UNIVERSITY OF HOHENHEIM

Annual Report 2018

State Institute of Agricultural Engineering and Bioenergy

LANDESANSTALT für Agrartechnik & Bioenergie

University of Hohenheim
State Institute of Agricultural Engineering and Bioenergy (740)

The State Institute of Agricultural Engineering & Bioenergy

The State Institute of Agricultural Engineering and Bioenergy is a special institution of the University of Hohenheim and has the following responsibilites:

- Practical research
- Delivering special consulting regarding agriculture in Baden-Würtemberg
- Giving technical advice to agricultural and industrial companies
- Providing agricultural management training to the teaching and consulting staff concerning new and state-of-the-art experimental results

As a result of the State Institutes's long-term devotion to special topics such as biogas production and bioeconomy issues, the university teaching component of the above mentioned duties has expanded substantially in recent years. Since the habilitation of Dr. Andreas Lemmer and his appointment as private lecturer, some of the teaching responsibilities have been fulfilled directly, and others are carried out together with the new head of the state institute, Prof. Joachim Müller. The subject of biogas has become an integral part of the curricula for students of NAWARO degree programmes and agricultural sciences. Students prepare their bachelor's and master's theses within the framework of research projects and gain valuable research experience by working as scientific assistants at the state institute.

In 2018, the University of Hohenheim celebrated its 200th anniversary. The State Institute took part in the public events marking the anniversary. In 1818, the University was founded to improve food production technology, train specialists in agriculture and mechanical engineering, prevent famine and to improve the nutrition of the population as a whole. Today, thanks to international networking and global trade, the danger of famine is largely averted in countries like Germany that are industrially dominated and thus have strong economies. We can afford to use renewable raw materials for energy production and thus increase the share of renewable energy. Almost 40% of the electricity consumed in Germany now comes from renewable sources, with a particular increase in wind and PV electricity. Biogas can compensate for these fluctuating sources. Extensive research is carried out in this area at the State Institute and deals with questions relating to power to gas, the flexible generation of biogas and increasing the efficiency of the systems. Research in this area can help to reduce the emission of climate-relevant fossil carbon dioxide and thus slow global warming. The year 2018 was an above-average warm and dry year and thus showed the first effects on agricultural production. It vividly confirmed the trend towards global warming of the atmosphere.

Research at the State Institute takes place in the laboratory and, above all, at the Unterer Lindenhof research biogas plant, for which the State Institute is scientifically responsible. In 2018, the old storage tanks for liquid manure and digestate dating back to the 1960s were finally replaced and extended by a gas-tight digestate storage facility, which significantly optimised the entire fermentation process. The fermentation residue can now be stored temporarily for a period of 270 days. This further reduces its residual gas potential. The large gas chamber of the storage tank also significantly enhances operational flexibility. Thanks to the increase in capacity, the research plant now also supplies the experimental station with continuously renewable electricity. Its function as a research plant is thus further improved, and it serves as a good example for biogas plants in practice.

Biogas has been of great interest in Germany for more than 20 years. Due to the legal regulations of the german renewable energie law (EEG), biogas production has developed into an important pillar for many agricultural businesses. Today, there are more than 9,000 agricultural biogas plants, where biogas is mainly converted into electricity and heat by means of CHP units. In addition, biomethane is also produced at around 200 large plants and fed into the natural gas grid. About 6% to 7% of German electricity consumption currently comes from biogas. The State Institute has made a significant contribution to this highly positive development through research and consulting as well as the identification of economic and technical boundaries.

Unfortunately, recent political decisions mean that there will be no further expansion of biogas in Germany at the present time. As a result of drastic changes to the EEG and a transition to a tender model with a limited power remuneration of a maximum of 16.9 ct/kWh, the use of renewable raw materials will no longer be economically

viable. Thus, a large part of the existing and well-functioning biogas plants could gradually phase out after 20 years of operation. Political actions are urgently required to break this trend. If actions are not taken against this, a valuable contribution to the expansion of renewable energies will be lost. Together with partner institutes, the State Institute is working on three projects from the post-EEG project call of the FNR and is investigating innovative strategies and perspectives for the presently existing biogas plants. Achieving self-sufficient local networks, the use of previously unused substrates and the use of biomethane as fuel are also being investigated and analysed in feasibility studies. Without political action and a clear direction, however, the long-term use of this technology will cease.

The young and highly motivated team of the State Institute willingly faces new challenges and attempts to strengthen and secure the situation of agricultural companies and biogas plant operators in the long term by developing new strategies and putting new findings into practice. We look forward to receiving any suggestions and are open to a partnership-based cooperation with research and industry partners in Germany and worldwide.

Dr. Hans Oechsner

Head of the State Institute

Scientifically competitive with practical research

The state institutions occupy a special position at the University of Hohenheim. They are jointly run by the state of Baden-Württemberg and the University of Hohenheim and carry out practical research as well as consulting and research transfer tasks. As can be seen in this annual report, the State Institute of Agricultural Engineering and Bioenergy fulfilled these tasks in an exemplary manner in 2018, as in previous years. The practical research of the State Institute is characterised by a successful combination of problem-oriented basic research and research applied in practice. In this way, the transfer of research does not represent a one-way street from science to practice, but ensures that practical experience and relevant questions are fed back into research. By obtaining greater insight brought about from investigations using the most recent methods, the basis for lasting solutions to current problems is created and verified in practice in a timely manner. The research of the State Institute of Agricultural Engineering and Bioenergy is internationally recognised through its publications in high-ranking peer-reviewed journals and thus significantly contributes to the University of Hohenheim's reputation. This is also the key to the success of highly competitive calls for proposals such as the Federal Ministry of Education and Research (BMBF) or - even more ambitiously - the German Research Foundation (DFG). Since 2018, the State Institute has been participating in the International Research Training Group DFG-IRTG 2366: "Adaptation of maize-based agricultural production systems for food, feed and biomass production to limited phosphate reserves" and is nearing the top position in research at the University of Hohenheim. This is a bilateral research programme with China, which will run for a total of nine years if the interim evaluation is successful. Three generations of doctoral students will receive funding and structured training at the highest level. The project is designed in such a way that agriculture in Baden-Württemberg will also benefit from the results. The necessary grounding is provided by the advisory board, which, according to the statutes, has the task of promoting cooperation between the State Institute, the agricultural administration and agricultural practice. Through creative impulses and lively discussion, the advisory board has always fulfilled this task. We would like to take this opportunity to thank the advisory boards for their commitment.

Prof. Dr. Joachim Müller

Senior director of the state institute

Biogas Measurement Program III - Factors for the efficient operation of biogas plants

The construction of new plants has been significantly reduced in recent years due to changes in the Renewable Energy Sources Act (EEG). At the same time, the end of the 20-year-long remuneration under the EEG 2004 and 2009 threatens to lead to a decommissioning of old plants. This situation has changed the biogas sector in Germany. An improvement in efficiency and thus profitability as well as a sensible re-design of bonuses in the EEG are urgently necessary to maintain the number of plants and the market leader in biogas in Germany.

In Biogas Measurement Program III, biogas plant operators and politicians are being developed with the help of a monitoring system for 60 biogas plants throughout Germany. A complete picture of the plant stock and current practice is presented as well as an evaluation of new measurement methods for the exact determination of the efficiency of biogas plants. This is intended to show both efficient plant concepts and difficulties in the operation of biogas plants.

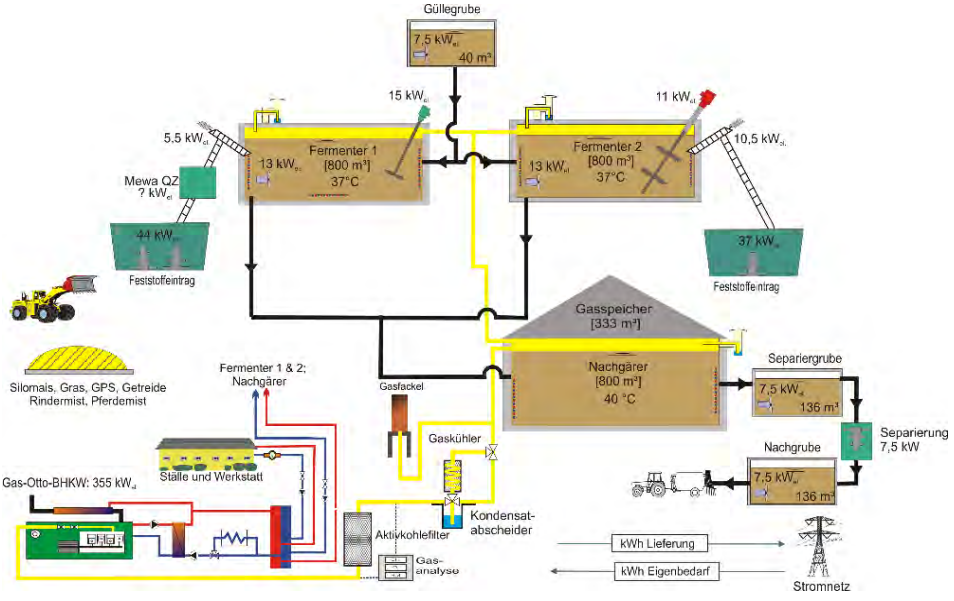
An economic, biological and technical analysis of the plants is prepared to determine the efficiency. For biological analysis, samples are taken from all containers and substrates on a monthly basis, and they are analyzed for a variety of parameters. All other analyses are based on operating data. In order to record these, operating daybooks as well as available meter readings are recorded and read.

A comparison of theoretical data calculated from the results of the biological analysis and the operating data is used to validate the measurement results. At the same time, the comparison is used as the basis for the doctorate awarded in BMP III. In the doctoral dissertation, the deviations of the data from one another are examined and the causes examined in more detail.

M. Sc. Benedikt Hülsemann

M. Sc. Lijun Zhou

Dr. Hans Oechsner



Scheme of the Unterer Lindenhof facility investigated under BMP III

Funding:
Fachagentur für Nachwachsende Rohstoffe e.V.

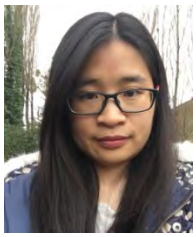
Partners:
Deutsches Biomasse Forschungszentrum (DBFZ)

Bayerische Landesanstalt für Landwirtschaft (LfL)

Kompetenzzentrum Erneuerbare Energien und Klimaschutz Schleswig Holstein (EEK.SH)

Project duration:
Jan. 2016 – Nov. 2019

German Biogas Measurement Program III – A Suitable Program for China? Biogas Plant Operation and Performance Assessment (CBMP)



M. Sc. Lijun Zhou

M. Sc. Benedikt Hülsemann

Dr. Guo Jianbin (CAU, Peking)

Dr. Hans Oechsner

China's agro-industries create billions of tons of biomass waste annually, which can potentially be used to produce energy. According to the country's 13th Five-Year Plan (2016-2020), China will allocate CNY 50 billion ($7.3 billion) to build biogas projects on rural areas to boost its clean energy use, which will include construction of 172 new biogas projects and 3,150 large-scale biomethane projects. However, given the current development status quo, obstacles in biogas sector, such as low plant operation efficiency and low biogas production efficiency, lack of standards and insufficient policies have emerged.

The research will be drawn from lessons learnt from the previous two German Biogas Mesurement Programs (BMP) and the on-going BMP III. Furthermore, BMP III methodology will be applied and adjusted in China, to establish the first Chinese BMP as appropriate. The first trial round of Chinese Biogas Measurement Program (CBMP) started in mid October 2017 at three politing biogas plants in Beijing, China. Such plants were selected due to the application of different substrates, plant scale (medium and large scale) and long operation history (min. 10 years). In align with the German BMP III, during the measurement, samples, i.e., substrates, feeding slurry, fermentation slurry, digestate, biogas were collected and lab measurements of key indicators, i.e., biogas potential of different substrates through HBT, features of samples (TS/oTS, FOS/TAC, NH_4-N, PO_4^{3-}-P, biogas quality, etc.) were measured. Furthermore, the methodology was adjusted to reflect the situation and different legislations.

In terms of policy, studies related to the government policy in countries with more advanced biogas technologies and market, for instance, Germany, Sweden and Denmark, will be carried out, to present a complete and clear picture to the Chinese government about how other governments are developing and supporting the sector. In addition, economic analysis will be carried out to all studied biogas plants to assess the viability. Analysis for the annual major income, expenses and balance will be carried out, comparisons for the different financial status by the application of the PRC domestic air pollution control policies will be conducted especially. This will draw a picture of how to make the biogas plant operation more profitable in the market, rather than only rely on the government subsidies. The analysis results will also provide the government a picture of how the policy shall be structured appropriately.

Partner:
China Agriculture University, The People's Republic of China

Project duration:
Nov. 2016 – Nov. 2019

The three plants of the Chinese biogas measurement program (Zhou, 2017)

Flexible feeding in biogas processes with model-based process detection in full-scale (FlexFeed)

M. Sc. Philipp Kress

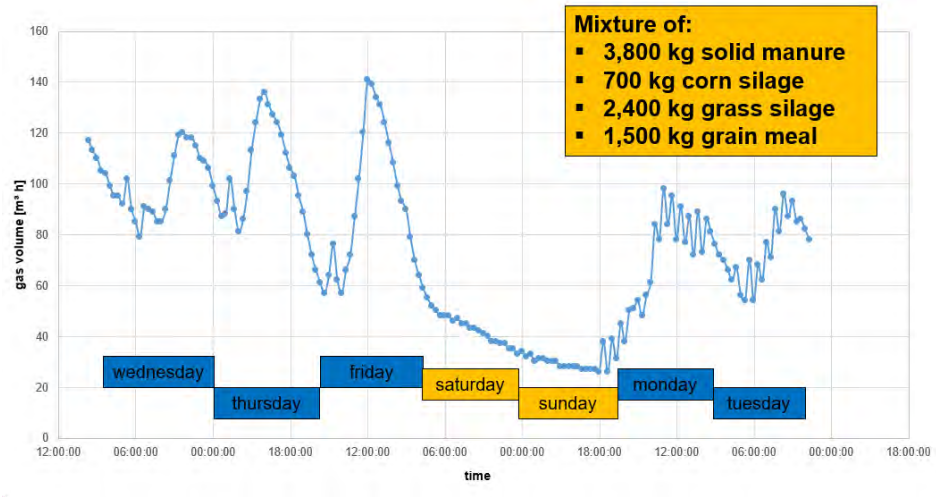
Dr. Hans Oechsner

Due to a decrease in farming area, the availability of raw materials as well as the current political conditions, biogas producers are using measuring techniques to either increase process efficiency or provide an alternative income. Biogas plants have the potential to secure the supply and stability by increasing dynamics in the power grid. As the gas upgrading processes are not profitable for many existing biogas plants, current attemps try to increase the flexibility of power production chiefly expanding gas storage and the co-generation unit.

With the help of storable biomass, it is possible to operate the digester in a controllable and flexible manner through optimized feeding management techniques. The impacts of the widely varying feeding management techniques on the biological, rheological process engineering parameters are not well understood. It is expected that through flexible process management, unknown conditions occur in the digester. They can endanger the undisturbed plant operation. It is therefore necessary to develop a strategy for innovative process monitoring and sample collection.

The aim of the investigtion is to evaluate and optimize the feeding management strategy in biogas plants. This strategy includes the combination of an innovative sensor in the liquid phase, model based monitoring and neural work as methodological approaches. This project is further divided into 3 different work packages:

- Package 1: Identification of crucial zones in the biogas digester
- Package 2: Installation and validation of the acoustic waveguide and near-infrared spectroscopy
- Package 3: Verification of developed models for a full scale biogas plant



Load dependend plant operation by adjusted feeding an weekend breaks

Funding:
Federal Ministry of Economic Affairs and Energy (BMWi)

Fachagentur nachwachsende Rohstoffe (FNR)

Partners:
TU-Berlin

SOTA Solutions (Berlin)

Project duration:
Aug. 2014 – March 2018

Two-phase anaerobic digestion of sugar beet for biomethane production – Process optimization of preservation and conversion for the improvement of energy yield (ZRCH4)

M. Sc. Elzbieta Kumanowska

Dr. Simon Zielonka

PD Dr. Andreas Lemmer

Dr. Hans Oechsner

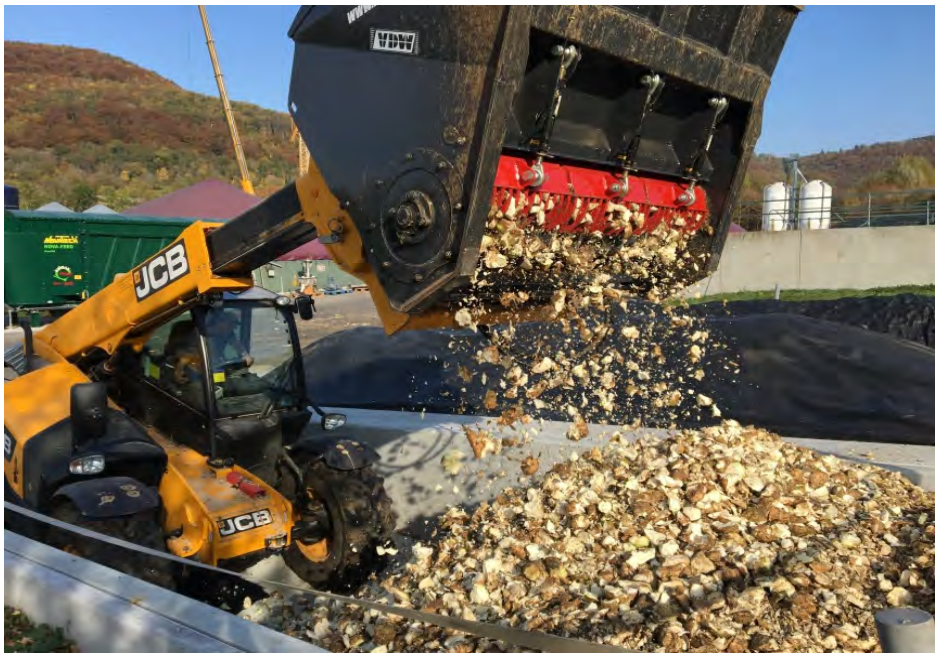
The aim of this project is to offer the biogas plant operators an ecologically, energy-oriented and economically superior method. Our focus is to produce a high caloric biogas to be used as fuel or as SNG, which in turn provides an alternative to previous applications of electricity production.

To achieve this objective, we pursue a bilateral approach. We use the rarely-applied substrate sugar beet, which improves the ecology of the process and furthermore allows us to optimally use new process technology.

The first step is to develop a novel, optimal method to preserve the sugar beet. Accordingly, the results of storage tests and laboratory experiments are compared with those of conventional storage processes. As such, we are able to duly evaluate how preservation methods influence the energy yield.

The next step is to determine how suitable the ensiled sugar beets are for digestion within two-phase anaerobic digestion laboratory systems and to optimize crucial parameters. The new biological conversion processes are already able to fractionate the biogas during the production. This in turn significantly increases the methane content of the biogas. We are able to therefore reduce the cost of preparing biogas to a natural gas quality, and furthermore utilize the gas as a fuel. Producing biomethane could be an alternative for generating electricity using a CHP unit. The problem of using heat when converting biogas in a CHP unit is furthermore eliminated.

Although problematic in conventional biogas plants, sugar beet is an almost ideal substrate for the two-phase anaerobic digestion. With high sugar content and a low level of indigestible materials, such as lignin, sugar beet is very suitable for acidification.



Hohenheimer pit silo while filling with sugar beet chips (Kress, 2018)

Funding:
Federal Ministry of Food and Agriculture (BMEL)

Fachagentur nachwachsende Rohstoffe (FNR)

Partners:
Novatech Corporation

Experimental Station Agricultural Sciences,

Location Lindenhöfe

Location Ihinger Hof

Project duration:
Sep. 2014 – Feb. 2018

Optimization of the operation and design of biogas plants for a demand-oriented, flexible, efficient and stable biogas production as a possible post-EEG strategy (OptiFlex)

The stirring system is one of the biggest power consumers in biogas plants. Therefore, the efficiency and profitability strongly depends on effective mixing of the digestate. Optimized mixing processes and consequently a reduction of auxiliary energy is a promising post-EEG strategy to operated biogas plants economically.

To this day, there is a lack of research in the interaction of substrates/digestate, biogas kinetics and rheological properties. Without this knowledge, a sensible optimization of the stirring system is not possible.

Thus, “OptiFlex” deals with the development and verification of rheological and kinetic models. On that basis, new agitators can be developed and tested at the full-scale research biogas plant of the University of Hohenheim. Several partners in research and industry work together to reach these goals.

Besides, suitable control parameters for the flexible biogas production will be identified. Together with the optimized stirring system, these means allow a sustainable operation of existing and newly built biogas plants.

First mixing results reveal a great saving potential concerning the power demand of the stirring system. Even small changes in the orientation of the agitators can have a strong influence on mixing times and power consumption. Additionally, the simultaneous operation of several stirrers is advantageous for reducing respectively mixing times and energy. Future CFD-simulations, laboratory experiments and full-scale trials will strengthen these results and disclose further saving potentials.

M. Sc. Benjamin Ohnmacht

M. Sc. Philipp Kress

PD Dr. Andreas Lemmer

Mixing trials at the full-scale research biogas plant of the University of Hohenheim to evaluate different mixing set-ups (Ohnmacht, 2018)

Funding:
Federal Ministry of Food and Agriculture (BMEL)

Fachagentur nachwachsende Rohstoffe (FNR)

Partners:
Fraunhofer Institute for Ceramic Technologies and Systems (IKTS)

German Biomass Research Centre (DBFZ)

Technische Universität Berlin (TU Berlin)

Maier Energie & Umwelt GmbH

Project duration:
Oct. 2017 – Sep. 2020

PowerLand 4.2 – Smart and Innovative Land Power Systems

Dr. Johannes Krümpel

M. Sc. Philipp Kress

PD Dr. Andreas Lemmer

Electricity generation from renewable sources such as wind or sun is subject to natural fluctuations. Decentralised plants with combined heat and power generation can make a significant contribution to reliably covering demand and balancing fluctuations at all times. They can be used flexibly and are very efficient. They are of particular importance as they offer the possibility to produce electricity and heat simultaneously among the renewable energies.

In Powerland 4.2 a modular control system for combined heat and power units (CHP) and biogas plants is developed. It is designed to self-learn and forecast the energy demand of a consumption unit (e.g. a rural community) for the following 48 hours. Weekend and seasonal effects are taken into account. In addition, a forecast for electricity generation from photovoltaics and wind turbines will be prepared. The residual load is then to be provided by the biogas-CHP.

This requires that a substrate timetable for the biogas plant is drawn up, which takes into account that the gas storage facility will never be completely emptied. Using the example of the Unterer Lindenhof as a consumption and production unit, the control system is optimised in such a way that a village can cover its electricity and heat energy requirements completely on the basis of renewable energies.

Funding:
Federal Ministry of Food and Agriculture (BMEL)

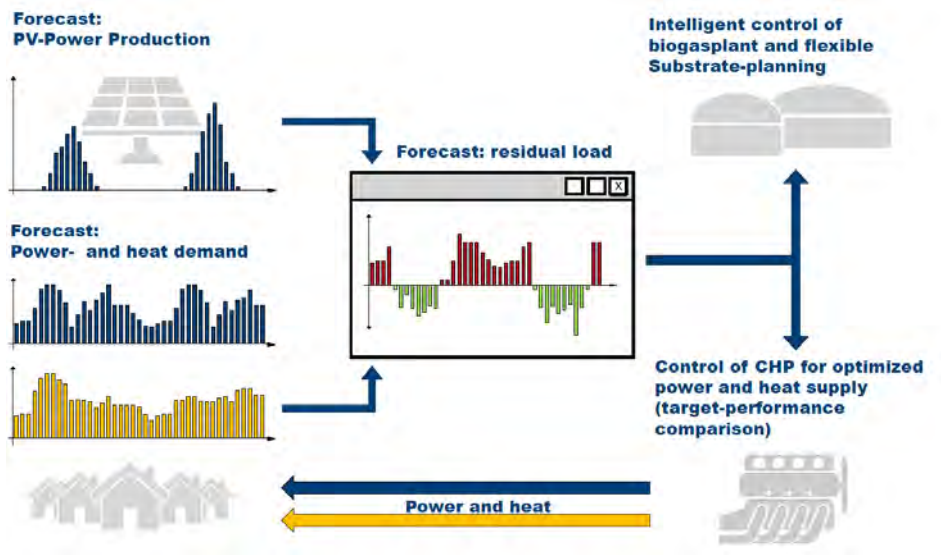
Fachagentur für Nachwachsende Rohstoffe e.V.

Partners:
Reutlingen University

Reutlinger Energiezentrum (REZ)

NOVATECH GmbH

Project duration:
Oct. 2018 – Sep. 2021



Ablaufschema der Anlagensteuerung zur bedarfsgerechten Strom- und Wärmeproduktion

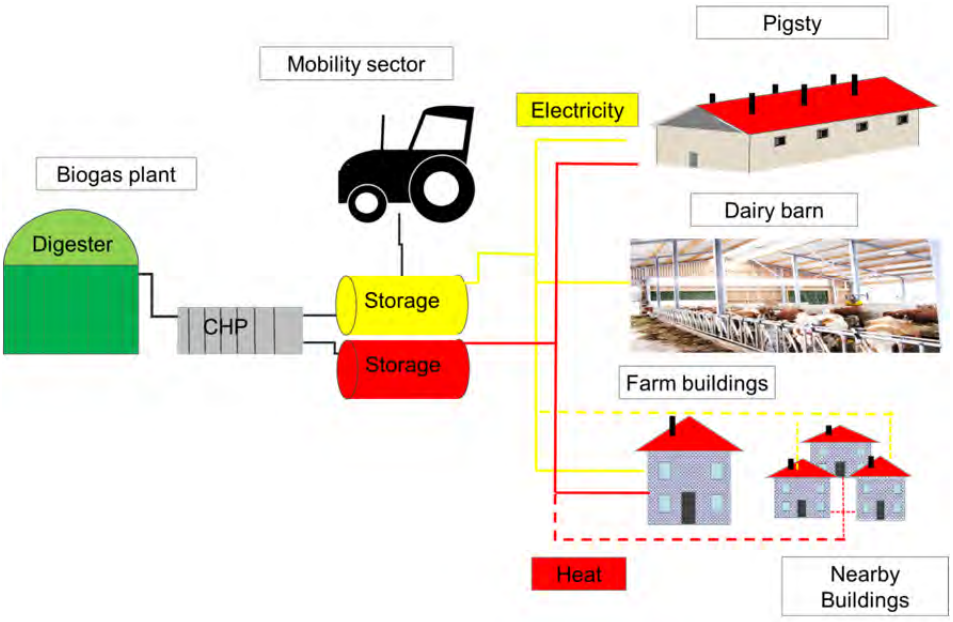
Biogas plants after the EEG phase - Business models of an energy self-supply of agricultural holdings by means of their biogas plants - Evaluation of practice plants (Biogas_autark)

Dr. Simon Zielonka

For many farms biogas plants have become a fixed part of the business. Due to the new regulations in the EEG, the continued existence of these facilities is seriously endangered. The overriding goal for biogas production was and still is - in the context of current sustainability criteria - to be economically viable without government subsidies. In this sense, the biogas industry is currently too dependent on the EEG.

The aim is to find ways to produce biogas without government subsidies. To this end, increased or complete own use of the energy produced by the biogas plant on the farm would be a possible future prospect. The focus is on farms that, due to their energy needs, have the opportunity to use the produced electricity and heat themselves. In addition, the field of fuel production and use is checked.

In the process, economic perspectives for individual agricultural biogas plants are to be worked out and recommendations for action developed on the basis of these results. Only agricultural biogas plants are explicitly considered in order to determine an optimized energy use of the biogas plant in concrete agricultural operations in relation to the various production processes. On the one hand, the findings will be worked out as a bottom-up analysis for farms with biogas plants. On the other hand, a cluster analysis draws conclusions about the nationwide effects and potentials for the existing plant park.



Scheme for energy self-sufficiency by biogas plant (IZES gGmbH/ J. Pertagnol, 2017)

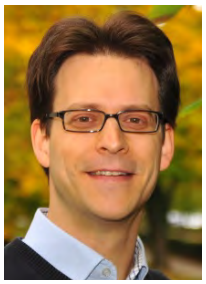
Funding:
Federal Ministry of Food and Agriculture (BMEL)

Fachagentur für Nachwachsende Rohstoffe e.V.

Partner:
Institut für ZukunftsEnergie- und Stoffstromsysteme gGmbH (IZES)

Project duration:
Oct. 2017 – Sep. 2019

Bioenergy - Potentials, long-term perspectives and strategies for electricity generation plants after 2020 - Stakeholder involvement (BE20Plus)



Dr. Simon Zielonka

Bioenergy contributes significantly to renewable electricity and heat production within the German energy transition. In 2015, about 27% of renewable electricity and 88% of renewable heat came from bioenergy plants. The expansion and operation of bioenergy plants for the generation of electricity has been promoted in recent years primarily by the EEG, under which the facilities were previously set for a period of 20 years fixed rates. Since most of the bioenergy plants for electricity production were built in the years between 2004 and 2014, the EEG support will expire for this part of the plant portfolio in the years 2025 to 2035. The aim of the research project is to evaluate which business models are suitable for existing plants in order to ensure continued operation beyond the previous compensation period, possibly also with a changed operational focus.

In addition to an evaluation of data inventories of existing plants, calculations are also to be made on the basis of selected individual plants, which will investigate the potential for increasing revenues and reducing costs. In addition to the option of transferring existing systems into the tender design created with the 2017 EEG amendment, further business models and operating strategies will be examined by way of example. In addition to the consideration of the individual plants, the contribution of the bioenergy plants for the future energy supply should also be assessed by means of modeling. Furthermore, effects on the electricity and heat supply, the reduction of greenhouse gas emissions and agriculture and forestry will be presented.

In 2018, the first BE20Plus stakeholder workshop was carried out in our own work package. The workshop on 18.04.18 in the state representation Saarland, in Berlin, was fully booked with 51 participants from 36 institutions. The circle of participants consisted mainly of experts from research institutions, companies, listeners, associations and practitioners from all over Germany.

Funding:
Federal Ministry of Food and Agriculture (BMEL)

Fachagentur für Nachwachsende Rohstoffe e.V.

Partners:
Deutsches Biomasse Forschungszentrum gGmbH (DBFZ)

Institut für ZukunftsEnergie- und Stoffstromsysteme gGmbH (IZES)

Helmholtz-Zentrum für Umweltforschung GmbH (UFZ)

University of Stuttgart Institute of Energy Economics and Rational Energy Use (IER)

Next Kraftwerke GmbH

Project duration:
Nov. 2017 – Oct. 2019

First BE20Plus Stakeholder-Workshop in Berlin (Zielonka, 2018)

BIOGAS PROGRESSIV – forward-looking strategies for agricultural biogas plants (ProBiogas)

Dr. Wolfgang Merkle

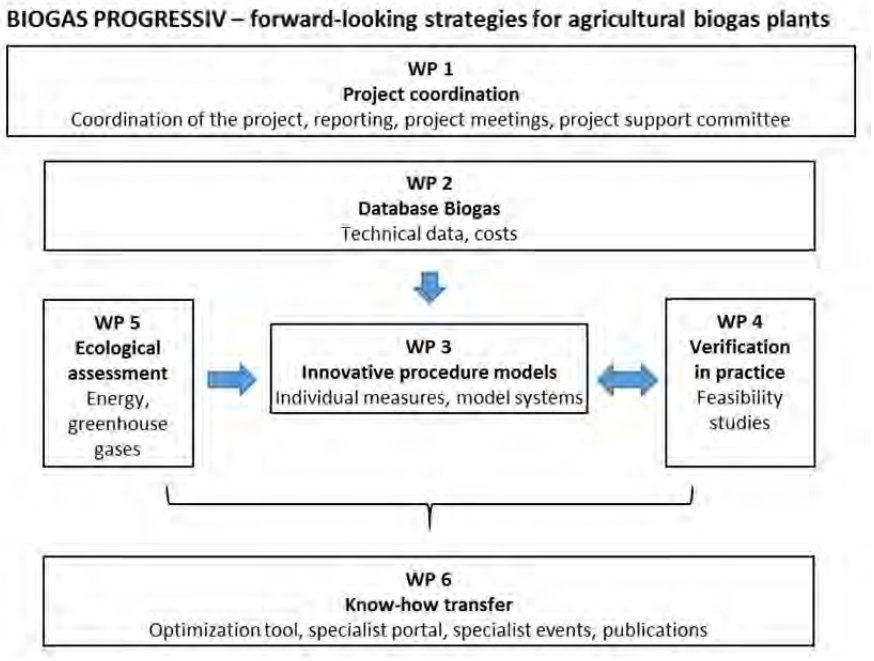
Dr. Hans Oechsner

A variety of approaches for optimizing biogas production have already been developed and determined in research projects from universities, agricultural research institutes and industry. However, a systematic evaluation of these approaches with regard to their usability in practicable business models and a range of information on this optimization geared to the operators of biogas plants and biogas consulting is still missing.

The aim of the project "BIOGAS PROGRESSIVE" is to provide a comprehensive range of information with the help of which plant operators and consultants are able to identify and develop suitable concepts for biogas plants.

In order to achieve this goal, a comprehensive data collection will be carried out at research facilities, manufacturers of plant components and biogas plants that have already implemented innovative concepts. These data, together with the information already available to the project partners, are the basis for the development and evaluation of optimization measures. These measures are combined into process models that represent viable business models for the operation of biogas plants. All measures and models are evaluated technically, economically and ecologically with the help of practical feasibility studies.

The result is a comprehensive and professionally secured information service for plant operators, agricultural consultants specializing in biogas, planning offices, municipalities, licensing authorities, banks and investors. Decision makers from politics and administration are also addressed. The know-how transfer takes place with the help of free online applications, target-group-specific specialist events, a specialist portal on the KTBL homepage and publications in various formats.



Working packages in the project "BIOGAS PROGRESSIV – forward-looking strategies for agricultural biogas plants"

Funding:
Federal Ministry of Food and Agriculture (BMEL)

Fachagentur für Nachwachsende Rohstoffe e.V.

Partners:
Association for Technology and Structures in Agriculture (KTBL), Darmstadt

Landwirtschaftskammer Niedersachsen, Fachbereich Energie, Bauen, Technik, Oldenburg

Project duration:
Dec. 2017 – Nov. 2020

Autogenerative Two-Phase High Pressure Fermentation (AG-HiPreFer)

Dr. Wolfgang Merkle

Dr. Simon Zielonka

PD Dr. Andreas Lemmer

The aim of this project is to integrate biogas production, purification and pressure boosting within one process saving up to 30% of energy consumption for the gas conditioning by avoiding the compression.

Therefore a new, two-phase pressurized anaerobic digestion process, with autogenerative increase of the pressure in the digester up to 100 bar will be developed (AG-HiPreFer), producing biomethane of natural gas quality inside the methane reactor, which can then be fed directly into the grid. In contrast to the technologies commonly used, no additional chemicals or compression are needed. Moreover, this bio-physical process makes use of the fact that CO_2 is more soluble than methane, resulting in a higher CO_2 content in the liquid phase at increased pressures. Methane contents over 92% can be reached in the gas phase. Additionally, studies to an anaerobic Microbial Fuel Cell (AMFC) integrated in the process will be done to increase the overall efficiency of the process.

In the project appropriate measurement and control concepts for process monitoring at operating pressures up to 100 bar have to be established. A new membrane concept for separating acids formed during the fermentation process will be developed. Experiments on the solubility of gases in the methane reactor will be done as well as studies to clarify the influence of pressure on microbiological process in the methane reactor.

Moreover, basic research on the aMFC will be done, which uses the difference of the redox potential and hydrogen ions between the acidification reactor and the pressure methane reactor for a direct generation of electricity via carbon, stainless steel or iron cyanide electrodes. A system-analytical consideration and an economic evaluation of the process will round off the project. At the end of the project, the whole process is to be set up in pilot scale.

Funding:
"BioProFi - Bioenergie - Prozessorientierte Forschung und Innovation"

Partners:
DVGW-Forschungsstelle am Engler-Bunte-Institut des Karlsruher Instituts für Technologie (KIT)

Johannes Gutenberg Universität Mainz, Institut für Mikrobiologie und Weinforschung (IMW)

Assoziierter Partner: Centre de Recherche Public Gabriel Lippmann, Département Environnement et Agro-biotechnologies (CRP), Luxemburg

Project duration:
July 2013 – July 2018

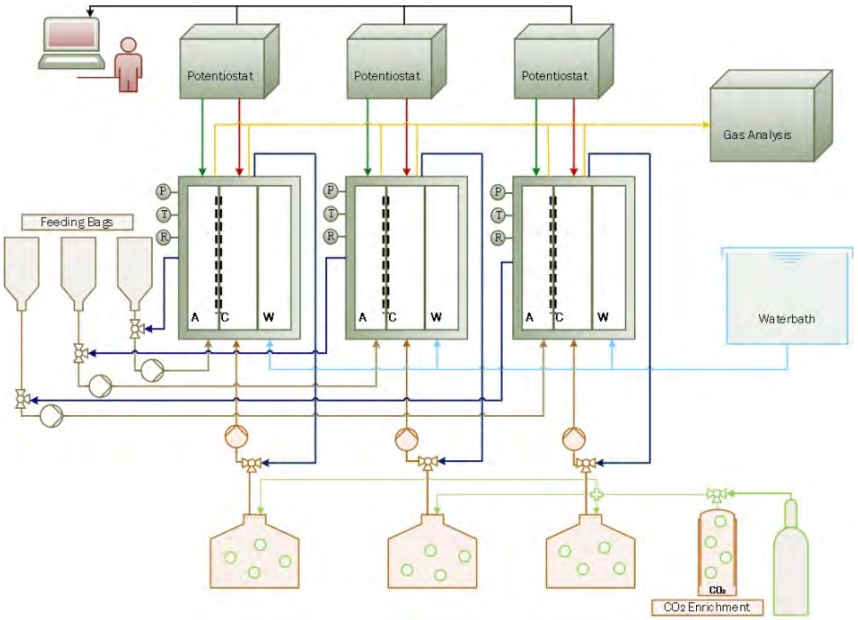
Construction of the pilot plant at research station Unterer Lindenhof (Merkle, 2018)

Bio-electrochemical production of high calorific biogas from waste materials (BioElektroGas)

The aim of the research joint project is to convert biogenic waste to highly caloric biogas in compact and very efficient systems. The basis of the novel process is the combination of fermentative processes for the digestion of solid biomass with bioelectric systems for methane production, so-called microbial fuel cells. By means of this process combination, various substrates, such as market waste or feedstuffs, can be utilized flexibly. These organic residues are first fermentatively decomposed ("dark fermentation") at low pH values and converted into organic acids, which in turn are fed to the bioelectrochemical reactor.

The research group is to develop and test suitable anode and cathode materials for the microbial fuel cell (MFC). The electrode structure must also be adapted to the bio-electrochemical conversion processes. Further Investigations are aimed at influencing the microorganisms at the electrodes. Finally, the overall fermentation-bioelectrochemical process has to be optimized at technical level in the laboratory scale at the state institute.

In the first test phase, the substrate mixture was fermented in a 2-stage system at various target pH values (5.5 and 6.0) in the acidification reactor (AR) to produce hydrolysate rich with organic acids. Followed by the second test phase, aimed to investigate the integration of a membrane filtration step in two-stage systems to remove inert particles from hydrolysate produced in AR in order to increase the efficiency of the subsequent MFC. Hydrolysates from vegetable waste (VW) and grass/maize silage (G/M) were treated in cross-flow ceramic membrane filtration system. For both the substrates, Organic acids were extracted efficiently through filtration of hydrolysate and the membrane permeability was stable and high. The continuous lab-scale system constructed with flat panel bioelectrochemical reactors with membrane electrode assembly is ready for the experimental run.



Process scheme of the BioElektroGas-research plant

M. Sc. Padma Priya Ravi

Dr. Anastasia Oskina

PD Dr. Andreas Lemmer

Funding:
Projektträger Karlsruhe – Baden Württemberg Programme

Umweltforschung Baden-Württemberg, Ministerium für Umwelt, Klima und Energie-wirtschaft

Partners:
Karlsruhe Institute of Technology (KIT) Institute of Applied Biosciences (IAB)

University of Freiburg Department of Microsystems Engineering (IMTEK)

University of Stuttgart Institute for Sanitary Engineering, Water Quality and Solid Waste Management (ISWA)

Project duration:
Sep. 2015 – March 2019

Development of efficient two-phase anaerobic digestion plants via coupled energetic and material utilisation (Optigär)

M. Sc. Jörg Steinbrenner

Dr. Hans Oechsner

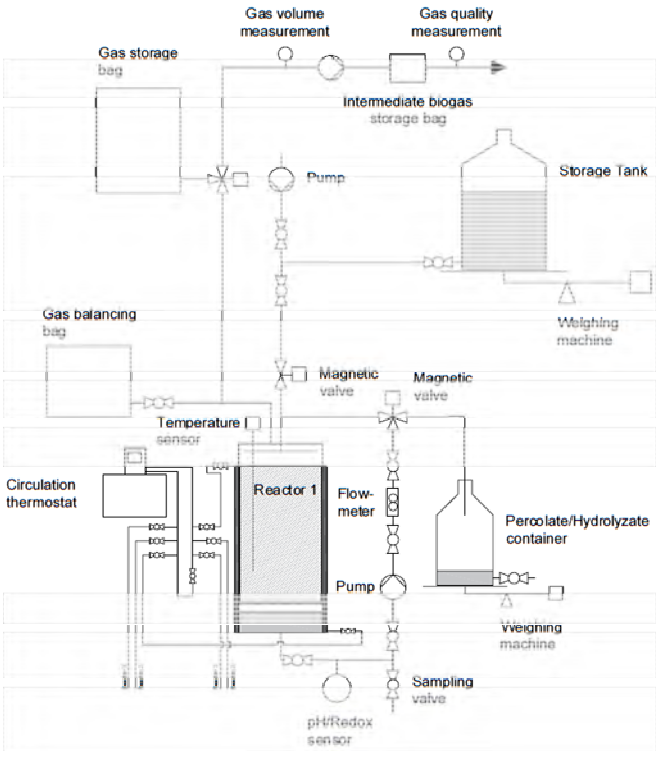
The overall objective of this project is the development of a procedure for a cascade use and thereby a sustainable and integral utilisation of agricultural raw materials. Here is the material use of coproducts as chemicals with potentially high prices in focus.

In this project, a new concept for integrated material use of two-phase biogas plants will be developed. With this approach, coupled material and energetic use of agricultural raw materials is to be enabled. To increase the concentration of usable chemicals in the hydrolysis process, variations of process parameters like temperature, organic loading rate, pH-value and buffering capacity and a specific feed material selection, will be tested to increase the concentration of usable chemicals. The produced hydrolysate is then be treated with membranes to separate the valuable chemicals. The residue of this process is recycled in anaerobic digestion.

To optimize the yields of valuable substances, both a screening of a variety of agricultural raw materials and as well of different reaction conditions to increase the yield of valuable products will be performed. The aim is the selection of suitable substrates and appropriate hydrolysis reaction conditions.

The separation of the value-making acids via membranes is done by the Fraunhofer Institute for Chemical Technology (ICT).

In addition, the European Institute for Energy Research and the Lipp GmbH will do a profitability assessment and a life cycle assessment as well as developing a concept for industrial scale production.



Automatized leachbed reactor system for hydrolysis and acidification

Funding:
Fachagentur Nachwachsende Rohstoffe e.V. (FNR)

Partners:
Frauenhofer Institute for Chemical Technology (ICT)

EiFER European Institute for Energy Research

Lipp GmbH

Project duration:
Sep. 2015 – June 2019

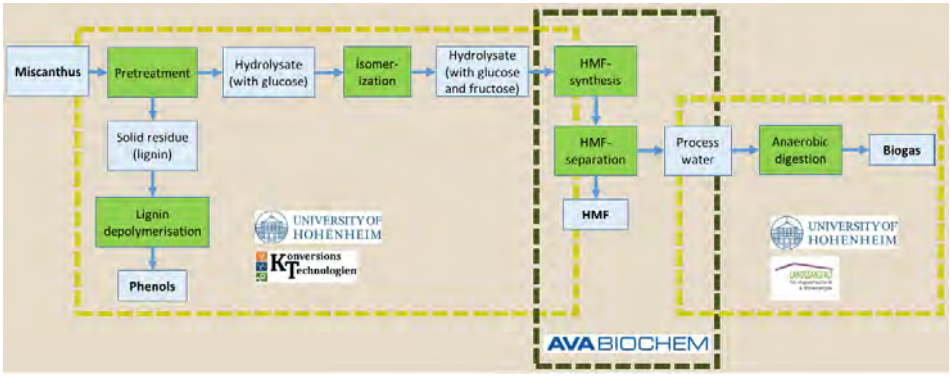
GRowing Advanced industrial Crops on marginal lands for biorEfineries (GRACE)

The BBI demonstration project “GRowing Advanced industrial Crops on marginal lands for biorEfineries” (GRACE) is a 15 million € project, which aims at optimizing different value chains for miscanthus and hemp.

The consortium consists of 22 partners from universities, agricultural companies, and industry. The project is coordinated by the University of Hohenheim in Stuttgart (Germany).

The goal of the project is to produce sustainable products with strong market potential, to guarantee a reliable and affordable supply of sustainably produced biomass, and to better link biomass producers with the processing industry. In order to avoid competition with the cultivation of food or feed crops, miscanthus and hemp are grown on areas that have been polluted by heavy metals, for example, or are unattractive for food production due to lower yields.

Within the framework of project GRACE, the task of the State Institute for Agricultural engineering and Bioenergy will be to evaluate the biogas potential of the process wastewater generated during the Hydroxymethylfurfural (HMF) synthesis from miscanthus biomass. HMF is a platform chemical utilized by bio-based industries for the production, among others, plastic goods. The fermented residue at the end of the digestion process can be used as fertilizers. Hence closing the loop.



Process flowchart of miscanthus byproducts

M. Sc. Tahir Khan

Dr. Johannes Krümpel

PD Dr. Andreas Lemmer

Funding:
Bio-based Industries Joint Undertaking (BBI JU)

Partners:
Wageningen University
INRA
Aberythwyth University
Università Cattolica del Sacro Cuore
University of Zagreb
Novamont S.p.A.
Mogu Srl
AVA Biochem BSL AG
Addiplast SA
INA d.d.
Indena SpA
C.M.F. GREENTECH S.R.L.
Consorzio di Bonifica di Piacenza
Gießereitechnik Kuehn
Ecohemp S.r.l.
Miscanthusgroep
Terravesta
Vandinter-Semo
NovaBiom
Johannes Furtlehner
Cluster SPRING

Project duration:
June 2017 – May 2022

Adaptation of maize-based food-feed-energy systems to limited phosphate resources (AMAIZE – P)

M. Sc. Konstantin Dinkler

M. Sc. Bowen Li (CAU, Peking)

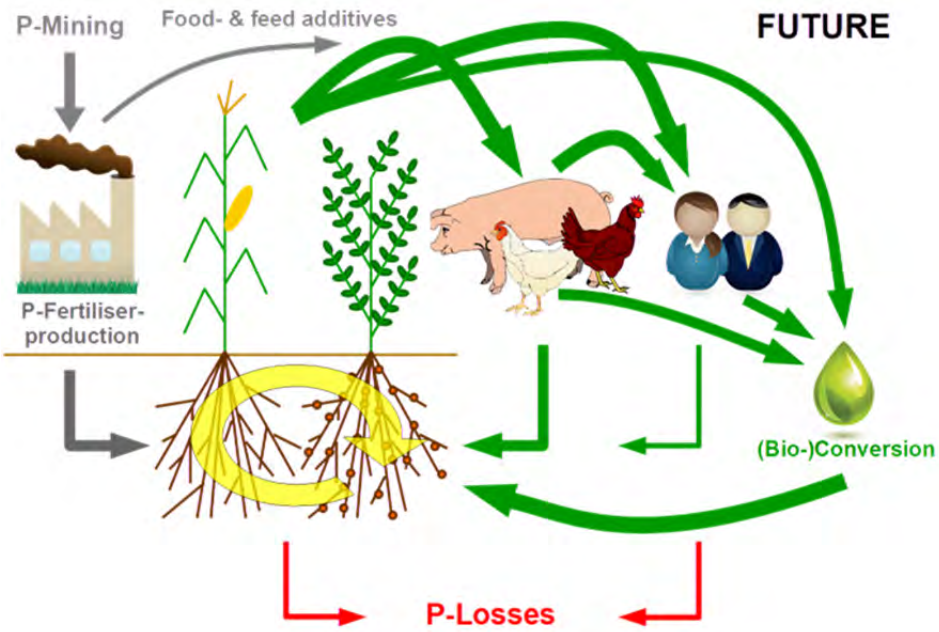
Dr. Guo Jianbin (CAU, Peking)

Dr. Hans Oechsner

Together with the Agricultural University of China in Beijing, the University of Hohenheim has started the international research-training group (IRTG) in November 2018. The project, funded by the German Research Foundation (DFG), has the title "Adaptation of maize-based food-feed-energy systems to limited phosphate resources", short AMAIZE – P, and incorporates an interdisciplinary approach for the evaluation and optimization of the phosphate cycle in agriculture, human and animal alimentation and nutrient recycling. The State Institute of Agricultural Engineering is involved in the research subject 3.3. This subject aims to achieve the following:

Residues from agriculture and food production, excrements from humans and livestock and other organic wastes are often neglected resources for nutrient recovery. Anaerobic digestion can be used to partly decompose the residues and create a fertilizer with high nutrient availability. This nutrient recycling is essential for future high yield agriculture. Simultaneously an energy rich gas is generated that can be used to cover every day needs such as heating and cooking or for electricity production.

It is the goal of this research to evaluate the potential recovery of phosphate from the available organic wastes or byproducts in Germany and China. The evaluation of the phosphate turnover during anaerobic digestion is the second part of this investigation. Furthermore, it is hypothesized that an enhanced phosphate recovery can be achieved while maintaining high gas yields.



Optimized future phosphate cycle (T. Müller, 2017)

Finanzierung:
German Research Foundation (DFG)

Partners:
China Agriculture University (CAU), Volksrepublik China

11 Institutes of the University of Hohenheim

Project duration:
Nov. 2018 – Apr. 2023

Research into the use of N-rich and lignocellulosic biomass for biogas production: methane yield potentials, process stability and nutrient management

Objective 1. Study on potential biogas and methane yields of bioenergy crops grown in Ukraine. Locally suitable varieties and different harvesting dates were investigated. The following crops were studied: soybean, sweet sorghum, soryz, sugar beet, maize, miscanthus, switchgrass and paulownia. 98 crop samples, collected on the research fields of Agrarian Academy of Sciences of Ukraine, were analyzed by using the Hohenheim biogas yield test (HBT). Additionally areal methane yields and methane production costs were calculated.

Objective 2. Digestate can be commercially used as a fertilizer. For its application in precision farming, amount of nutrients in digestate should be controlled and their content should correspond to a specific crop demand. By separation of digestate, the specific nutrients concentration in solid and liquid fractions can be obtained. The experiment is conducted in a full-scale biogas plant. Different working modes of a screw press are investigated.

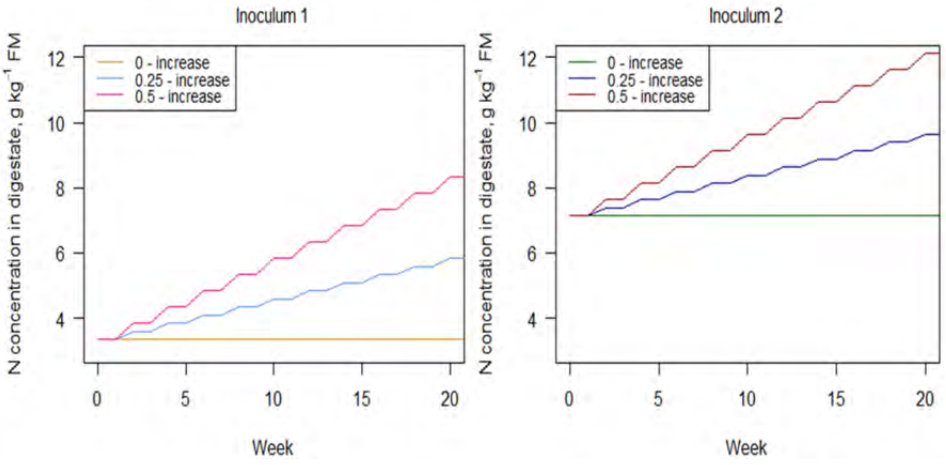
Objective 3. Anaerobic digestion (AD) of protein-rich substrates (e.g. kitchen waste, poultry manure, microalgae, oilseeds, green legumes, wastes from the fish industry) raises nitrogen content of digestate. High concentrations of total ammonia nitrogen (TAN) and free ammonia nitrogen (FAN), formed during AD, are major hazards for biogas process stability and efficiency. In this research, the stepwise increase of N-content in feedstock was studied. The experiment was carried out in the lab-scale system of fifteen continuously stirred-tank reactors. Effect of different initial nitrogen concentrations and different N-increase rates was analyzed.

M. Sc. Ievgeniia Morozova

M. Sc. Nadiia Nikulina

Dipl.-Ing. agr. Christoph Serve-Rieckmann

PD Dr. Andreas Lemmer



Schrittweiser Anstieg der Stickstoffkonzentrationen im Gärrest beim Inokulum 1 (l) und Inokulum 2 (r)

Funding:
German Academic Exchange Service (DAAD)

Partner:
Institute of Bioenergy Crops and Sugar Beet of the National Academy of Agrarian Sciences of Ukraine

Project duration:
Oct. 2016 – Nov. 2019

Optimized substrate management and how the composition of biogas digestate influences soil-nitrogen and soil-humus balance

B. Sc. Florian Siemeister

Dr. Hans Oechsner

The nutrient composition in fermentation residues and thus the later humus effect differs greatly depending on the fermentation substrates. The influence of fermentation residue processing on the composition of fermentation residues and their fertilising effect has not yet been adequately investigated. Furthermore, storage capacity problems due to the observance of blocking periods lead to a seasonal shift in nutrient supply. In practice, storage capacity is often already exhausted in autumn, although the nitrogen requirement would be highest in spring.

Established methods of fermentation residue treatment (dryers, vacuum evaporators) have been analyzed using a mass balance and checked for their efficiency. The aim is to develop an optimised nitrogen separation process for the purpose of selling and storing fertizer.

In each 3-week measurement period, heat input and power consumption were measured for various vacuum evaporators and paddle dryers. Vacuum evaporators have two elementary advantages and thus explains the promising results that were shown. First, the upstream separation of the digestate allows the solids to be used as a separate fertilizer. On the other hand, the nitrogen can be converted into a mineral form, an ammonium sulphate solution, and thus used as a highly concentrated fertilizer.The paddle dryers can also be benificial in terms of its simple pellet storage. When it comes to volume reduction, the paddle dryer outperforms vacuum evaporators due to its very high output (95% compared to 46-58% for evaporators). For this purpose, the vacuum evaporators make much better use of the energy provided in the form of electricity and heat.

In addition, the fermented products obtained from using ryegrass in this investigation were tested for their fertilising effect. The variants with the ammonium sulphate solution significantly showed the highest yields.

By optimising the assessment of the fertilising effect of the fermentation residues, production recommendations can be given for ecologically and economically sustainable biomass production systems

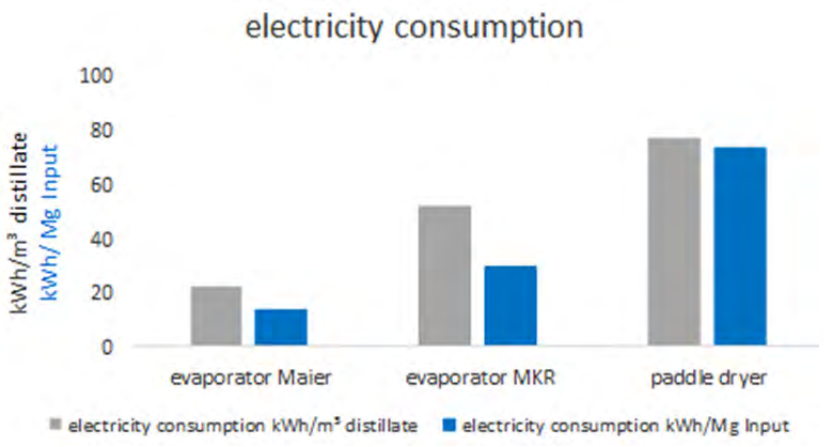
Funding:
Fachagentur für Nachwachsende Rohstoffe (FNR)

Partners:
University of Hohenheim
Fertilization and Soil Matter Dynamics (340i)
Institute of Crop Science

University of Rostock
Chair of Soil Science

Steinbeis Research Center

Project duration:
Nov. 2014 – April 2018



Efficiency comparison of digestate treatment systems

Developing a procedure for the fermentative conversion of hydrogen by fluctuating sources of biomethane in biogas plants (H2-Transfer)

Biogas plants can metabolize H_2 and CO_2 to CH_4 by means of hydrogenotrophic methanogens present in the biocenosis. The direct entry and subsequent implementation of hydrogen in biogas plants is referred to as in-situ methanation and may be an important key position for existing biogas plants in a future post-EEG scenario. A conversion of the existing biogas plants into storage service providers would significantly increase the importance of biogas systems.

Methane production can be carried out both chemically-catalytically and biologically in biogas plants. For this purpose, the amount of carbon dioxide in the biogas is determined and four times the amount of hydrogen is added in the form of fine bubbles to achieve a complete methanation. As a result of CO_2 conversion, the proportion of methane in biogas increases. If necessary, this biogas can be raised to the methane concentration required for feeding into the natural gas network by means of a downstream fine cleaning. The system makes sense as a current transition system and allows the buffering of renewable surplus electricity in the natural gas grid. In addition, a temporal decoupling of power generation and consumption can be achieved.

Four identical 100 liter reactors are operated at a capacity of 2 kg oTS $(m^3\ d)^{-1}$. Gas quality and quantity, introduced amount of H_2, pH values, redox potential and fermenter temperature are recorded online. The percentage of hydrogen in the biogas is used to automatically adjust the amount of H_2 introduced. The resulting biogas is also partly recirculated. The conditions under which methane bacteria optimally convert the added hydrogen to methane are investigated.

Semi-stoichiometric hydrogen gasification was tested, resulting in a 36.6% increase in methane content and a 41.1% decrease in CO_2 content relative to the initial percent distribution. A hydrogen radical of 6.6% could also be measured. Room load variations and thermophilic temperatures will soon be tested.

M. Sc. Bernhard Lecker

Dipl.-Ing. agr. Christoph Serve-Rieckmann

B. Sc. Daniel Riehle

Dr. Hans Oechsner

Laboratory container for hydrogen injection experiments (Lecker, 2016)

Funding:
Ministry for Science Research and Art Baden-Württemberg „Bioökonomie-Projekte“

Partner:
DVGW Research Unit at Engler-Bunte-Institut (DVGW-EBI), KIT

Project duration:
June 2014 – May 2018

Process development for the use of biological methanation in two-stage production of biogas; Subproject 1: Investigation of a fixed-bed fermenter and continuous stirred tank reactor (BioHydroMethan)

M. Sc. Lukas Illi

M. Sc. Bernhard Lecker

B. Sc. Daniel Riehle

Dr. Hans Oechsner

Process development for the use of biological methanation in two-stage production of biogas; Subproject 1: Investigation of a fixed-bed fermenter and continuous stirred tank reactor (BioHydroMethan). The planned expansion of renewable energies in Germany requires considerable storage capacity for electrical energy, which of this size, can only be provided by chemical energy carriers. The biological methanation of hydrogen in the biogas digester is a promising alternative to catalytic methanation.

Within this project, the two-stage digestion with separate acidification stage and the targeted introduction of hydrogen into the methane reactor will be investigated. A particular advantage of this approach is that the produced carbon dioxide during the anaerobic digestion process can be used by hydrogenotrophic methane bacteria, which almost completely convert it to methane. Subsequently, the biogas can be injected into the natural gas grid as biomethane with, compared to conventional biogas, significantly lower treatment costs or can be used as fuel.

As part of this joint project, which consists of three sub-projects, technological tests with different reactor designs, such as anaerobic filters, continuous stirred tank reactors and membrane reactors are carried out on a laboratory scale. The development of a technique for fine bubble hydrogen injection, entering the digester liquid, will be a fundamental task in order to achieve an optimum supply for the archea. Additionally, the influence of bubble size, injection technique as well as the design of the bubble ascension on the transfer efficiency to the digester liquid and the methane bacteria will be examined. A special emphasis will be on the change in the biological community by adding hydrogen to the methane reactors. By measuring the composition and concentration of volatile fatty acids, the buffering capacity, the pH-value, the concentration of dissolved gases in the fermentor substrate and the quality of the resulting product gases, the reactor types will be evaluated, optimized and refined.

The first results of the investigation show that the biological methanation of hydrogen is possible in the two-staged system and does not lead to process disturbances. The amount of methane increases by 16% with a half stoichiometric addition of hydrogen (1:2 CO_2:H_2) and by 32% with a stoichiometric addition of hydrogen (1:4 CO_2:H_2). With a half stoichiometric addition of hydrogen, 75% of the added hydrogen is converted.

Fixed-bed reactors with feeding pump for biological methanation (Illi, 2017)

Funding:
Federal Ministry of Food and Agriculture (BMEL)

Fachagentur Nachwachsende Rohstoffe e.V. (FNR)

Partners:
DVGW Research Unit at Engler-Bunte-Institute (DVGW-EBI) – Water-chemistry and water-technology

Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB)

Project duration:
May 2015 – Dec. 2019

Use of biological methanation for Power-to-Gas Concepts: Fermentative high-pressure methanation of hydrogen

M. Sc. Timo Ullrich

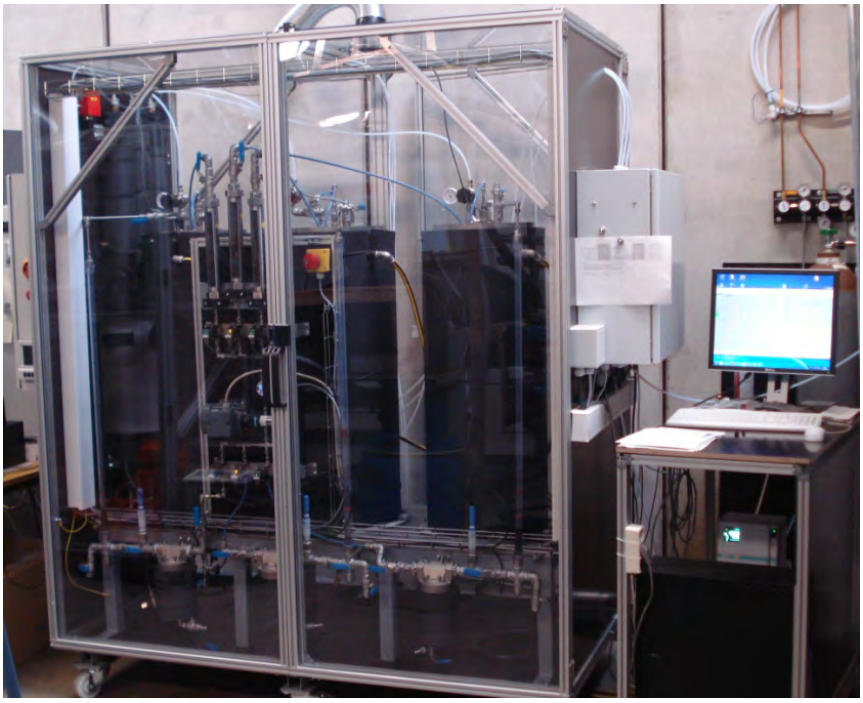
PD Dr. Andreas Lemmer

The biological high-pressure methanation of carbon dioxide and hydrogen to methane is an interesting vector technology for the storage of surplus flow in natural gas networks. Carbon dioxide is converted microbiologically to methane in a pressure reactor by hydrogen produced by electrolysis from wind and solar energy. This "bio-natural gas" can be used as fuel in the area of mobility or fed into natural gas networks. The biological high-pressure methanation of hydrogen to methane is thus a solution approach for a sustainable energy supply in rural areas.

Within the scope of the project, a novel concept of multi-phase high-pressure trickle bed reactors is investigated for methanation, which can be connected downstream of a conventional biogas plant. Compared to alternative methods, this new approach has significant advantages. For example, the fixed bed allows intensive contact between microorganisms and gases and the increased reaction pressure of up to 10 bar improves the previously problematic gas solubility. As a result, high gas and methane yields are expected with this concept.

To this end, a laboratory system for the conversion of hydrogen and carbon dioxide into methane was initially planned and constructed, and equipped with measuring, control and regulation technology. Experimental series on the influence of the operating parameters, such as loading rates, residence time, pressure and temperature, are currently being carried out with regard to an increase in the gas and methane yields.

In initial preliminary tests, the functionality of the concept was successfully demonstrated. Thus, methane contents >97% and methane formation rates of 2.5 l (l d)$^{-1}$ were achieved in the three reactors realized.



Facility at laboratory scale for fermentative high-pressure methanation of hydrogen and carbon-dioxide (Ullrich, 2017)

Funding:
Ministry of science, research and art Baden-Württemberg

Partners:
DVGW Research Unit at Engler-Bunte-Institute (DVGW-EBI)

Engler-Bunte-Institute of KIT (KIT-EBI)

Project duration:
June 2014 – March 2018

Demonstration of dry fermentation and optimization of biogas technology for rural communities in the MENA region (BIOGASMENA)

M. Sc. Nadiia Nikulina

Dr. Hans Oechsner

Funding:
ERANETMED

German Aerospace Center (DLR)

Partners:
State Institute of Agricultural Engineering and Bioenergy - University of Hohenheim (Coordination)

FnBB e.V.

Institut Nationa de la Recherche Agronomique (INRA)

Nenufar SAS

ERM Energies

University of Verona

Fundación IMDEA Energy

Agricultural University of Athens

University of Cyprus Nireas-IWRC

RTD TALOS Limited

S.K. Euromarket LTD

Centre de Biotechnologie de Sfax

EGE University

Universite Sciences et Technologie d'Oran (USTO)

Cairo University

Project duration:
Sep. 2017 – Aug. 2020

In rural areas of the MENA region, communities face multiple challenges: insufficient infrastructure for waste treatment, limited access to cheap energy, particularly electricity, poor soil fertility and water retention capacity.

The BIOGASMENA project is aimed at solving these issues, faced by agrarian communities, by means of treatment and stabilization of organic waste into high-quality, pathogen-free compost and use of biogas in raw form as low-cost fuel for domestic needs or through conversion into electricity in a generator. The project has the following objectives:

- bench-scale dry fermentation trials for process optimization;
- methane potential assays and characterization of digestate
- investigation of the combination of microalgae cultivation with biogas technology;
- planning, installation, and monitoring of a small-scale pilot plant of 5m^3, with a planned electrical power of 500W in Tunisia;
- performance of LCA and techno-economic analyses of designs;
- training and mobility of young researchers from the ERA and MENA region to EU;

Informing the research community, farmers in the MENA region and the public about biogas technology by means of a project website, workshops and project conferences.

The project is intended to develop biogas technologies, environmental-friendly microalgae cultivation, to improve decentralized waste treatment and energy supply as well as fertility in rural communities of the MENA region. The project will also have an impact on environmental and socio-economic levels, for instance, increasing in career opportunities for young researchers and development of local expertise and management of renewable energy projects.

The tunesian farm (l) und area in the farm in Tunisia to implement the pilot plant (r) (Nikulina, 2018)

Research biogas plant "Unterer Lindenhof"

On behalf of the rectorate, the State Institute of Agricultural Engineering and Bioenery is responsible for the operational management and coordination of research projects at the biogas plant "Unterer Lindenhof". In addition to the general operational management responsibilities, the tasks of the State Institute in 2018 focused on the completion of the new digestate storage facility and the replacement of the solids doser at fermenter 2.

In 2018, the new digestate storage facility and the pump and control technology were put into operation together with the new test stand for separators. The new digestate storage facility enables the fermentation residues to be stored for up to 270 days. Due to the gas-tight covering of the digestate storage, the gas storage volume of the research biogas plant was increased to over 1,800 m³. In combination with the new CHP unit with an electrical output of 355 kW, future topics can now be dealt with such as load-dependent, decentralised electricity and heat production to stabilise the grids.

With the test stand for separators, investigations on nutrient separation from fermentation residues can now be carried out on a practical scale at the research biogas plant. The flow rates and the power consumption of the pumps and the separator are recorded online and stored in a database. Company test equipment can also be easily connected to these data records via plug-in connections. With this test stand, the scientific possibilities of using the research biogas plant could be further extended.

The utilisation of the research biogas plant for projects and for the constant high number of visitors from science, society as well as associations and licensing authorities underline the very high relevance of this unique large-scale research station for bioeconomy research at the University of Hohenheim.

PD Dr. Andreas Lemmer

M. Sc. Philipp Kress

The new solid feeder at the digester 2 of the research biogas plant (Kress, 2018)

Funding:
University of Hohenheim
University Building Department of Stuttgart and Hohenheim

Duration:
2017 - 2018

The chemical laboratory of the State Institute of Agricultural Engineering and Bioenergy

Dipl.-Biol. Annette Buschmann

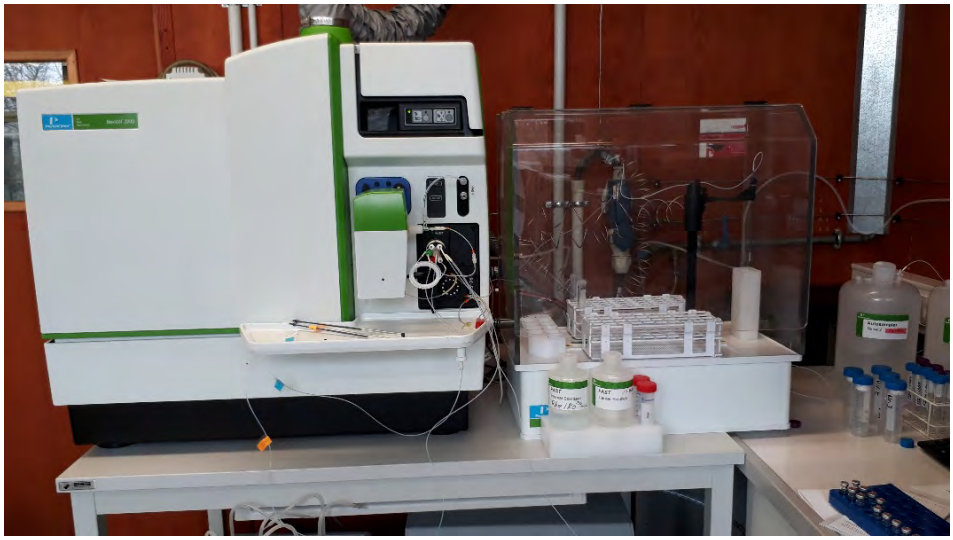
Jacqueline Kindermann

In the chemical laboratory of the State Institute of Agricultural Engineering and Bioenergy, comprehensive chemical analyses for the biological process assessment of fermentation processes during ensiling, biogas production or the biological production of platform chemicals were carried out within a wide variety of projects in 2018.

In addition to the modern laboratory equipment already present (GC, HPLC; TC etc.), a mass spectrometer with inductively coupled plasma mass spectrometry (ICP-MS) was put into operation in 2018.

As the name implies, ICP mass spectrometry is the connection between inductively coupled plasma (ICP) and a mass spectrometer (MS). The ICP-MS uses the capability of argon plasma to efficiently generate single charged ions of the elements of a sample. These ions are then passed into the mass spectrometer. Here, the ions are separated according to their mass/charge ratio. The analytical advantages of the ICP-MS is the rapid quantitative multi-element analysis of a sample within just a few minutes. The detection limits are extremely low. Furthermore, a fast semi-quantitative identification of unknown samples is also possible. In addition, the ICP-MS has the unique ability to identify the isotope of an element.

In the meantime, first results on the trace element composition of liquid samples have been obtained. The results provide a deeper understanding and an improved assessment of the nutrient and trace element supply of different fermentation processes. A methodology is currently being developed for the analysis of solid samples.



The new ICP-MS (Buschmann, 2018)

Co-organized Conferences

Biogas-Infotage
10.-11. January 2018, Ulm Fairs, Ulm, organised together with renergie Allgäu e.V.

ALB Fachtagung - „Wirtschaftsdünger – Rechtliche Bedingungen und Optimierungsmöglichkeiten“
01. March 2018, University of Hohenheim, Stuttgart, organised together with ALB Baden-Württemberg

ALB Fachveranstaltung - „Aktuelle Entwicklungen in der Jungviehaufzucht“
11. April 2018, Dietingen near Rottweil, organised together with ALB Baden-Württemberg

Erster BE20Plus Stakeholderworkshop
18. April 2018, Berlin, organised together with the partners of the BE20Plus project

International Biogas & AD Training Course
06. Mai 2018, Stuttgart, organised together with IBBK

International Biogas & AD Training Course
11.-19. September 2018, Stuttgart, ZIMT, organised together with IBBK

ALB Beratungsdienst 100. Landwirtschaftliches Hauptfest
29. September - 7. October 2018, Stuttgart, organised together with ALB Baden-Württemberg

Internationale Tagung - Fortschritt Gülle und Gärrest 2018
16.-18. October 2018, Schwäbisch Hall, organised together with IBBK

ALB Fachgespräch - „Pferdehaltung“
22. November 2018, Laupheim, organised together with ALB Baden-Württemberg

International Exchange

International Guest Scientists to the State Institute

Stephanie Lansing
Comparison of the legal framework and support measures for renewable energies in Germany and the USA. Investigations on the utilization of waste materials in biogas plants.
University of Maryland - Department of Environmental Science & Technology, United States of Amerika

Joanna Kenit Huertas Parrales
Investigations on processes of biogas desulphurisation
Universidad Nacional Agraria La Molina, Peru

Irina Miroshnichenko
"Methane yield tests of Russian substrates" and "Process stability studies on the fermentation of nitrogen-rich substrates"
Agricultural University Belgorod, Russia

Scientists of the State Institute abroad

Benedikt Hülsemann
TEEP Programm
01.06.2018-31.08.2018, Feng Chia University, Taichung, Taiwan

University examinations 2018

Habilitation

Dr. Andreas Lemmer
Biologische Wasserstoffmethanisierung: Eine Möglichkeit zur Stabilisierung der deutschen Stromnetze. Habilitation lecture, University of Hohenheim, 20.06.2018, Stuttgart

Aufbereitung von Biogas auf Erdgasqualität - Stand der Technik und Zukunftsperspektiven. Inaugural lecture in the context of the habilitation procedure, University of Hohenheim, 20.07.2018, Stuttgart

Doctoral Theses

Timo Ullrich
Biologische Wasserstoffmethanisierung in Hochdruck-Rieselbettreaktoren für Power-to-Gas-Konzepte. Dissertation, University of Hohenheim.

http://opus.uni-hohenheim.de/volltexte/2019/1553/pdf/Dissertation_Timo_Ullrich_VDI.pdf

The doctoral thesis at the faculty of agricultural sciences are scientifically supervised by the Senior Head of the State Institute, Prof. Dr. Thomas Jungbluth.

Master Theses

Michael Brunner
Batteriespeicher in der Landwirtschaft

Nadiia Nikulina
Influence of Nitrogen Concentration in Substrate on the Process Stability in Anaerobic Digestion

Bachelor Theses

Marian Augustin Baumgart
Verfahrenstechnische Untersuchungen einer Kugelmühle zur Biogasertragssteigerung für schwierige Substrate im Praxiseinsatz

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Bär, K., Merkle, W., Tuczinski, M., Saravia, F., Horn, H., Ortloff, F., Graf, F., Lemmer, A., Kolb, T.
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Committee work

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- KTBL - Round Robin Working Group
- KTBL - Sustainable Biogas Generation Working Group
- VDI Guideline 4630
- VDLUFA - commission on biogas yield, residual gas potential
- DLG - Examination Board "separator"
- VERA - International VERA Commission for liquid manure separation
- BCN - Biogas Competence Network e.V.
- International working group "Method Biogas yield determination"
- Various conference committees (eg VDI, KTBL, FNR, FV-Biogas, Progress in Biogas, University of Stuttgart, BITE, doctoral colloquium)
- Project Advisory Boards (Bio2020Plus, OptiSys)

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