

IEA Bioenergy Task 37: Country Report Germany

Jan Liebetrau; Velina Denysenko, Jaqueline Daniel Gromke



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- (1) Biogas plant inventory (year of reference 2015)**
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(1) Biogas plant inventory (2015)



Plant type	Number of plants	Electricity production ¹⁾ [GWh _{el} /a]	Heat production ²⁾ [GWh _{th} /a]
Sewage sludge	1,252	1,389	2,022
Biowaste	333: 133 ³⁾ + 200 ⁴⁾	1,294	551
Agriculture	8,000	31,097	13,225
Biomethane	187 (148 ⁵⁾)	2,599	2,924 ⁶⁾
Landfills	440	396	129
Total	10,212	36,775	18,851

1) excluding efficiency losses;

2) Heat utilization (external heat purposes excluding heat demand for biogas production); heat production from biogas and biomethane (without sewage and landfills) in 2015 16.7 TWh_{th} in total (AGEEstat); from biomethane-CHP according BNETZA; heat from biogas according to ratio of waste/agricultural plants

3) Substrate input according to § 27a EEG 2012, § 45 EEG 2014 (≥ 90% of biowaste of the whole input amount per year); biowaste = separate collected municipal waste (e.g. kitchen waste, green cut)

4) < 90% of biowaste of the whole input amount per year which is used for the biogas production (data as to 12/2015);

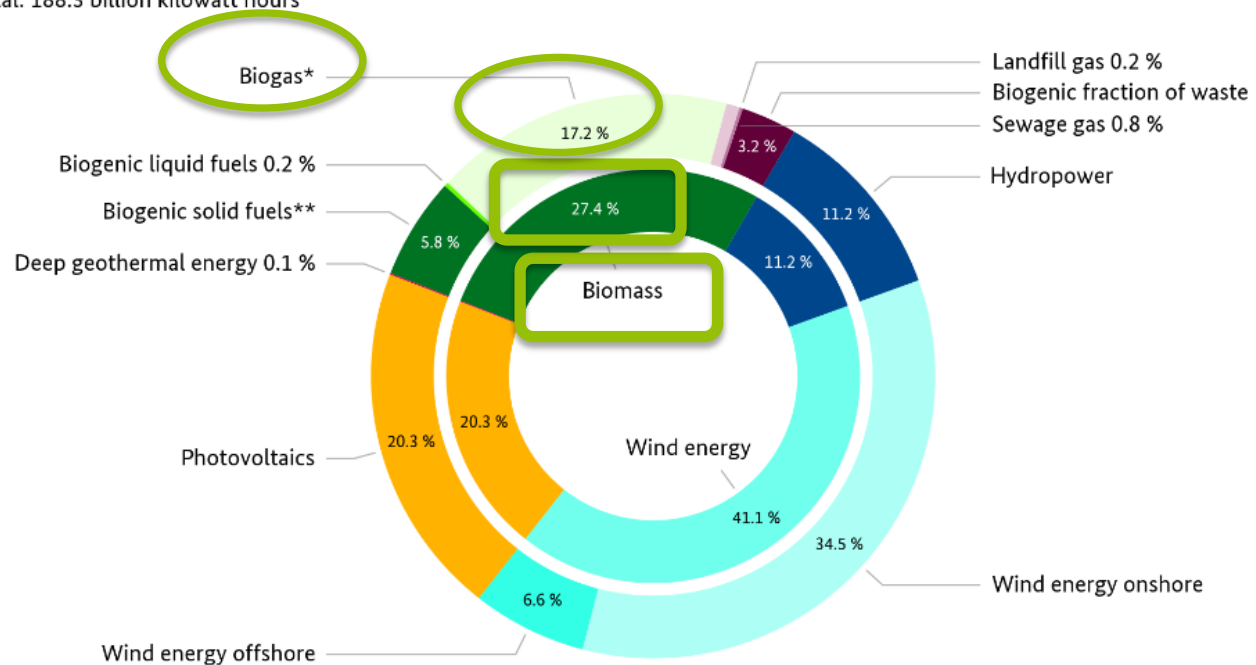
5) Biogas plants with upgrading technology to produce biomethane based on energy crops or energy crops in combination with manure.

6) Heat production resp. heat utilization from biomethane CHP; electricity production from biomethane according to BNETZA ; estimation heat production: electrical efficiency 40%, thermal efficiency 45%

Sources: numbers for sewage sludge and landfills based on the Federal Statistical Office (destatis), others according to the Federal Ministry for Economic Affairs and Energy (BMWi), as to 02/2017 - Development of Renewable Energy Sources in Germany based on the data of the Working Group of Renewable Energy Statistics (AGEE-Stat)

(2) Role of biomass and biogas within the renewables-based electricity generation in 2016 in Germany

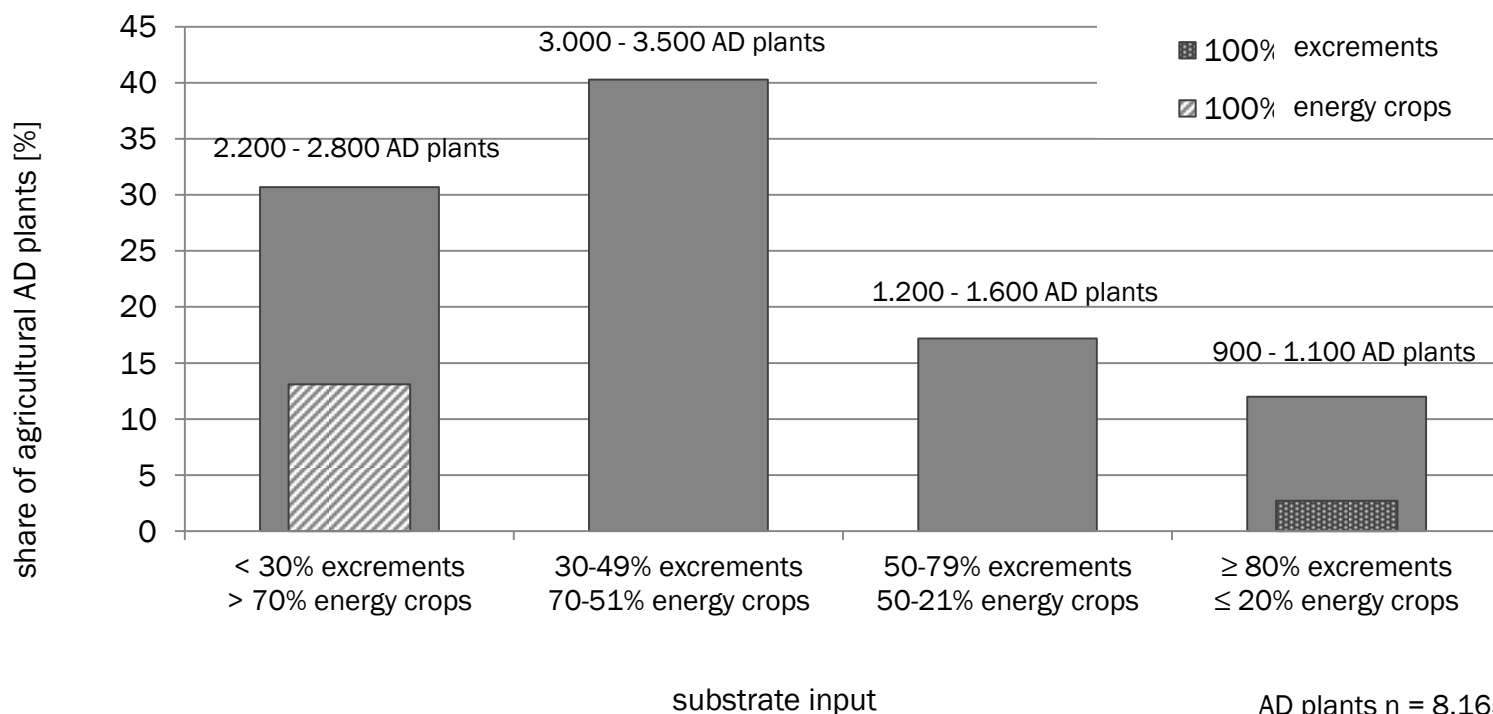
Renewables-based electricity generation in Germany 2016
Total: 188.3 billion kilowatt hours



* incl. biomethane, ** incl. sewage sludge; BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as at February 2017; all figures provisional

Manure-based small scale biogas plants (≤ 75 kW)

Manure-based small scale biogas plants (as to 31.12.2015)		Zubau 2016 (forecast plant register BNetzA)		as to 12/2016 (forecast + Bestand 2015)	
No. of biogas plants	installed el. capacity, [kWel]	No. of biogas plants	installed el. capacity, [kWel]	No. of biogas plants	installed el. capacity, [kWel]
385	27.362	174	12.685	559	40.047



Amendment of the Fertiliser Act and Fertiliser Ordinance (I)

Background: EU Commission's lawsuit against the German Fertiliser ordinance from 2006 and thus, violation of the contract (limitations of amounts, areas/ ,red' vs. ,green', compliance with retention periods, storage capacities for manure/ digestate) and

Consequence: amendment of the Fertiliser Act and Fertiliser Ordinance in spring 2017

Fertiliser Act: cap of 170 kg N/ha + accounting of biogas digestate, compost and sewage sludge from 2018 on;

Site-specific limitations of N-fertilisation;

Permission for German federal states to compare the data with other sources while handling the legal issues

Penalties up to €150,000 (former €15,000)

Amendment of the Fertiliser Act and Fertiliser Ordinance (II)



Fertiliser Ordinance: entry into force 01/06/2017

Storage capacities for manure and liquid digestate from biogas generation: sufficient to bridge the retention time with a minimum of 6 months; for farms with a high stocking density (> 3 grazing livestock unit) and without own application areas 9 months will be required from 2020 on; 2 months for compost, solid digestate/ manure;

Material flow analysis for all farms > 30 ha from 2018 on/ resp. > 20 ha from 2023 on;

National-wide N-fertiliser assessment for arable and grassland (depending on yield, site and climate conditions);

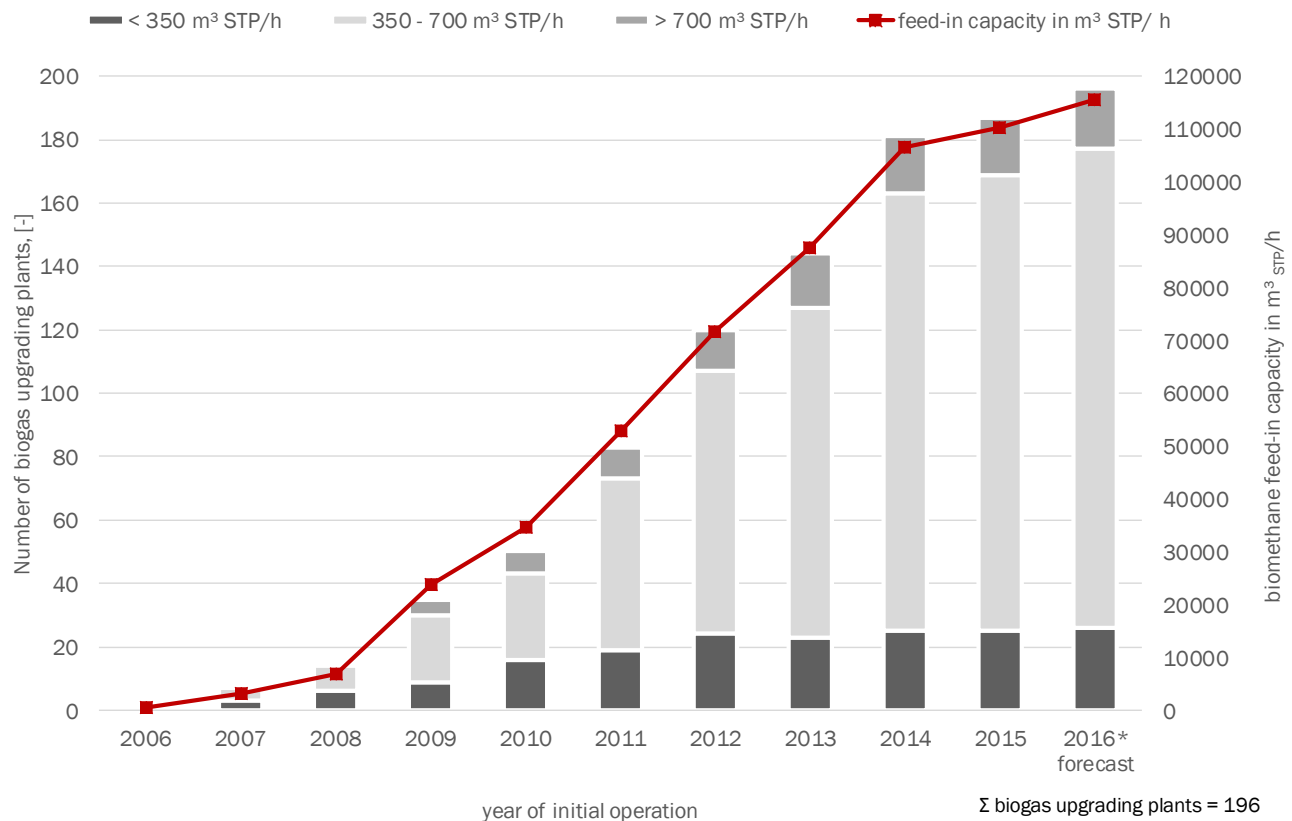
Prolongation of the retention time/ special requirements for ,red'/ polluted areas;

Derogation from 170 kg N/ha for biogas digestate and grassland possible – depending on the decision of the Commission

(2) Biogas plant inventory: biogas upgrading plants in Germany



- end of 2015: 187 biogas upgrading units in operation with the overall feed-in capacity of 110,310 m³_{STP}/h biomethane
- 2016: 196 biogas upgrading units with the feed-in capacity of 115,100 m³_{STP}/h
- annual number of newly built upgrading facilities has been declining (from 27 new plants to 9 in 2015 resp. 6 new plants in 2016);



(3) Biogas utilization 2015

Utilization type	Amount, [GWh/year]	Share, [%]
Electricity ¹⁾	36,775	61
Heat	18,851	31
Vehicle fuel	385	1
Flaring ²⁾	4,379	7

1) excluding efficiency losses;

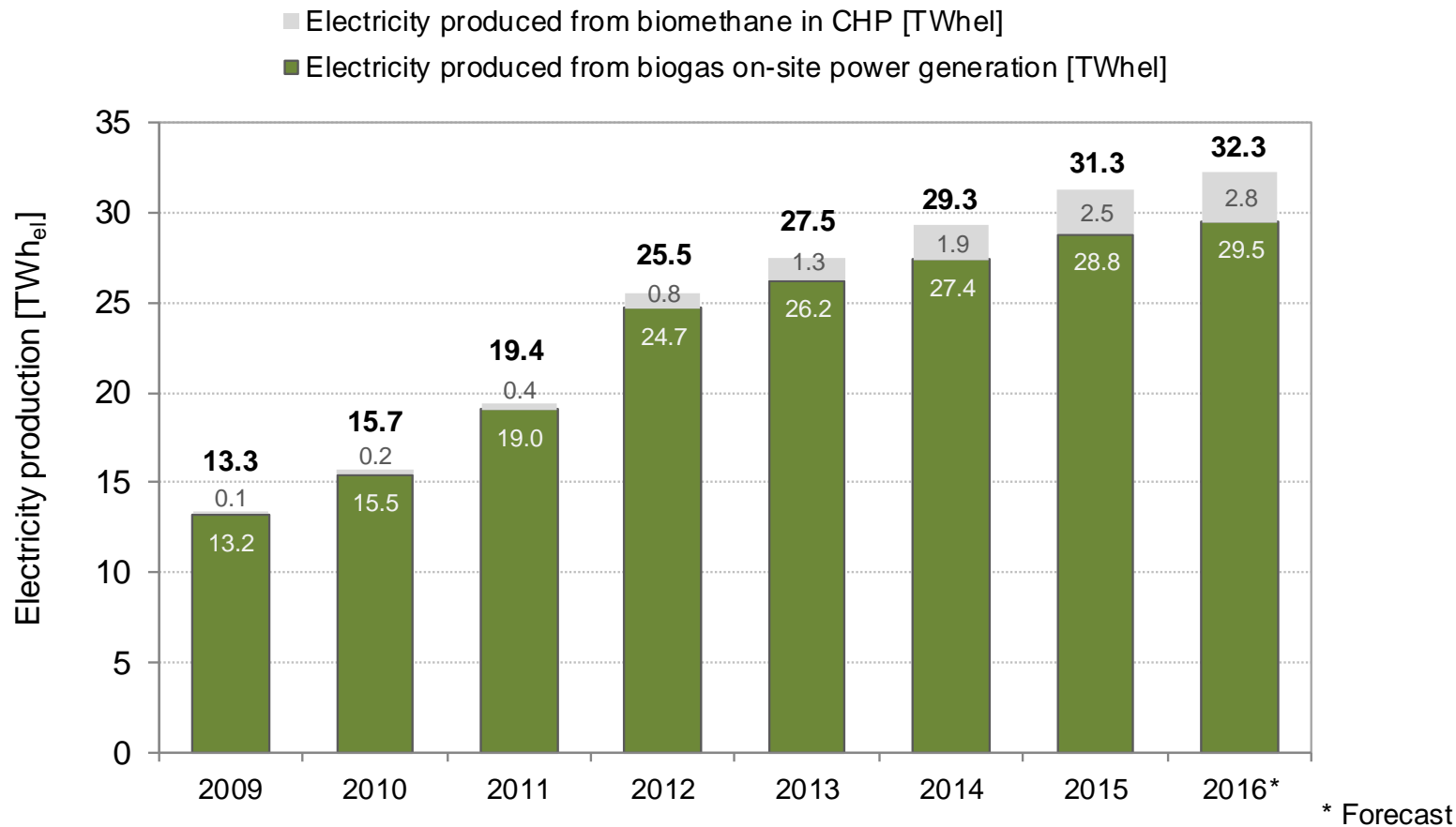
2) estimation, 5 % flaring losses for all types of biogas plants, except of landfill with 10 %;

Source: Federal Ministry for Economic Affairs and Energy (BMWi), as to 02/2016.

2015: the number of the filling stations offering biomethane (partly or up to 100%) declined from 293 to 251.

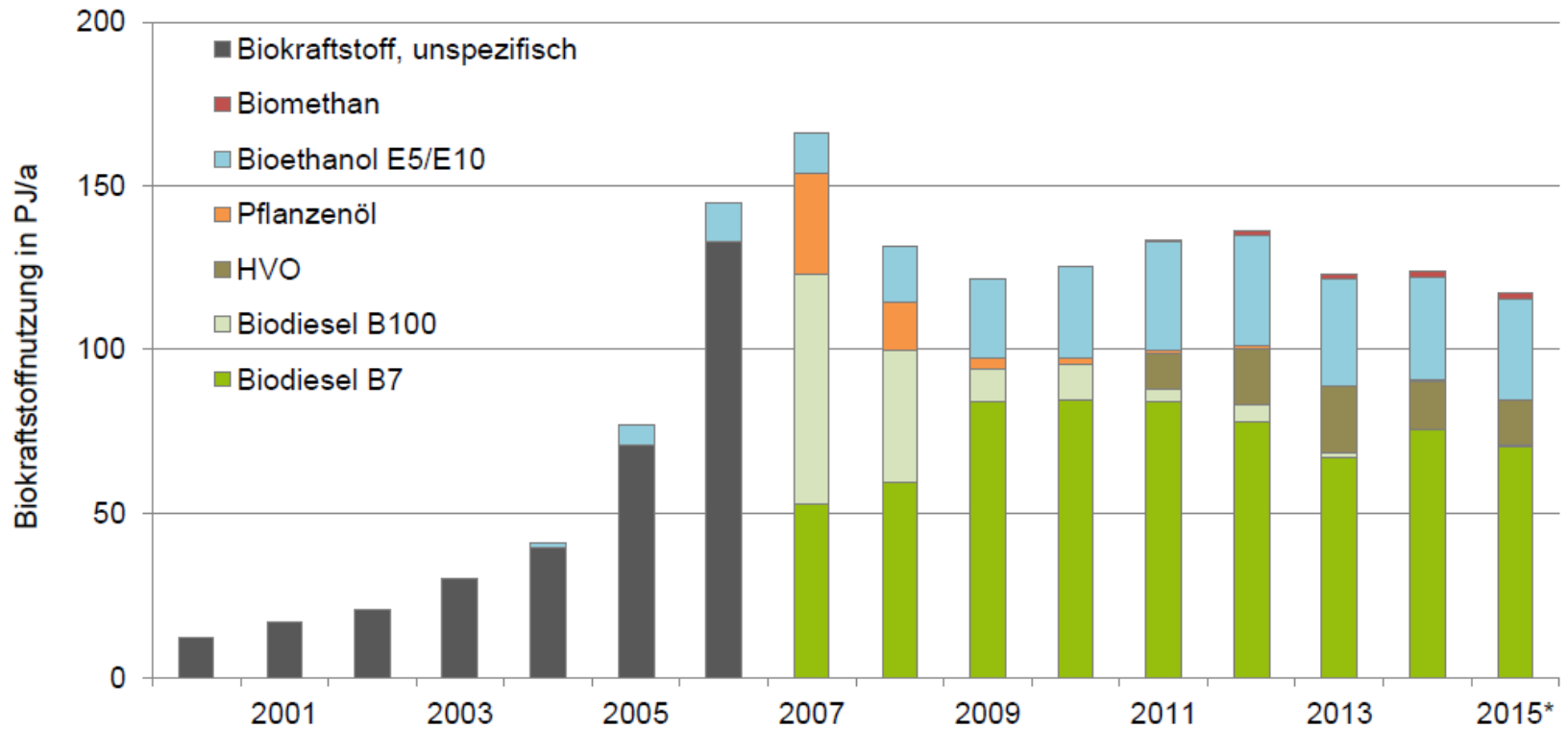
The amount of biomethane corresponds to 20 % of the whole amount of natural gas sold in 2015 as a vehicle fuel.

(3) Biogas utilization: electricity production from biogas and biomethane 2009 - 2016



Data base: 2009 – 2015 according to BNetzA, 2016 according to AGEE-Stat
 Source: Daniel-Gromke et al. 2017, Innovationskongress Osnabrück

Biofuel Utilization in Germany 2000 – 2015



Datenbasis: 2000-2006: BMVI 2014, BMF 2007, 2007-2014: BAFA, BLE, *2015: vorläufige Schätzung DBFZ

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(4) Financial support system: Renewable Energy Act (EEG) 2017

- Switch from the feed-in tariffs (EEG 2000 – 2014) to the auction model from 1.1.2017 on;
- Participating technologies: biomass (> 150 kW_{el}), wind (on- and offshore) and PV;
- Existing biomass plants can bid as well in order to receive the follow-up 10-years funding only by compliance with the flexible operation;
- The development corridor for biomass:
 - 2017, 2018, 2019 – 150 MW_{el} can be auctioned each year
 - 2020, 2021, 2022 – 200 MW_{el} can be auctioned each year.

Anaerobic process

Research Results | Measurements of Methane Emissions from biogas production



University of Natural Resources and Life Sciences, Vienna



- Main sources: open digestate storage and pressure relief vent at biogas upgrading unit
- Different techniques: not all teams were equipped for all sources
- Not all team found all leakages
- Coefficient of variation for point sources: 55 % - more import the consideration of large sources
- Highly variable emissions (e.g. status of operation changed)
- Remote sensing – background analysis?





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 720714.

<http://www.demeter-eu-project.eu/>

DEMETER - Demonstrating more efficient enzyme production to increase biogas yields

Aim: Demonstration of a yield increase and cost reduction of the enzyme production process and its positive effect on biogas production in Europe

Performance:

Improvement and scale-up of the enzyme producing fermentation process and downstream processing leading to a cost reduction

Test of enzyme application to anaerobic digestion process (lab- till full-scale) and development of a predictive model of the effect of enzyme addition on the biogas yield

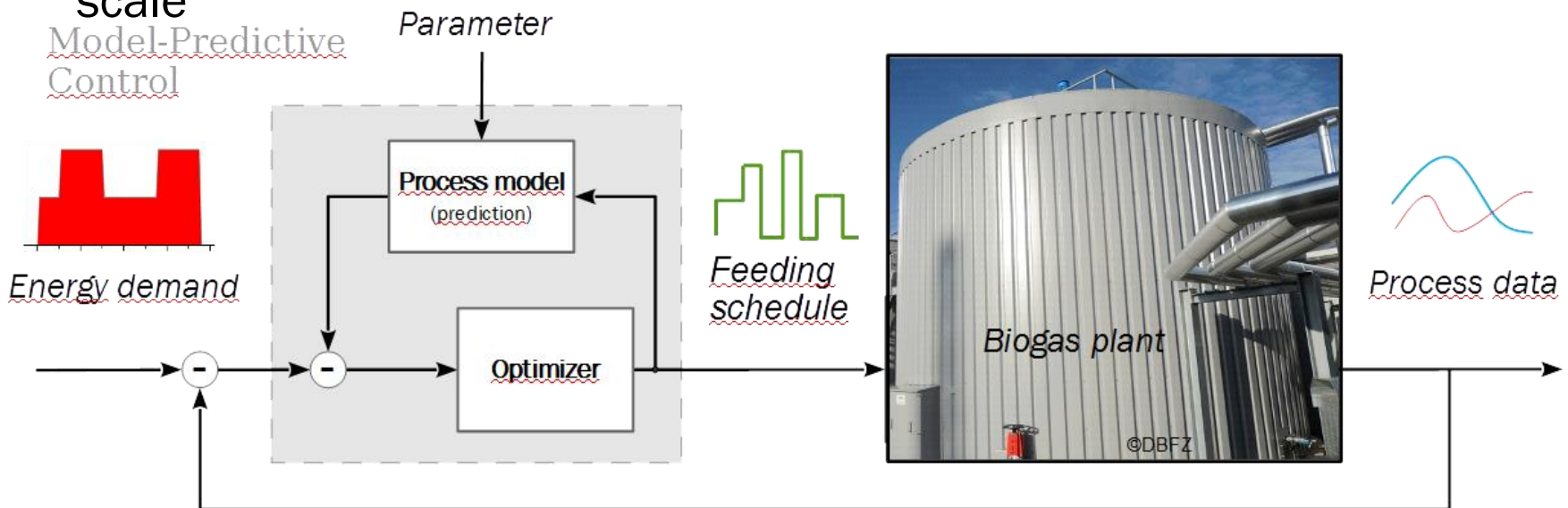
→ Demonstration of the industrial and economic feasibility to apply a cost-effective enzyme product in biogas plants



Project „GAZELLE“

Aim of the project:

- The combination of substrate management, substrate pre-treatment, heat- and gas-management, process monitoring and model predictive control in order to reach a high level of process flexibility and economic efficiency of biogas plants.
- The demonstration of the enhanced process control at biogas plant scale



Biogas Monitoring Programme III

Basic information

- **Funding body:** Fachagentur für nachwachsende Rohstoffe (FNR)
- **Consisting of two part projects:**
 - PP 1: Factors for an efficient operation of biogas plants
 - PP 2: Systems Biology (ATB Potsdam)
- **Project partners in PP 1:**
 - State Institute of Agricultural Engineering and Bioenergy, University of Hohenheim (UHH): Dr. Hans Oechsner
 - Competence Centre Renewable Energies and Climate Protection Schleswig-Holstein (EEK.SH): Dr. Christian Moschner
 - Bavarian State Research Center for Agriculture (LfL): Dr. Matthias Effenberger
 - DBFZ as coordinator: Jan Liebetrau, Jan Postel

Background:

- Control and monitoring of demand driven biogas plants necessary
- Need for consumption and production data of the biogas plus gas storage filling level
- Detectability of the gas storage filling level
- Operational emissions

Aims:

- Minimizing gas losses
- Forecast of gas storage filling level
- higher capacity utilisation
- Development of gas extraction strategies
- technical improvement of the storage filling level measurement
- Development of integrated systems for coupling the gas storage with the gas production and the conversion units

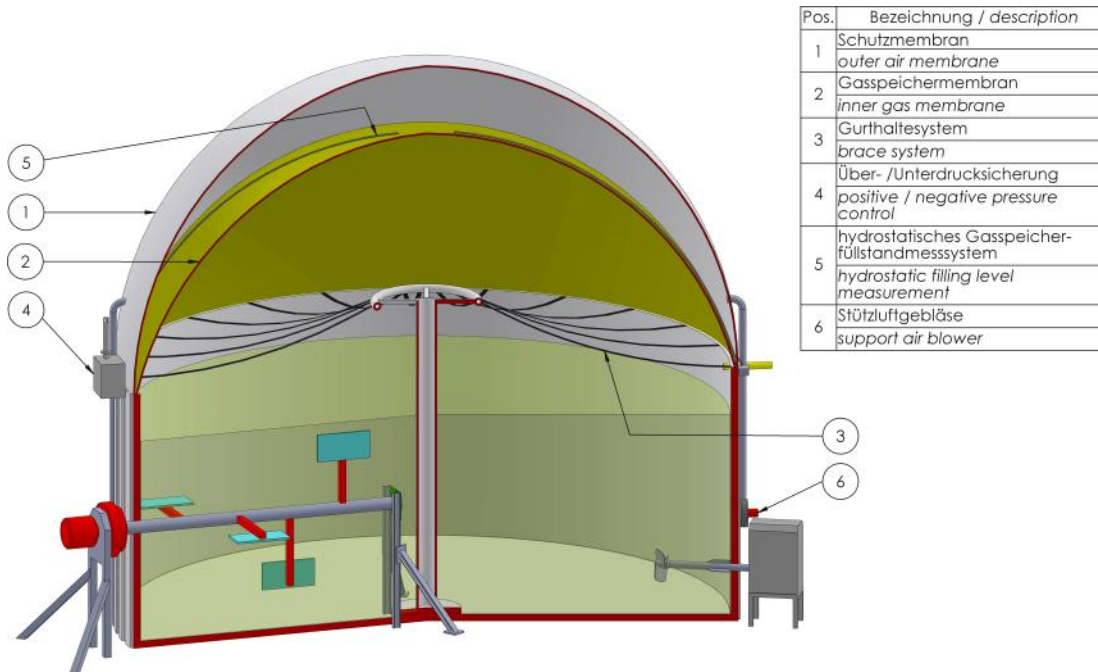


Fig.1: Description of fermenter with gas storage

Smart Bioenergy – innovations for a sustainable future Come and join us!

Contacts

Prof. Dr. mont. Michael Nelles

Daniel Mayer

Prof. Dr.-Ing. Daniela Thrän

Dr.-Ing. Jan Liebetrau

Dr.-Ing. Volker Lenz

Dr.-Ing. Franziska Müller-Langer

Dr. rer. nat. Ingo Hartmann

**DBFZ Deutsches
Biomasseforschungszentrum
gemeinnützige GmbH**

Torgauer Straße 116

D-04347 Leipzig

Phone: +49 (0)341 2434 – 112

E-Mail: info@dbfz.de

www.dbfz.de