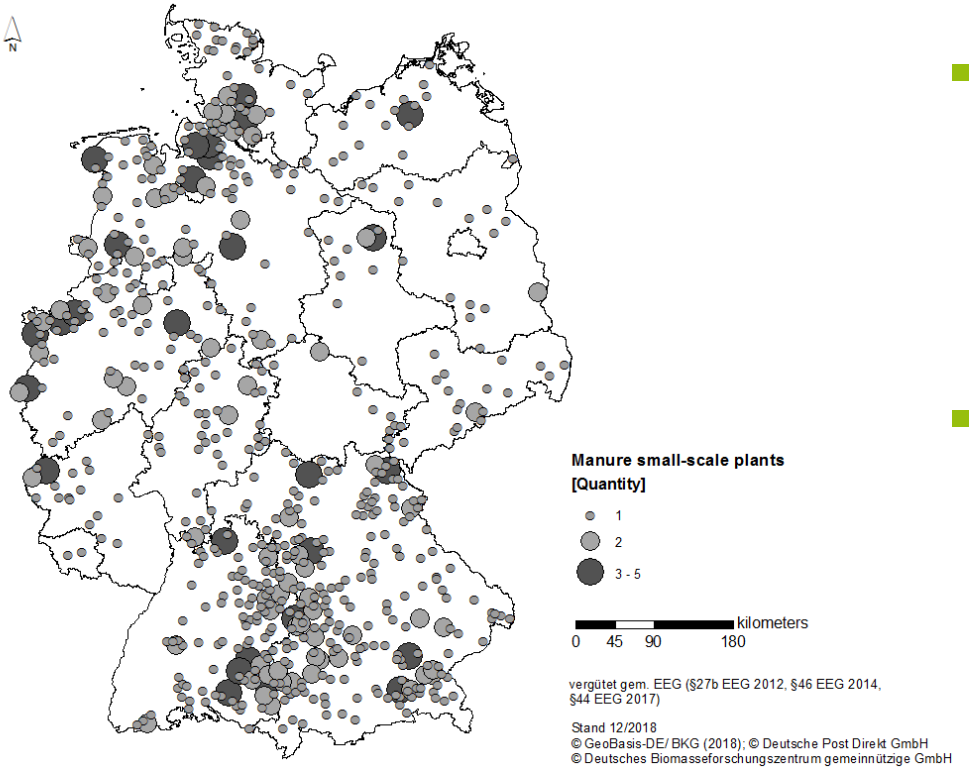
Mass-related distribution

- liquid cattle manure accounts for around 66% of the quantities of animal excrements used in biogas plants



DBFZ plant operator survey 2020, reference year 2019

Small-scale biogas plants - AD of manure

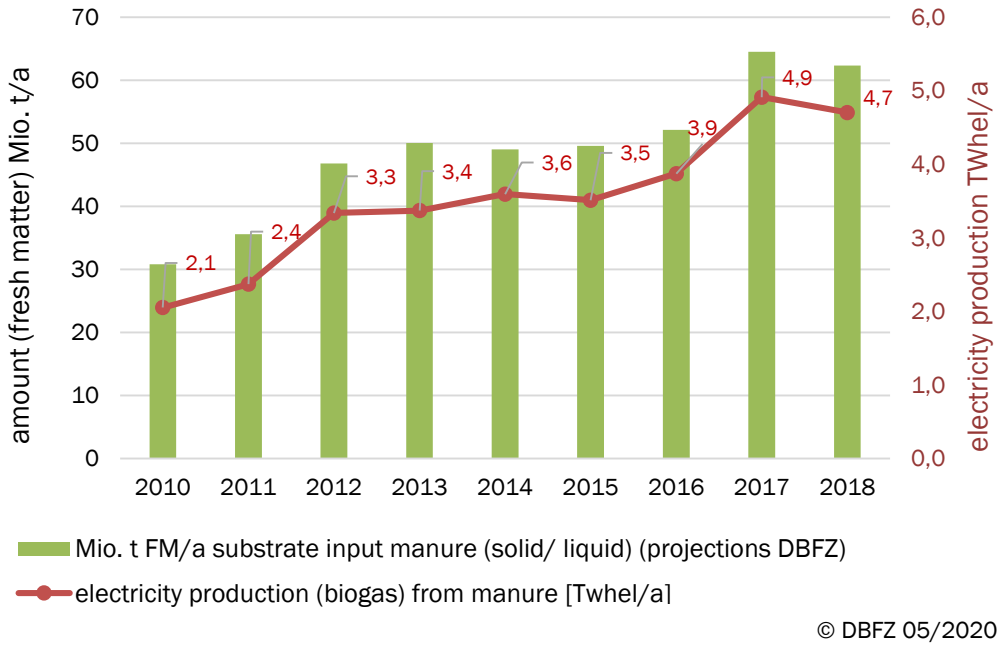


- as of end of 2019: approx. 900 manure-based small-scale plants in operation (remunerated according to EEG*)
- regional focus of the plants in southern and northwestern Germany

* § 27b EEG 2012 / § 46 EEG 2014 / § 44 EEG 2017

DBFZ biogas database 2019

Development of manure utilisation for electricity production from biogas in Germany



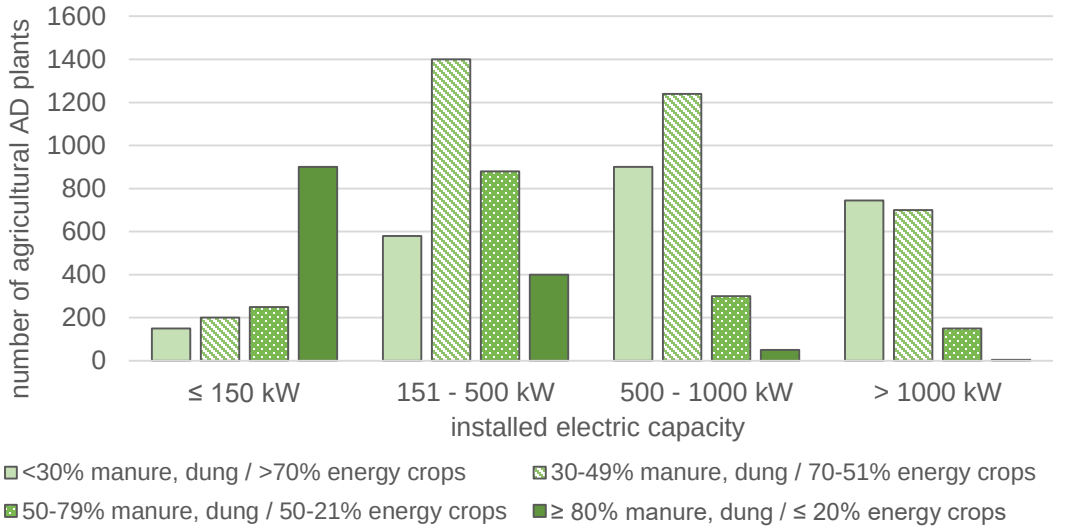
- Electricity production from manure in total about 4.7 TWh_{el}/a
- approx. 0.4 TWh_{el}/a from manure-based small-scale biogas plants

With about 62 million t/a of manure, about 40% of the available quantities of manure are used in biogas plants.

Source: Scholwin et al. (2018): Aktuelle Entwicklung und Perspektiven der Biogasproduktion aus Bioabfall und Gülle. FKZ 37EV 17 104 0

Agricultural biogas plants and feedstock

- in the power range ≤ 150kW, biogas plants with a high proportion of liquid and solid manure in the substrate input predominate (including manure based small-scale biogas plants)
- with increasing plant capacity the share of energy crops in the substrate input increases



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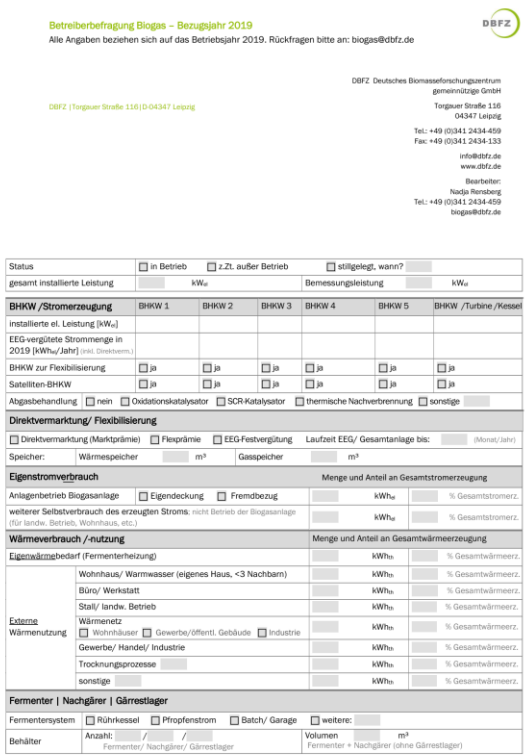
DBFZ biogas database 6/2020, DBFZ plant operator surveys

DBFZ biogas plant operator surveys 2020

Manure management and biogas plants (reference year 2019)

DBFZ biogas plant operator survey 2020

- Written survey
- Carried out in spring 2020
- Reference year 2019
- Recording of parameters on biogas plant technology, operation of the plant, substrate input, agricultural business and manure management



Betreiberbefragung Biogas – Bezugsjahr 2019

Alle Angaben beziehen sich auf das Betriebsjahr 2019. Rückfragen bitte an: biogas@dbfz.de

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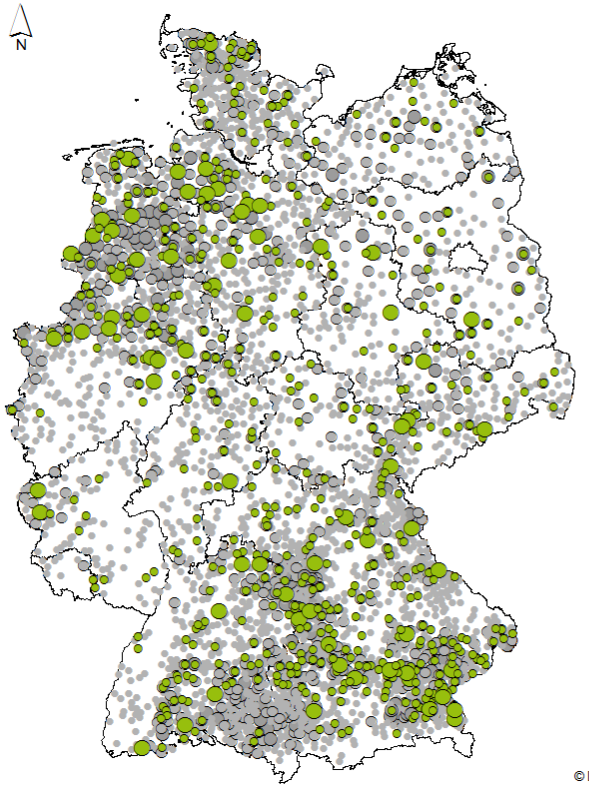
Status	☐ in Betrieb ☐ z.Zt. außer Betrieb ☐ stillgelegt, wann?					
gesamt installierte Leistung	kW$_{el}$		Bemessungsleistung	kW$_{el}$		
BHKW /Stromerzeugung	BHKW 1	BHKW 2	BHKW 3	BHKW 4	BHKW 5	BHKW /Turbine /Kessel
installierte el. Leistung [kW$_{el}$]						
EEG-vergütete Strommenge in 2019 [kWh$_{el}$/Jahr] (inkl. Direktverm.)						
BHKW zur Flexibilisierung	☐ ja	☐ ja	☐ ja	☐ ja	☐ ja	☐ ja
Satelliten-BHKW	☐ ja	☐ ja	☐ ja	☐ ja	☐ ja	☐ ja
Abgasbehandlung	☐ nein ☐ Oxidationskatalysator ☐ SCR-Katalysator ☐ thermische Nachverbrennung ☐ sonstige					
Direktvermarktung/ Flexibilisierung						
☐ Direktvermarktung (Marktprämie) ☐ Flexprämie ☐ EEG-Festvergütung Laufzeit EEG/ Gesamtanlage bis: (Monat/Jahr)						
Speicher:	Wärmespeicher m³		Gasspeicher m³			
Eigenstromverbrauch	Menge und Anteil an Gesamtstromerzeugung					
Anlagenbetrieb Biogasanlage	☐ Eigendeckung ☐ Fremdbezug			kWh$_{el}$	% Gesamtstromerz.	
weiterer Selbstverbrauch des erzeugten Stroms: nicht Betrieb der Biogasanlage (für landw. Betrieb, Wohnhaus, etc.)				kWh$_{el}$	% Gesamtstromerz.	
Wärmeverbrauch /-nutzung	Menge und Anteil an Gesamtwärmeerzeugung					
Eigenwärmebedarf (Fermenterheizung)				kWh$_{th}$	% Gesamtwärmeerz.	
Externe Wärmenutzung	Wohnhaus/ Warmwasser (eigenes Haus, <3 Nachbarn)			kWh$_{th}$	% Gesamtwärmeerz.	
	Büro/ Werkstatt			kWh$_{th}$	% Gesamtwärmeerz.	
	Stall/ landw. Betrieb			kWh$_{th}$	% Gesamtwärmeerz.	
	Wärmenetz ☐ Wohnhäuser ☐ Gewerbe/öffentl. Gebäude ☐ Industrie			kWh$_{th}$	% Gesamtwärmeerz.	
	Gewerbe/ Handel/ Industrie			kWh$_{th}$	% Gesamtwärmeerz.	
	Trocknungsprozesse			kWh$_{th}$	% Gesamtwärmeerz.	
	sonstige			kWh$_{th}$	% Gesamtwärmeerz.	
Fermenter | Nachgärer | Gärrestlager						
Fermentersystem	☐ Rührkessel ☐ Pfropfenstrom ☐ Batch/ Garage ☐ weitere:					
Behälter	Anzahl: / / Fermenter/ Nachgärer/ Gärrestlager		Volumen m³ Fermenter + Nachgärer (ohne Gärrestlager)			

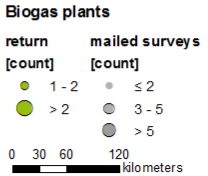
Betreiberbefragung Biogas – Bezugsjahr 2019 Fax an: 0341 – 2434 133, E-Mail: biogas@dbfz.de

	☐ Nutzung eigener ehemaliger Güllebehälter ☐ Nutzung fremder ehem. Güllebehälter ☐ Kombination/ beides					
Einbringung Feststoffe in BGA	☐ Feststoffeinbringung ☐ Vorgrube/ Anmaischung m. Gärrest ☐ Gülleabwurfschacht d. Stalles					
Gibt es einen nicht gasdicht geschlossenen (offenen) **Anmaisch-/Vorlagebehälter**?	☐ ja ☐ nein m³					
Abdeckung Gärrestlager und Volumen (Volumen Gärrestlager je nach Abdeckung eintragen!)						
m³ offen	m³ gasdicht (techn.) abgedeckt		m³ abgedeckt, nicht gasdicht			
Gärrestaufbereitung vorhanden?	☐ ja ☐ nein wenn ja, welche?:					
Landwirtschaftlicher Betrieb / Güllemanagement und Biogas						
Entmistung	☐ Schieber/ maschinelles tägliches Abschieben ☐ Spaltenboden ☐ eingestreuter Stall mit saisonaler Entmistung ☐ anderes					
Zeit zw. Gülleanfall und Einbringung in BGA	☐ bis 24h ☐ bis 7 Tage ☐ länger					
Bewerten Sie Ihre Anlage hinsichtlich genutzter Güllemanagementverfahren als vorbildlich?	☐ ja ☐ nein ☐ weiß nicht					
Baukosten der Biogasanlage	☐ < 4.000 €/kW$_{el}$ install. ☐ 4.000 – 8.000 €/kW$_{el}$ install. ☐ > 8.0000 €/kW$_{el}$ install. Angabe bezieht sich auf: ☐ Mehrkosten der Biogasanlage ☐ gemeinsame Einrichtungen Stall/ Biogasanlage					
Substrate						
Kreuzen Sie bitte jeweils an, ob sich die Mengenangaben auf Silage oder frische Ernte beziehen.	Eigenproduktion/Anbau			Zukauf/von extern		
	Menge [t/Jahr] Frischmasse	Kosten [€/t$_{FM}$] frei BGA		Menge [t/Jahr] Frischmasse	Preis [€/t$_{FM}$] frei BGA	Anzahl Zulieferbetriebe
Gülle ☐ Rind ☐ Schwein:						
Festmist ☐ Rind ☐ Schwein:						
☐ Geflügelmist ☐ Hühnertrockenkot						
Mais: frisch ☐ Silage ☐						
Ackergras: frisch ☐ Silage ☐						
Grünland: frisch ☐ Silage ☐						
GPS (Hauptfrucht), Art:						
Zwischenfrucht, Art:						
Getreidekorn:						
Reststoffe, welche?						
weitere:						
Perspektive nach Auslaufen der EEG-Vergütung						
Was planen Sie nach Auslaufen der EEG-Vergütung?	☐ Weiterbetrieb der Anlage ☐ Stilllegung ☐ aktuell keine Planung hierzu ☐ Interesse/Bedarf an Beratung ☐ Teilnahme an Ausschreibungen ☐ Eigenbedarf ☐ lokale Direktvermarktung ☐ Aufbereitung zu Biomethan ☐ KWK ☐ Kraftstoff ☐ ausschließlich Wärmenutzung) ☐ Reduktion der Substratmengen/ Gasproduktion ☐ sonstiges:					
Ist die Hofnachfolge für den Weiterbetrieb der Anlage gesichert?	☐ ja ☐ nein ☐ noch ungewiss, Grund					
Nachhaltigkeitszertifizierung von Biogasanlagen						
Die Nachhaltigkeitszertifizierung wird Mitte 2021 auf Strom und Wärme aus Biogas ausgeweitet. Haben Sie von dieser Änderung Kenntnis?	☐ ja ☐ nein ☐ nicht relevant für mich					
Haben Sie bereits Erfahrungen mit Nachhaltigkeitszertifizierungen?	☐ nein ☐ ja wenn ja: ☐ Selbsterklärung als Anbauer ☐ Zertifizierung der Biogasanlage					
Besteht Interesse an einer freiwilligen Zertifizierung der Biogasanlage?	☐ ja ☐ nein ☐ vielleicht					
Welche Herausforderungen sehen Sie bei der Zertifizierung einer/ Ihrer Biogasanlage?	☐ Bürokratie ☐ Aufwand/Kosten ☐ fehlendes Fachwissen ☐ THG- Berechnung ☐ sonstiges					

Vielen Dank für Ihre Unterstützung!

DBFZ biogas operator survey 2020





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	Questionnaires [number]
Dispatch	ca. 6,400
Return	630
Response rate	9 %

Manure removal systems in barn

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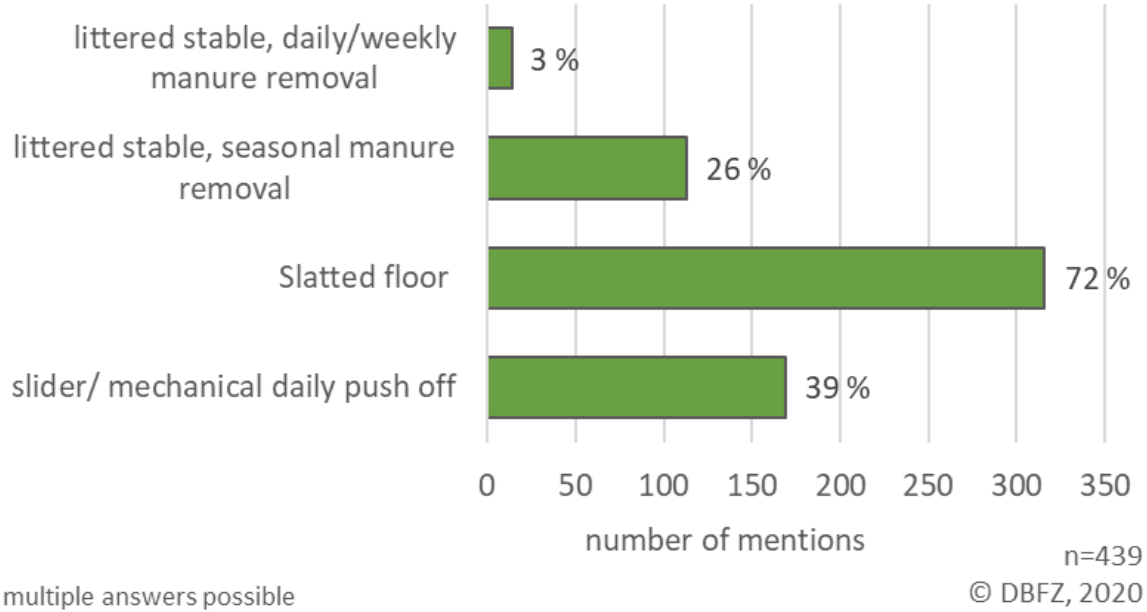

Slatted floor systems are predominant.

Storage period of manure before utilization for biogas production (I)

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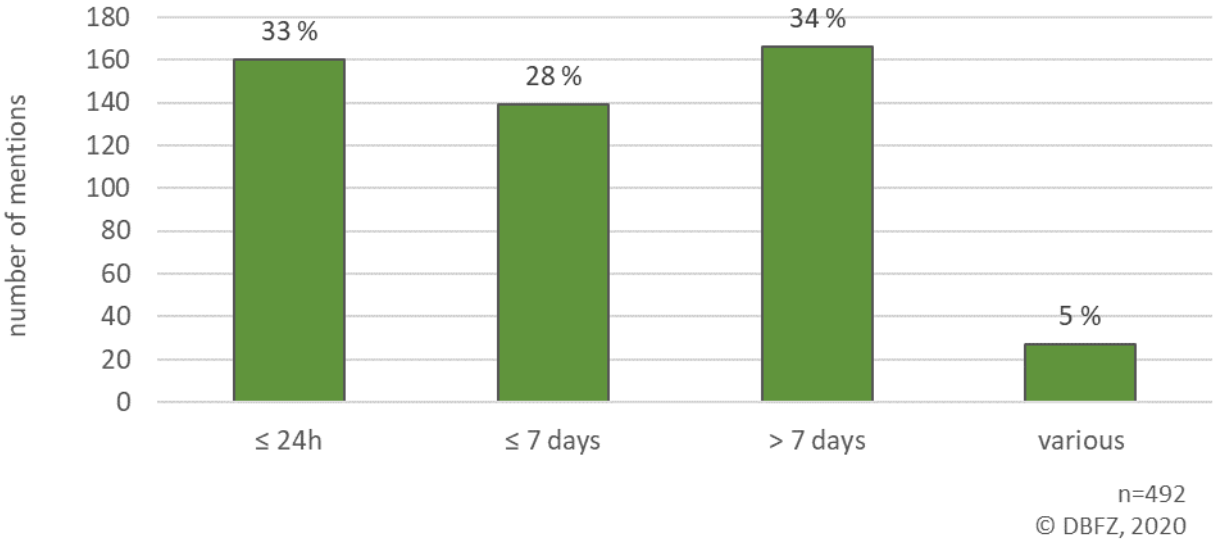

Equal distribution of responses on storage period of manure before use

Storage period of manure before utilization for biogas production (II)

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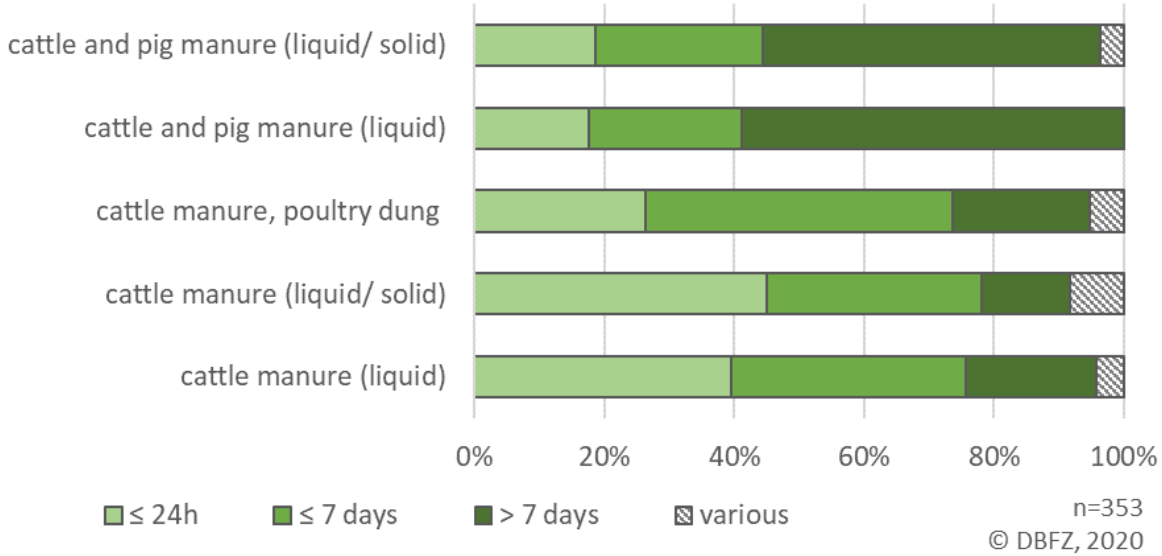
Type of substrate and storage period



The feeding of cattle slurry and solid manure into the biogas plant is often faster than other animal excrements.

Storage period of manure before utilization for biogas production (III)

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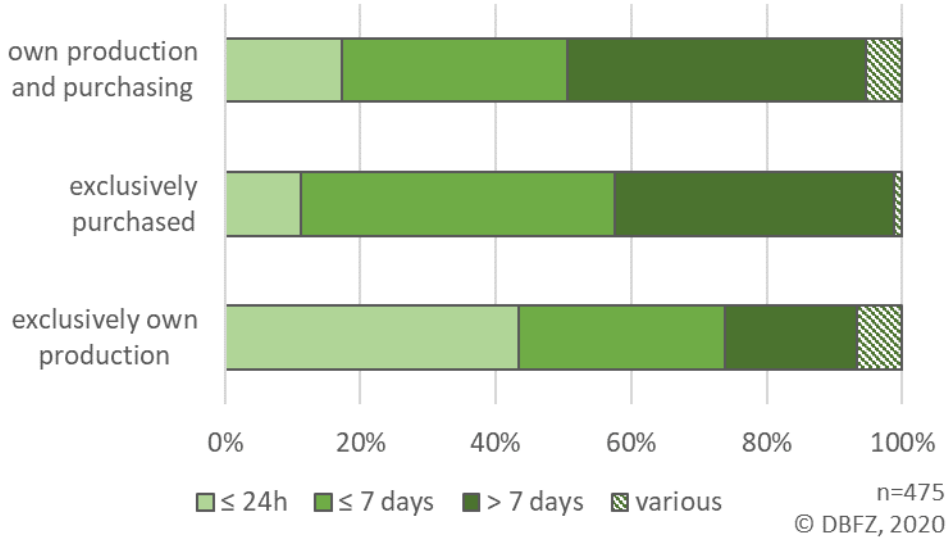
Origin of excrements



The storage periods of own manure tends to be shorter than for purchased manure.

Logistic challenge?

Solid substrate supply of biogas plants

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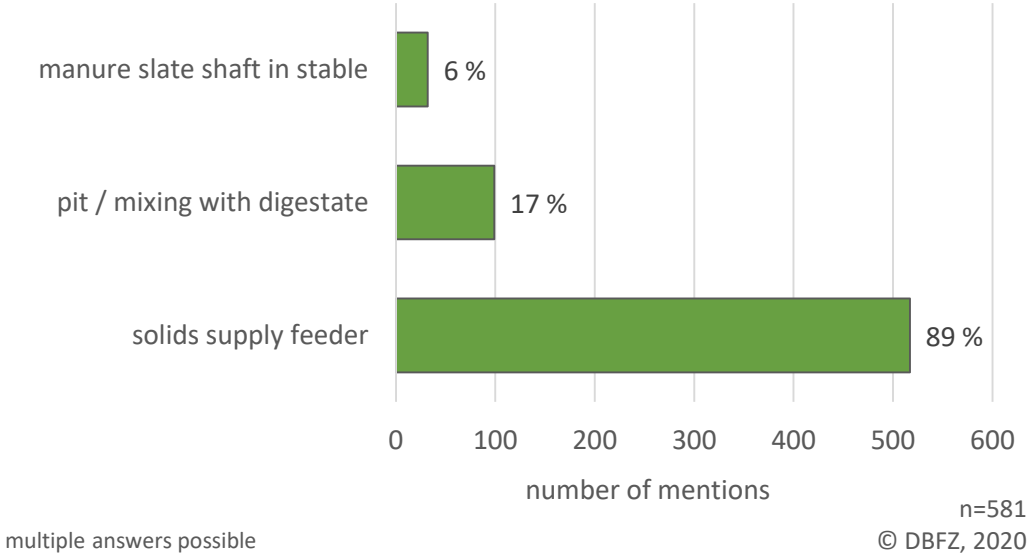

Solids supply feeders are predominant in biogas plants fed with solid substrates.

Self-assessment about manure management

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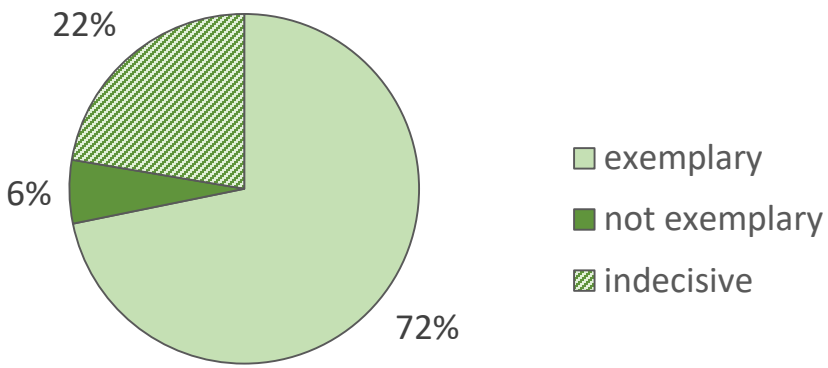

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Most of the biogas plant operators rate their manure management as very good.

DBFZ biogas plant operator surveys 2020

Construction costs for German biogas plants (reference year 2019)

Relation construction costs and excrement ratio of feedstock

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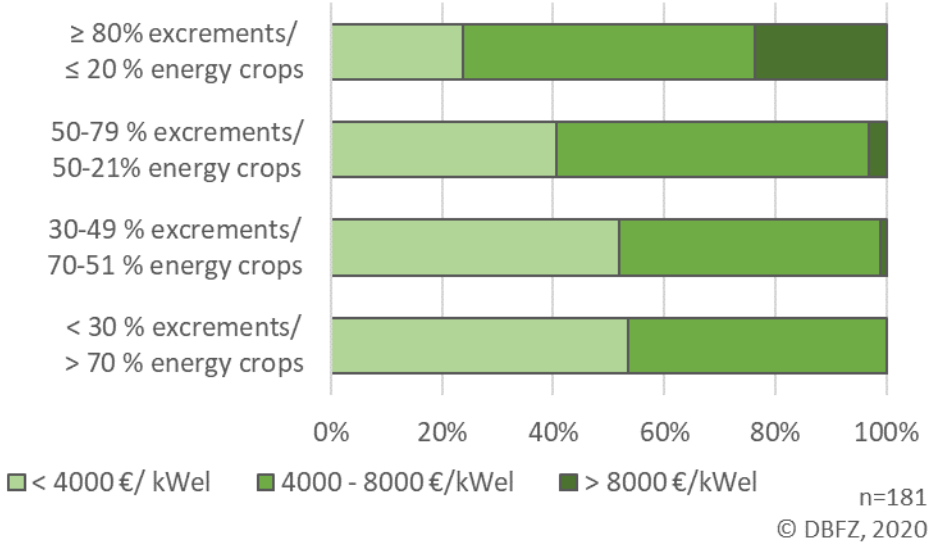

Construction costs (€/kWel) tend to be higher for biogas plants with a high share of excrements. The low energy density of liquid excrements (low biogas productivity per reactor volume) might be a reason.

Relation size and construction costs for biogas plant

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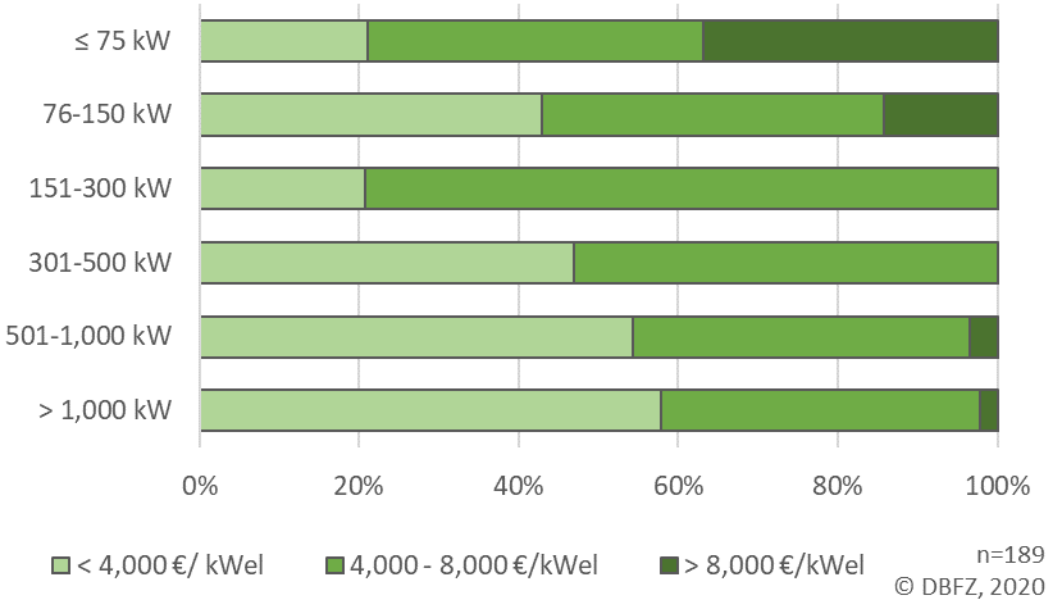

Construction costs (€/kWel) tend to be higher for small biogas plants. The low energy density of excrements might be a reason.
Addition of crop residues feasible?

Conclusion - biogas plant operator survey 2020 (data 2019)

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- The storage period of manure in/beside barns before use in biogas plants is up to 7 days in 60 % cases (33 % up to 24 h).
- The storage periods of own manure before use tend to be shorter than for purchased manure.
- Most of the biogas plant operators rate their manure management as very good.
- Construction costs (€/kWel) tend to be higher for biogas plants with a high share of excrements. Addition of crop residues feasible?

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Smart Bioenergy – Innovations for a sustainable future

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