SUCCESS STORIES

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European Biogas Association

January 2015

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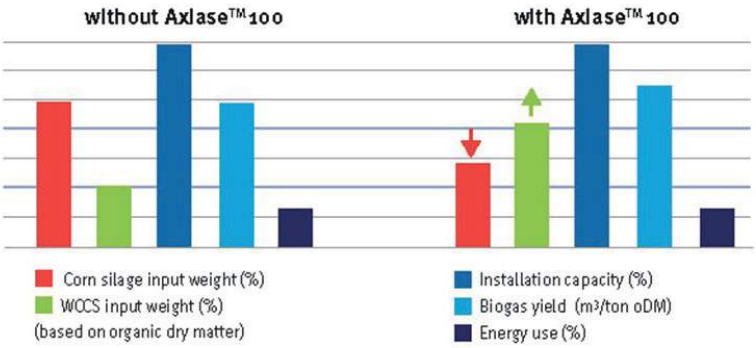
Development of new enzyme product Axiase™ 100

Success Story



Operator

DSM Food Specialties B.V. -
DFS Enzyme Solutions - Biogas

Location of the project

Zeven, Germany

Contact details

Christian Löchte
Christian.Loechte@dsm.com

Results of the project

Biochemical

- *Higher biogas/methane output*
- *Increased process stability*
- *Application of whole crop silages from cereals*
- *(WCCS)*

Physical

- *Optimised feedstock use*
- *Improved mixing*

Economical

- *Feasibility of using substantially more cereal based fibre substrates, increase of specific energy production, replacement of maize silage by WCCS without reducing the methane yield*
- *Cultivation of WCCS on for maize-inappropriate sites*
- *Balance out the crop rotation Equalisation of peak workload*

Socio-environmental

- *Renewable electricity or heat supply*

Project outline

In general, all organic substances are suitable for anaerobic digestion processes, but some are better than others. To run a biogas plant efficiently and without pre-treatment the best substrates are considered easily degraded materials, like sugars, starch, fat and proteins. More complex material containing more non-starch-polysaccharides (NSP) increases viscosity and risk of scum layer formation; mixtures of hydrolytic enzymes are added to improve the use of whole crop cereal silages (WCCS) in the biogas process.

Having this issue in mind, Dutch life sciences company DSM have developed and tested together with MT-Energie GmbH (German biogas plant builder) and IASP/Berlin Humboldt University, the enzyme AxiaseTM 100, which should allow plant operators to use a wide range of cereal-based fibre substrates, and consequently to increase the cost-effectiveness of biogas plants.

DSM
BRIGHT SCIENCE. BRIGHTER LIVING.

Technical data

Year of performed service:
2011 - today
Plant size:
625 kW
Digester volume:
2 x 2.285 m³
Gas storage:
2.450 m³ nett
HRT:
approx. 145 days
Process temperature:
Mesophilic
Type of raw material:
corn silage, whole crop cereal silages (WCCS) from triticale, chicken manure
Utilization of biogas:
conversion into electricity by CHP
Utilization of digestate:
fertiliser

Picture: Bad Königshofen - MT-Energie

Performed actions

The application study was designed in different phases, in which the share of the cereal based fibre substrates was increased step by step. The goal was to increase the rye-WCCS input up to 60% of the total substrate input without using manure or other liquids. In each period of the enzyme application, the conditions of the process were compared with the starting conditions in the reference period. For the balance and the study evaluation the following process data were taken into account: gas yield/energy production, substrate input, rheological behaviour of the fermentation mass and the own energy consumption of the stirrers/total biogas plant.

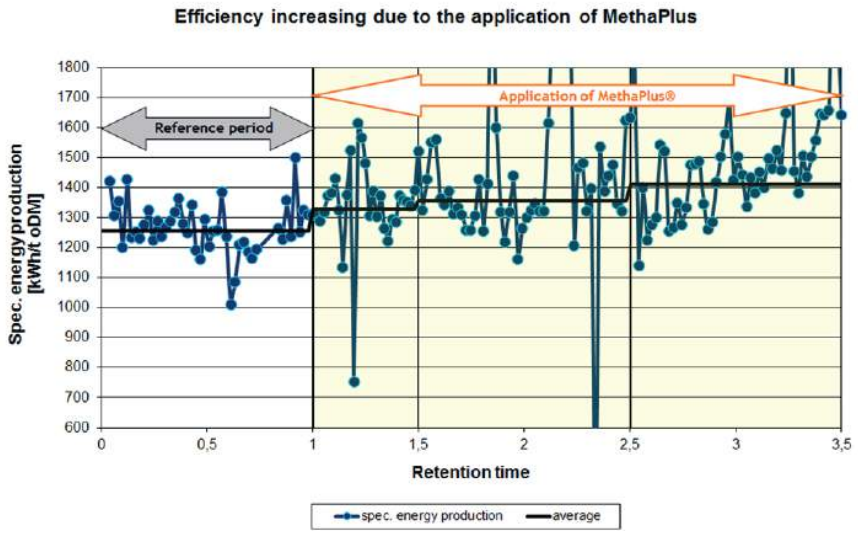
Results of performed service

Axiase™ 100 was developed and field tested in close cooperation of DSM, MT-Energie GmbH and IASP/Berlin Humboldt University. During the field trial, German and Dutch companies were able to validate that when using the enzyme biogas producers can increase use of cereal silage (rye-WCCS) from 25% of total substrate mass to over 60%. This was achieved, thanks to hydrolytic enzymes contained in enzyme mixture, which improve degradation of non-starch- polysaccharides in the biogas process. The key benefits of using the enzyme in cellulosic materials are:

- Replacement of maize silage by more cereal based fibres without reducing the methane yield
- Cultivation of more cereal-based fibres for maize- inappropriate sites
- Better agitation (reduced scum layer)
- Less stress and damages of stirring units and pumps
- Less own energy consumption
- Improved utilisation of the substrate and methane yield

Driving efficiency improvements through MethaPlus® L100 enzyme

Success Story



Operator

DSM Food Specialties B.V.
DFS Enzyme Solutions - Biogas

Location of the project

Klostermansfeld, Germany

Contact details

- Operator: DSM Biogas

Christian Löchte
Christian.Loechte@dsm.com

- Customer: Danpower GmbH

Results of the project

Biochemical

- *Higher biogas/methane output*
- *Increased process stability*

Physical

- *Improved mixing*
- *Reduced digestate through better substrate conversiont*

Economical

- *Lower operation costs*
- *Significant increase of specific energy production by 12%*
- *Raw material savings of 3 tons fresh corn silage each day*
- *Less digestate transportation costs*

Socio-environmental

- *Renewable electricity or heat supply*

Project outline

The development of hydrolytic enzymes to support the speed-limiting step of the biogas process, the degradation of fibres and other lignocelluloses is an important development the biogas processes of the future.t

The enzyme product MethaPlus® L100 especially developed to enhance anaerobic digestion was used in biogas plant Klostermansfeld with the aim of improving both the energy yield and the mixing properties. MethaPlus® is a DSM owned brand.

Technical data

Year of performed service:
2011 - today
Plant size:
834 kW, Agraferm Technologies AG
Digester volume:
Fermenter: 1,600 m³, Storage 3,600 m³
HRT:
approx. 106 days
Process temperature:
mesophilic
Type of raw material:
corn silage, grass silages, grain
Utilization of biogas:
conversion into electricity by CHP
Utilization of digestate:
fertiliser

Picture: DSM Biogas

Performed actions

The study started with a reference period (one hydraulic retention time, HRT) to define the actual energy consumption and output of the biogas plant, which will serve as a reference period to enzyme application. Afterwards, enzyme application followed on a daily basis. For the overall assessment the process was observed during 3,5 hydraulic retention times. During the entire period of experiment, the daily production of energy was recorded and compared with the daily feed amount of substrate based on biweekly substrate analysis (dry matter = DM, organic dry matter = oDM). These tests are used for evaluation of the performance of the biogas plant. Also the energy consumption of the stirrers inside of fermenter was monitored to record the changes in mixing.

Results of performed service

Through application of the enzyme MethaPlus® L100, the specific energy production from crop has increased by 12% in comparison to the reference period (see front page picture). Due to reduction of the mass viscosity in fermenter the overall energy consumption of stirrers has decreased by 30%. As a consequence, the biogas plant saves every day up to 1,5 t oDM of the substrate (4,5 t FM), resulting in financial saving of 45-65.000/a (30-45 /t FM). Thanks to additive application, the operator requires less land for energy crop production. Also amount of the digestate has been lowered, which allowed to store it for longer period of time and save costs on disposal facility. In a majority of cases, savings on investment and substrate are essential to improve economic efficiency of the biogas plant.

Flexible and demand-oriented power production in Klein Meckelsen, Germany

Success Story

Picture: MT-Energie

Operator
Naturenegie Osteraue GmbH & Co. KG

Location of the project
Klein Meckelsen, Germany

Contact details
MT-Energie GmbH
info@MT-Energie.com

Results of the project

Socio-environmental

- *Raised public awareness/acceptance on biogas and renewable energies*
- *Demand-oriented power production*

Project outline

Most of the existing power plants produce electricity continuously or depending on the weather conditions. Although wind and solar plants are very effective, their production is rather unpredictable. Due to surplus or under production of electricity it comes to fluctuations in the power grid, to which the current power transmissions systems are not fully adapted. To balance the production and the demand, power plants which can be powered down or up for a few minutes are absolutely necessary in today's electricity management. Thus, it is important in the context of the targeted energy change to supplement not controllable renewable energy technologies with controllable technologies.

MT-ENERGIE
Biogas-Technologie

Technical data

Year of plant construction:
2012
Year of performed service:
2012
Plant size:
837 kWel installed
Running 16 h/d -> in average 563 kWel 2.300.000 Nm³/a , 263 Nm³/h
Digester volume:
Digester 1.900 m³ secondary digester 1.900 m³
Gas storage:
6.000 m³
HRT:
100 days
Process temperature:
40 °C
Type of raw material:
Maize silage, rye whole plant silage, grass silage, pig slurry
Utilization of biogas:
Electricity goes to "energy2market" (e2m)
Heat utilization:
Heating of households
Utilization of digestate:
The digestate is spread out on the fields of the plant owner
Total investment costs:
2.500.000 €
Subsidy:
Plant didn't receive any subsidy. The average FIT is for a plant of this size approx 19,21 €-c /kWhel

Performed actions

To balance power production and demand, MT-Energie has developed a practice-oriented biogas plant concept, which is based on a purchase contract between the plant operator and energy2market. Core of the concept is large overnight gas storage (N8 type) with twice the size of usual double membrane gas storage. The continuously produced biogas can be stored for several hours without using it in a CHP unit. Each day, plant operator communicates for how long he will run his CHP so that energy2market knows how much electricity will be produced and can be sold. The difference between night and day price amounts approx. 3-4 c/kWhel. N8 storage allows CHP unit (837 kWel) to be switched off for 8 hours, thus an average capacity for running during another 16 hours is 563 kWel. In case of power excess, grid operator can switch off certain biogas plant automatically. Apart from N8, a water buffer tank was installed to store the heat during the day time and to use the heat at night when the CHP unit is not running.

Results of performed service

Electricity in plant "Naturenegie Osteraue" is produced demand-oriented. Because the electricity price is higher during the day, the plant operator receives higher revenue. Additionally, through the German Energy Law (EEG 2012) a premium of 130 per additional installed kW per year is paid for a flexible operation, meaning in this case 28.000/a of additional profit. Thanks to extensive gas storage the biogas plant can also be powered down for short periods of time and the fluctuations in the grid are counteracted. Such a control is also additionally remunerated by the grid operator.
Due to this innovative technology and the resulting possibilities related to the operation, the importance and meaning of biogas plants has increased. This form of plant technology is an important contribution to the energy change and the full supply by renewable energies.

Pre-treatment of dry feedstock in biogas plant in Tongeren, Belgium

Success Story

Picture: Schmack Biogas GmbH

Operator
Schmack Biogas GmbH
Viessman Group

Location of the project
Tongeren, Belgium

Contact details

- Schmack Biogas GmbH
  Gernot Buchta
  Gernot.Buchta@schmack-biogas.com
- Customer: Biopower Tongeren NV

Results of the project

Physical
- *Optimised feedstock use*
- *Digestate use*

Thermodynamics
- *Higher efficiency*

Economical
- *Lower operational costs*
- *Additional revenues through*
- *Heat certificates*
- *Sales of digestate as fertiliser*

Environmental
- *Renewable electricity or heat supply*

Project outline

The biogas plant in Tongeren is the biggest project of its kind in the province of Limburg, and one of the largest in Belgium. Located in the industrial area of Tongeren, it has been designed to digest maize silage (80% of feedstock) and industrial residues, such as glycerine from biodiesel production and other organic waste (20%). In order to ensure high sustainability and to produce 35 000 tons of energy crop per year local farmers have been contracted to deliver maize within maximum 20 km from the plant. Due to the high dry matter content of the feedstock, the plant constructor has decided to install a pre-treatment hydrolysis digester EUCO.

Schmack

VIESMANN Group

Technical data

Year of plant construction:
2011-2012
Plant size:
2,8 MW_{el}
Digester volume:
13,000 m^3
HRT:
approx. 110 days
Process temperature:
Mesophilic, approx. 40°C
Type of raw material:
Maize silage and glycerine; residues from industry and agriculture, approx. 40 000 t/year
Utilization of biogas:
Electricity production, feeding into grid
Heat utilization:
Heat is used for digestate drying and digesters heating
Utilization of digestate:
After drying the digestate is used as a high quality, low odor and environmentally friendly fertiliser for agriculture
Total investment costs:
11 Mio. €
Subsidy:
The plant gets Green Certificates for produced electricity in the frame of the Flemish support scheme

Performed actions

The biogas plant in Tongeren consists of a pre-treatment digester EUCO, a tank digester and a gas-tight storage. Inside the first digester, which is constructed in a horizontal form, a paddle agitator mixes solid feedstock with pre-fermented material. The main function of the EUCO is to liquefy the solid feedstock (hydrolysis) to provide the second-stage digester with well broken-down material. As a result of such hydrolysis and the homogenisation of the feedstock, less mixing is required at the second stage. After the entire retention time, fermented mass is pumped from tank digester into the covered, gas-tight storage.

Results of performed service

The biogas plant in Tongeren is operational since August 2012. With the current installed capacity of 2,8 MWel, the plant supplies 6 500 households with renewable electricity and saves up to 10 000 tonnes of CO2 annually. In the future, the project can be extended to even double size. The inauguration of "Biopower Tongeren" was celebrated in the presence of the Minister of Economy and Innovation and the Mayor of the City of Tongeren.

Thanks to the EUCO pre-treatment tank, energy needed for mixing significantly decreased and material with high dry matter content can be simply digested without addition of liquids. Furthermore, even up to 50% of the biogas yield can be produced on the first stage of fermentation process. Nowadays, scientists and operators are seeking for new substrates and optimisation of anaerobic digestion. Therefore, different pre-treatment methods of the feedstock and increased availability of easily digestible organic matter will gain more importance in the future.

The first biomethane plant running on hop silage in Oberlauterbach-Hallertau, Germany

Success Story

Picture: Oberlauterbach plant Schmack Biogas GmbH

Operator
Bioerdgas Hallertau GmbH

Location of the project
Oberlauterbach, Hallertau, Germany

Contact details
Schmack Biogas GmbH (Viessmann Group)
Bayernwerk 8
92421 Schwandorf - Germany

Results of the project

Biochemical:
- *Application of extrusion and magnets to remove metal contaminants and increase gas yield.*

Physical:
- *Optimised feedstock usage*
- *Improved mixing*
- *Gas upgrading*

Economical:
- *Lower operation costs, reduced feed- stock costs, reduced fertiliser costs for farmers*

Socio-environmental:
- *Waste reduction*
- *Soil improvement*

Project outline

At the heart of Bavaria, Hallertau is a major hop growing region worldwide. Unlike hop umbels, hop silage (residues from hop growing) cannot be used for the process of beer brewing. It was previously stored and spread on hop fields as a fertilizer, without any energetic use. The idea behind the project was to recover energy from hop silage produced in Hallertau. Schmack built a biogas plant specifically designed for processing fibres-rich materials (lignocelluslosic). Schmack technology enables the digestion of a broad range of agricultural residues including grass, corn silage and hop silage.

Schmack

VIESMANN Group

Technical data

Year of plant construction:
2012
Year of performed service:
2012
Plant size:
11.5 MWGAS approx. 95 million kWh/a
Digester volume:
22,000 m³
Gas storage:
10,000 m³ on site, unlimited storage in gas grid
HRT:
approx. 110 days
Process temperature:
Mesophilic, approx. 40°C
Type of raw material:
65% hop silage
35% maize / grass silage
Utilization of biogas:
Biogas upgrading to biomethane, injection to the gas grid
Utilization of digestate:
High-grade, low odour fertiliser

Picture: Oberlauterbach plant - Schmack Biogas GmbH

Performed actions

The hop silage is collected among 170 farms that represent one third of the total production in the region. It is mechanically pre-treated before entering the AD system. The spikes, which are needed to mount the hops at the rack, are removed during pre-treatment. This way no metal is spread on field and metal can be recycled. The AD system is made of 3 horizontal digesters and 4 round digesters. It is able to process various fibrous material, including hop silage. The biogas produced at Oberlauterbach plant undergoes upgrading process (CO2 removal) so that biomethane is injected to the national gas grid, 5 km away from the plant. Finally, digestate is sent to a covered post-fermenter and samples are tested in a lab for their content in trace elements (phosphorus, etc). This way, the farmer knows exactly the amount of digestate to spread on the fields to achieve best nutrition.

Results of performed service

The 95 million kWh produced every year roughly correspond to the average gas consumption of 5,000 households should biomethane be used for heat generation only. The plant, owned by Bioerdgas Hallertau GmbH, is the result of a joint venture between a large hop grower (HVG) and an energy provider (E.ON Bioerdgas GmbH). It was inaugurated by Bavarias's State Governor Seehofer in September 2012.

Waste to Energy in England

Success Story

Pictures: BioCycle - MT-Energie

Operator
Swancote Energy Ltd.

Location of the project
Bridgnorth, Shropshire, England

Contact details
Simon Fox-Davies
simon@swancoteenergy.com

Results of the project

Socio-environmental

- *Waste reduction*
- *Raised public awareness/acceptance on biogas and renewable energies*

Project outline

The EU and the UK Government tightened the regulations for waste disposal, so that organic waste disposal on the landfill should be gradually lowered and no longer available after 2020. Due to this and also other reasons, the disposal costs for waste have increased in almost all Member States. There is overall increasing pressure, also public pressure, to make a better use of resources and to make the best possible use of the waste. Facing this multiple background, companies are searching for alternatives regarding waste disposal or for an efficient and ideally profitable recycling.

Schmack

VIESMANN Group

Technical data

Year of plant construction:
2011
Year of performed service:
2011
Plant size:
>2.000 kWe installed, 7.000.000 Nm^3/a , 850 Nm^3/h
Digester volume:
Digester 2 x 2,300 m^3, Secondary digester 1 x 2,300 m^3
Gas storage:
4,500 m^3
HRT:
50 days
Process temperature:
40°C
Type of raw material:
Food waste, Potato peel, Yoghourt sludge, Maize Silage, Grass Silage
Utilization of biogas:
Electricity production
Utilization of digestate:
Heat is used for running a pre-pasteurization system for the feed stock and is also used ina steam generator, that turns the excess heat into electricity
Total investment costs:
n.a.

Performed actions

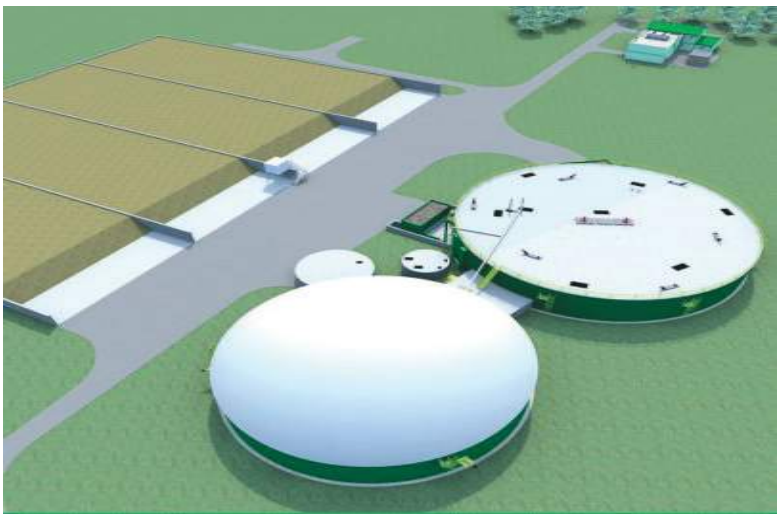
The know-how established over many years in the development and construction of biogas plants, as well as research and diverse application of input materials (substrates), had an undeniable influence on this project. Biogas plant Swancote Energy Ltd has been designed to digeste organic material. Besides energy crops also food waste are used on site and a de-packing system was installed to handle any kind of packed food waste. For the professional waste disposal a hygienisation unit (processing food waste at 70°C for 1 hour) was implemented by the plant operator which uses the exhaust heat of the CHP. This is an intelligent interconnection of different processes for an increased degree of efficiency. At the end of the process, digestate is separated from liquid and spread on the nearby fields. Instead of cost intensive waste disposal, supermarkets or food producers / processers can now deliver directly to the nearby biogas plant in Bridgnorth.

Results of performed service

Since the Swancote plant is operating, local food companies save both transportation costs and a part of the disposal costs. The plant operator, private households, the climate protection and the regional climate balance are benefitting from the sensible waste recycling for producing regenerative electricity as a substitution to fossil and nuclear energy. Furthermore, landfills are relieved.
Additionally, with the digestate a nutritious, almost odourless organic fertiliser is produced as a by-product which can be spread on the farmland. This fertiliser is less aggressive for the soil and plants compared to, for example, manure and an economical alternative for expensive artificial fertilizer.

The first biogas plant in Serbia

Success Story



Picture : Biogest

Operator
BIOGEST Energie- und Wassertechnik GmbH

Location of the project
Vrbas, Serbia

Contact details
- Client : Mirotin Energo, d.o.o.

tel: +381 21 6350 780
e-mail: office@mirotinen.rs

Results of the project

Socio-environmental
- *Renewable electricity or heat supply*

Picture : Opening ceremony Vrbas biogas plant - Biogest

Project outline

In the course of constructing this biogas plant, the plant manufacturer had to overcome numerous problems, which were related, on one hand, to project implementation in a non-EU country and, on the other hand, to the general conditions for renewable energy from biogas in this target market.

Since Serbia doesn`t belong to the EU and there was no existing biogas plant at the time, project in Vrbas had to overwhelm numerous administrative and legal hurdles. First of all, instruments for support of energy production from biogas were not existing or underestimated according to Serbian law, in e.g. low tariffs for electricity or no investment subsidies. Local authorities and grid operators lacked previous experience with such projects, which made the permitting procedure and connection to the grid more difficult. Also different than in other parts of Europe climate conditions had to be taken into account (colder winters, hotter summers). Existing infrastructure, e.g. manure storage, was not sufficient for the investment and had to be adopted. Last but not least, bridging the language was also a challenge for the Austrian plant manufacturer and constructor.

BIOGEST® BIOGAS

Technical data

Year of plant construction:
2012
Year of performed service:
2011 - 2012
Plant size:
1,000 kWel, 2.074.463 Nm³/y, 237 Nm³/h, 45.960 t fresh material/ y
Digester volume:
5,300 m³
Gas storage:
3,100 m³
HRT:
60 days
Process temperature:
Mesophilic, 40°C
Type of raw material:
Agricultural waste (70%)
Energy crops (30%)
Utilization of biogas:
Supply of electrical power to about 3.000 households
Heat utilization:
Supply of the regional hospital
Utilization of digestate:
Separation, distribution on agricultural fields
Total investment costs:
~ 6 Mio. EUR
Subsidy:
FIT is 14,22 euro cent/kWh, heat price still under negotiation

Performed actions

In order to build the first biogas plant in Serbia, the technology supplier together with the future operator had to perform much more work than in case of many other projects located in other countries. The Serbian law is not unified with the EU directives, thus the company law, labour law and tax law have been deeply studied and the differences were incorporated into the project planning. For trading with the outside of the EU, the constructor had to ensure export credit guarantees from his national agency, pass the customs clearance at Serbian authority and at the same time to monitor price fluctuations of exchange rates. Due to several reasons some parts of the biogas plant had to be produced locally, but the investor managed to find local suppliers and subcontractors, who delivered products adequate for a biogas plant. Part of the work was performed with national and international consultants, who contributed to internal acquisition and expansion of the necessary know-how. Finally, the qualified staff was found and trained for constructing and operating the biogas plant.

Results of performed service

The first biogas plant in Serbia was completed in a short time, within less than 4 months of the construction process and with only 6 weeks of start-up for reaching the full load. The raw materials are provided by Mirotin Group, one of the largest agribusinesses in Vojvodina Province. The plant, which in 70% is fed by manure and agricultural residues, has an excellent efficiency of above 95% of full load (average) and can supply now 3.000 nearby households with electricity. Apart from material effects of the investment, also some non- visible profits have been gained. Opening of the first Serbian plant was celebrated with the Prime Minister and numerous representatives from politics, industry and media, which made the biogas project known in the whole country. Also, a very good constructor-customer relationship has been established, and it became a starting point for the future cooperation and biogas investments in this target country.

Absolute efficiency in electricity and heat production from biogas by fermenting renewable substrates in Třeboň, Czech Republic

Success Story

Picture: MT-Energie

Operator
BIOPLYN Třeboň spol. s.r.o.

Location of the project
Třeboň, Czech Republic

Contact details
- MT-Energie: info@MT-Energie.com
- Customer: BIOPLYN Třeboň

Results of the project

Socio-environmental
- *Renewable electricity or heat supply*
- *Waste reduction*
- *New jobs*
- *Raised public awareness/acceptance on biogas and renewable energies*

Project outline

The City of Třeboň is a famous health resort village in southern Czech Republic. The huge energy demand and rising energy prices for the resort town on, together with the enthusiasm of a farmer for biogas, made it possible to create an innovative biogas project for the area.

The investor was already running one of the oldest biogas plants in the country (built in the 1970s) and wanted to build another one using modern technology to fully use the excess heat. The new biogas plant, built next to the first one, was expected to be a significant economic contribution to the farm.

MT-ENERGIE
Biogas-Technologie

Technical data

Year of plant construction:
2009
Year of performed service:
2009 - today
Plant size:
844 kW + 170 kW
Digester volume:
2 x digester (2 x 3.325 m^3 gross or 6.095 m^3 net). Dimensions: 21 m x 6 m
1x secondary digester (3.325 m^3 gross). Dimensions: 23 m x 6 m
Gas storage:
2.450 m^3 net
HRT:
approx. 130 days
Process temperature:
40°C
Type of raw material:
Maize silage
Grass silage
Pig manure
Utilization of biogas:
Production of electricity and heat in 2 independent cogeneration units.
Heat utilization:
Heat is used in health resort village and for heating of the swimming pool. Part is also used by the operator of biogas plant.
Utilization of digestate:
Digestate is given for free to farmers and spread as a fertilizer on nearby fields
Total investment costs:
about 4,5 Mio. €
Subsidy:
5% from the Czech Ministry of Industry . FIT for electricity obtained in 2009 4.12 CZK/kWh (approx. 0,16 EUR/kWh). Internal contract for heat between the operator and consumer.

Performed actions

MT-Energie developed a concept for this situation. A new biogas plant was built and connected to the old one. When biogas produced in the old facility meets certain quality requirements, it is mixed with gas of the new plant. Biogas produced passes through a 4,6 km long pipeline to the resort village. Locally, the gas is used in a cogeneration plant with the capacity of 820 kW to generate heat and electricity. All excess heat is used in spa and wellness center. Electricity is fed into the network. The CHP is located in the immediate vicinity of houses and is particularly well sound-proofed.
There is also a small cogeneration plant with the capacity of 170 kW located directly at the biogas plant. With the heat it produces, the buildings of the investor are heated, and the power created is used for own consumption with the excess power fed into the grid.

Results of performed service

The operator of the resort gets stable, cheap, and ecological energy year round. The biogas plant accepts animal waste from the pig production, lowers energy costs and creates a stable income for the farm. In such operations, both entities can operate very effectively.
This project concept is positively presented not only to the Spa visitors, but also in local press and energy journals and has won many awards. One of the most important is the designation: "Czech Ecological and Energetic Project of 2009".
Positive reaction to this project has helped increase the acceptance of biogas plants and renewable energy in the Czech Republic, which in recent years had been heavily damaged by the photovoltaic industry.

Dry anaerobic digestion biogas plant "Biodigester I" at the University of Wisconsin, Oshkosh

Success Story

Picture: BIOFerm Energy Systemstt

Operator
BIOFerm GmbH/BIOFerm Energy Systems

Location of the project
Oshkosh, WI, USA

Contact details
BIOFerm Energy Systems
Amber Blythe, Application Engineer
blya@biofermenergy.com
Tel: +1 608 229 6503

Project outline

The University of Wisconsin - Oshkosh (UWO) is the first campus in its State, which adopted a comprehensive Climate Action Plans with goals for energy efficiency and renewable energy. The campus is supposed to achieve carbon neutrality by 2025 and a biogas plant was one of the first steps to reduce amount of organic waste and to increase energy independence. BIOFerm GmbH and BIOFerm Energy Systems have designed and installed a dry fermentation anaerobic digester (BD1), which was a first of its kind in the U.S.A.

Results of the project

Biochemical
- *Waste-to-energy: Digestion of organic waste material and material from landscape maintenance from the municipal- ity and campus*

Physical
- *Optimized feedstock usage*
- *Reduced odours, noise (enclosed mixing lobby and exhaust*
- *air filtering)*

Thermodynamics
- *Lower electric energy process for the process*
- *Lower heat energy process for the process*
- *Higher efficiency*

Economical
- *Lower operation costs*
- *Lower maintenance costs*

Socio-environmental
- *Reduced pollution*
- *Waste reduction*
- *Project for the students to learn more about biogas and dry AD technol- ogyRaised public aware- ness/acceptance on biogas and renewable energies*
- *Renewable electricity or heat supply*

Schmack

VIESMANN Group

Technical data

Year of plant construction:
2010-11
Plant size:
Approx. 2,3 million kWh/a electric and 2.8 million kWh/a thermal output
Digester volume:
Approx. 2,900 m³ digester volume; percolate tank: approx. 450 m³
HRT:
approx. 80 days
Process temperature:
Mesophilic 40°C
Type of raw material:
Material from landscape maintenance and biowaste
Utilization of biogas:
Feed into the electrical grid and the local campus district heating network. Co-utilisation of gas from the local sewage treatment plant in summer.
Heat utilization:
Local campus district heating network
Utilization of digestate:
Further processing through local composting company
Total investment costs:
$ 3,5 Mio. (approx. € 2,7 Mio.)
Subsidy:
Grant funding for the biodigester came from the state of Wisconsin ($232.587), the U.S. Department of Energy ($500.000) and the U.S. Treasury Section 1603 ($1 million). The rest was paid for by the University of Wisconsin—Oshkosh

Performed actions

Biogas plant receives its substrates from the University canteen, local grocery stores and bedding materials from some of the surrounding farms. Due to high dry matter content of the feedstock, plan designer used BIOFerm dry AD process, which is a batch process with a substrate loaded into garage-style digesters with front-end loaders. The solid material does not need to be pre-processed or turned into pumpable slurry, and the digesters have no moving parts like agitators. The advantages of such a plant are low maintenance costs and no downtime in case of contamination (e.g. plastic bags) tangled up in the mixers. Produced biogas is incinerated in a CHP unit to produce electricity, which goes into local power grid and supplies the campus with about 8% of its electrical needs.

Results of performed service

The University plant is in full operation since September 2011. Currently, BD1 acts as a "living, learning laboratory" for students in the field of renewable energies. In addition to the digester, UWO established the Environmental Research and Innovation Center (ERIC), a laboratory for students to conduct water and soil tests and where the new substrates can be tested before going into the digester.
BD1 is nationally recognized as the first dry fermentation anaerobic digester to be in operation in United States, although several have been installed since 2011. It regularly hosts tours of its operations and is frequently featured in biogas and waste management media across the country.

Installation of an energy-saving fermenter-agitator in Japan

Success Story

Picture: Streisal

Operator
Streisal GmbH

Location of the project
Shihoro, Kato District
Hokkaidō, Japan

Results of the project

Physical
- *Improved mixing*

Thermodynamics
- *Lower electric energy process*

Economical
- *Lower operation costs*
- *Lower maintenance costs*

Socio-environmental
- *Renewable energy from waste*

Project outline

After the nuclear plant catastrophe in Fukushima, Japan changed course of its energy policy and introduced new Feed-in Tariffs (FIT) for renewable energy. Biogas has received one of the highest support within other sources and the net electricity can be sold at very favourable rates of 40,95 ¥/kWh (approx. 0,33 €/kWh) for biogas from sewage sludge and manure. Biogas plants in Japan are fed usually with manure and waste only, which have usually lower energy content, high volume (dry matter content between 8% and 10%) and require bigger reactors. Plant builders require a very reliable stirring solution with maximum possible efficiency and low maintenance to make the investment economically feasible.

Technical data

Year of plant construction:
2012
Year of performed service:
2012 - today
Plant size:
60 kW
Digester volume:
780 m3 (hydraulic tank)
HRT:
30 days
Type of raw material:
Cow manure
Utilization of biogas:
Combined heat and power
Heat utilization:
Heating farm houses and barns
Utilization of digestate:
Fertilizer

Picture: Installation of Streisal Biobull® agitator with external support column

Performed actions

A new agitator streisal Biobull® (11 kW) has been installed in September 2012 and a few months later the plant in Shihoro was in start-up phase. The efficiency of an agitator is basically determined by the mechanical efficiency of the propeller (profile, diameter, etc.), the turning speed (low speed is much more efficient than high speed, because the losses are lower) and the efficiency of the motor. The maximum efficiency in installed mixer has been achieved thanks to large propellers and low, frequency controlled speed, which is beneficial for the biological system.

Results of performed service

Already in the first weeks of the plant operation, it has been proved that internal energy consumption of the plant was lower than in previously installed, comparable biogas plants in Japan. The mixer provides optimum serviceability, because all important wear parts are mounted externally and are thus easy to access for maintenance. As a result, the fermenter doesn`t have to be opened for service work, and the biological processes inside of the reactor are not influenced.
Well-adopted technology for anaerobic digestion of liquid substances can help to reduce volumes of animal manure and to create additional revenue for the plant operator.

Smooth and cost-effective hydrolysis in Tannhausen, Germany

Success Story

Picture: Streisal Maischebull® / Hydrobull® agitator system for mixing pits and hydrolysis tanks

Operator
Streisal GmbH

Location of the project
Tannhausen, Germany

Contact details
Bioenergy Abele GbR
Schloßstraße 10 D-73497 Tannhausen

Results of the project

Physical
- *Improved mixing*

Thermodynamics
- *Lower electric energy process*

Economical
- *Lower operation costs*
- *Lower maintenance costs*

Project outline

Hydrolysis tank of the biogas plant in Tannhausen was equipped with 1 compulsory mixer ZM4 (Zwangs-Mischer, Serie 4) and 1 submersible mixer. The installed mixers were suitable only for low concentration of dry substance, thus the fresh material had to be diluted with a substance from post- digester. Such a mixing required a lot of recirculation from post-digester (additional pumping power), resulting in long operating time of mixers at full load and high energy consumption and operating cost of the facility.

Due to this high recirculation the pH-value in the hydrolysis tank was increasing. (continued next page)

Technical data

Year of plant construction:
2010
Year of performed service:
2011 - today
Plant size:
570 kW
Digester volume:
200 m3 (hydraulic tank)
Process temperature:
approx. 39°C
Type of raw material:
Pig manure, grass silage, corn silage, GPS
Utilization of biogas:
Combined heat and power
Heat utilization:
District heating of the neighbouring village
Utilization of digestate:
Fertilizer

As a consequence, decomposition of the fresh substrate and the process stability was insufficient and it further resulted in a lower biogas production. Mixers maintenance required each time opening of the reactor, which couldn`t be done without disturbance of the biological processes.
Moreover, alternating substrate level in hydrolysis reactor required from the plant operator manual height adjustment of the mixers nearly every day. The Tannhausen plant required new stirring solution to overcome the deficiencies, to make the hydrolisis process work and to reduce the operating and service costs. The Tannhausen plant required new stirring solution to overcome the deficiencies, to make the hydrolysis process work and to reduce the operating and service costs.

Performed actions

The old mixers have been replaced by powerful streisal Hydrobull® agitator system, consisting of two long-axis agitators, customised for the particular mixing task. Due to large, three-dimensionally profiled propellers and low, frequency controlled speed this mixing system ensures maximum efficiency and is suitable for hydrolysis tanks with fibrous substrates and highest dry substance concentrations.

Results of performed service

Thanks to the new stirring tools the entire tank volume is now mixed homogenously at all substrate levels and the fermenter is able to handle significantly higher dry substance concentrations. There is much less recirculation from post digester required and as a consequence much lower power consumption of recirculation pumps. Plant operator reduced internal power consumption for mixing of hydrolysis tank by 50%, which resulted in annual cost savings of around 6.500 €. Also the maintenance work and related costs have been significantly reduced.
Proper agitation system inside of reactor ensures correct distribution of substrates and microorganisms. Correct pH level of hydrolysis ensures better process stability, better decomposition of fresh material and allows for longer retention time.

Financing the first Anaerobic Digestion cogeneration project in Romania

Success Story

Picture : Vireo Energy AB

Operator
Vireo Energy AB through Joint Venture Genesis BioPartner SRL

Location of the project
Filipestii de Padure, Prahova, Romania

Contact details
Genesis BioPartner SRL
Ariceștii Rahtivani
Str. Bruxelles 877A
Prahova, 107025, Romania

Results of the project

Socio-environmental

- *Renewable electricity or heat supply*
- *Waste reduction*
- *Soil improvement*
- *Reduced pollution*
- *New jobs*
- *Raised public awareness/acceptance*
- *on biogas and renewable energies*

Project outline

Biogas projects can be financed using different financing structures: credits from private banks, energy contracting in the field of biogas production or investment funds. Each financing model has particular advantages and disadvantages for the investor and the financing bodies; however, each project is specific and may require different form of a financial support.

Swedish biogas investor and operator - Vireo Energy - sought a stable business partner for a Romanian market entry and reached an agreement with Baupartner SRL. In 2012 the Romanian joint venture company JV Genesis BioPartner SRL was founded with the goal to build a substantial number of biogas plants in Romania over the next few years. The first plant, called Bio 1 was completed in early 2013 and both partners contributed funds to the project. The companies also hold shares in an approx. 500 ha agricultural holding in the Prahova region, which supplies feedstock to the new plant: maize silage, sorghum, triticale.

Vireo ENERGY

Technical data

Year of performed service:
2012-2013
Year of performed service:
Inaugurated on July 9, 2013
Plant size:
1,063 kW_{el}
Digester volume:
Net usable volume: approx. 3,500 m^3 + approx. 2,500 m^3
6,000 m^3 digestate storage
HRT:
approx. 70 days
Process temperature:
40°C
Type of raw material:
Maize silage
Sorghum
Triticale
Expired margarine Waste yeast
Fats from WWTP
Utilization of biogas:
Decentralised electricity and heat production
Heat utilization:
Steam and hot water sold to adjacent meat processing plant
Utilization of digestate:
Used as fertiliser on own fields and on the fields of our agriculture partners
Total investment costs:
N/A
Obtained FIT / certificate:
3 Green Certificates per MWh
Subsidy:
None

Performed actions

The Bio 1 plant was constructed in less than 12 months, on schedule and on budget, thanks to the hard and diligent work of the local Genesis Biotech team. Fermentation line, cogeneration unit and civil works were provided or performed by proven and experienced partner companies. The local meat processing factory - Cris-Tim - is the heat off-taker (steam and hot water) and Cris-Tim also supplies waste used in the fermentation process. The project started out being fed exclusively with corn silage but over time other crops and increasing volumes of organic waste have been added. The project was refinanced with Romanian Banca Comerciala Carpatica in February 2014.

Results of performed service

Bio 1 was the first cogeneration Anaerobic Digestion (AD) biogas project in Romania, breaking new ground on a virgin market. The project would not have been possible without the co-operation of the Swedish and Romanian investors. A large number of prominent guests have visited the plant, spreading the knowledge about biogas as an efficient and environmentally sound source of energy.

In terms of socio-economic aspects, the project has created job opportunities in Prahova region; some 5-10 direct employments and a larger number in the agriculture companies and transport companies supplying the feedstock.

Bio 1 is now operating on 100% capacity and also uses locally sourced organic waste that otherwise would have ended up on landfills, where approx. 99% of Romanian waste ends up today.

While the project has been successfully implemented from an operational point of view, the project economics have suffered from Romanian legislators introducing unfavourable changes to the renewable energy incentive scheme. In addition, a further cause of concern is the lack of project finance opportunities in the Romanian market, as most investors will not be able to invest equity to refinance at a later stage.

Biogas power plant with record performance in 2013

Success Story

Picture : BTS Biogas

Technology supplier:
BTS Biogas crl/GmbH

Location of the project
Concamarise, Province of Verona, Italy

Contact details
BTS Biogas Srl/GmbH
San Lorenzo, 34 St. Lorenznerstr.
I-39031 Brunico/Bruneck (BZ) T +39 0474 37 01 19 info@bts-biogas.com

Results of the project

Bio-chemical
- *higher biogas output or methane content*

Physical
- *improved mixing*

Thermodynamics
- *higher efficiency*

Picture : Awarding ceremony

Project outline

Located in Concamarise, in the province of Verona, the Finato Martinati farm chose BTS Biogas to design, construct and manage a biogas plant. Owned by Guido Finato-Martinati, this historic property in the Verona countryside has over 334 hectares devoted to growing tobacco, maize, onions, herbs, triticale and organic rice; it also has barns for about 400 dairy and breeding cows. Set up in the far-off 1800s for growing tobacco, in 2009 it was decided to invest in renewable energy by constructing a photovoltaic system and a biogas power plant. After Finato Martinati farm opted for BTS Biogas, the analysis stage was followed by the construction of a 703 kW biogas plant that would guarantee maximum yield from cattle slurry, maize silage and ryegrass silage. They also needed to use the resulting digestate to fertilize their land.

The plant operated for over 8600 hours, had an average daily production of 16,870 kW and 68 m3 of digested waste and an energy efficiency level of over 85%. The criteria analysed when choosing the plant with the best performance included the percentage of unfermented biomass, cost, quality, the level of forage conversion and the percentage of manure used.

Technical data

Year of performed service:
2009
Plant size:
2013
Plant size:
703 kW
HRT:
approx. 106 days
Type of raw material:
11 t of corn silage, 13 t of ryegrass silage, 2 t of manure, 3 t of sorghum and 35 m3 of cow slurry
Utilization of biogas:
biogas plant operation (7%) and conversion to electricity and fed to the grid
Heat utilization:
district heating of the farm's houses and offices
Utilization of digestate:
fertiliser and natural soil improver in the fields
Obtained FiT/certificate:
Biogas Award 2013 for the biogas plant with the best performance of the year

Performed actions

The owner and the operator of the plant are very committed and well informed about the project. They use additives in a fermenter to provide optimal biological conditions for microorganisms (adequate substrates, right harvesting date, perfect silos and loader system). Furthermore the installation of the BIOaccelerator S helps to get such good results. The pretreatment system optimizes the input substrate breakdown through defibration in order to achieve a higher biogas yield.
The thermal energy produced by the biogas plant is used for district heating the farm's houses and offices. With the exception of about 7% used for operating the biogas plant, the remaining energy is conveyed at medium voltage to the farm-owned substation which interfaces with distribution from the national electricity supplier (ENEL).

Results of performed service

The anaerobic digestion of cattle slurry, maize silage and ryegrass silage produces an average of 16,870 kW of electric and thermal energy a day, in addition to the digested waste that is used as a fertilizer and natural soil improver for the fields.

Biogas upgrading in Osterby

Success Story

Picture : Malmberg Water AB

Operator:
Malmberg Water AB

Location of the project
Osterby, Germany

Contact details
- Customer:

Biomethan Osterby GmbH & Co. KG

Results of the project

Physical
- *Gas upgrading*
- *Socio-environmental:*
- *Renewable electricity or heat supply*
- *Waste reduction*
- *Reduced pollution*
- *Raised public awareness/acceptance on biogas and renewable energies*

Project outline

The site in Osterby had two existing biogas plant producing electricity for CHP. It is owned by local farmers who decided to start producing bio-methane thanks to the EEG incentives.

MALMBERG

Technical data

Year of plant construction:
2011
Year of performed service:
2011
Plant size:
up to 700 Nm³/h
HRT:
approx. 106 days
Type of raw material:
Maize silage
Cow manure
Utilization of biogas:
Grid injection

Performed actions

Malmberg performed all main services in-house for the biogas upgrading plant from start to finish. Actions started with design work after contract signing. The design was based on the large number of successful plants that have been constructed prior to this project, but includes some specific modifications. Process engineers dimensioned the flows and optimized the plant to the customer's requests. Quality controls were made before shipping the plant (pressure testing, x-ray testing etc.) and after transport to site, Malmberg staff installs the plant at the customers site.

Malmberg staff also commissioned the plant, briefed and introduced the new staff to the plant with. After handing over the plant, Malmberg is still offering back-up support and live monitoring to tune in the plant.

Results of performed service

Malmberg's upgrading plant in Osterby has successfully upgraded gas for three years and counting. The gas is injected in the natural gas grid of Schleswig-Holstein Netz AG. The Osterby project was awarded the "Biogas partnership of the year" award presented by German Energy Agency in 2012.

Biogas to grid at Minworth sewage

Success Story

Picture : Malmberg Water AB

Operator:
Malmberg Water AB

Location of the project
Minworth, England

Contact details
- Customer:

Imtech/Severn Trent Water

Results of the project

Physical
- *Gas upgrading*
- *Socio-environmental:*
- *Renewable electricity or heat supply*
- *Waste reduction*
- *Reduced pollution*
- *Raised public awareness/acceptance on biogas and renewable energies*

Project outline

To increase the renewable energy production, the UK government recent-ly introduced a Renewable Heat Incentive scheme. The scheme provides improved incentive for Biomethane production compared to power gen-eration using CHP units.
Severn Trent is UK's largest producer of electricity from sewage gas. The site continued to generate electricity and heat through CHP but a part of the biogas is upgraded into Biomethane.
With Malmberg's installation of a biogas upgrading plant the Minworth site becomes energy self-sufficient and have increased income.

MALMBERG

Technical data

Year of performed service:
2013/2014
Year of performed service:
2013/2014
Plant size:
up to 1,500 Nm³/h
Digester volume:
16 digesters, in total 80,000 m³/day
Type of raw material:
Sewage sludge
Utilization of biogas:
Grid injection

Performed actions

Malmberg performed all main services in-house for the biogas upgrading plant from start to finish. Actions started with design work after contract signing. The design was based on the large number of successful plants that have been constructed prior to this project, but includes some specific modifications. Process engineers dimensioned the flows and optimized the plant to the customer's requests. Quality controls were made before shipping the plant (pressure testing, x-ray testing etc.) and after transport to site, Malmberg staff installs the plant at the customers site.

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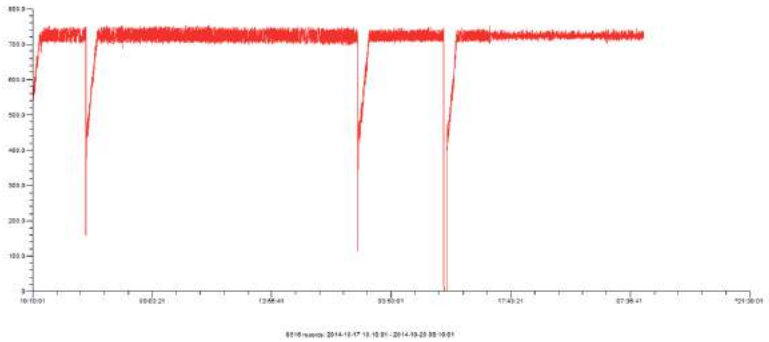
For this delivery, Malmberg also supplied RTO (Regenerative Thermal Oxidation), lightning protection, piping, and emergency flare.

Results of performed service

The Malmberg COMPACT® GR14XL unit at the Minworth site produces around 600 Nm3/h of 97-98% pure Biomethane. The gas is injected to the national grid.



Flow of biomethane during three days

European Biogas Association

EBA
European Biogas Association

Location
Rue d'Arlon 63-65
1040 Brussels, Belgium

Advantages for members

Policy
- *Make your voice heard and contribute to the legal framework at the EU level*
- *Represent your company's interests in Brussels*

Information exchange
- *Get first-hand news on EU policies and activities in the biogas sector*
- *Benefit from EBA's extended network*

Publications and studies
- *Biogas Report*
- *Country Profiles*
- *In-depth analysis of National Renewable*
- *Action Plans and policy developments*

Objectives

EBA promotes the deployment of sustainable biogas production and use in Europe. This covers all energetic applications of biogas : heat, electricity and automotive fuel. Founded in 2009 with 11 founding members - all national associations - EBA has been growing steadily. More than 60 national biogas associations, companies and research institutes have now joined EBA.

Committee

The current Board Committee is composed of:
Dr. Jan Štambaský - President - Czech Republic
Harm Grobrügge - Germany - Vice-President
Franz Kirchmeyr - Austria - Vice-President
Dr. Stefano Bozzetto - Italy
Dr. Attila Kovács - Hungary
Göran Strandberg - Sweden
David Collins - UK
Sebastian Stolpp - Germany
Agata Przadka - Belgium
Susanna Pflüger - Belgium
Nicolás de la Vega - Belgium
Erneszt Kovács - Belgium

Advantages for members

Company Advisory Council:

- *Exchange on market experience and technological developments*
- *EBA Pavilion for companies at trade fairs and exhibitions*

Projects:

- *BIOSURF*
- *FAB Biogas*
- *GreenGasGrids*
- *European Sustainable Biofuels Forum*

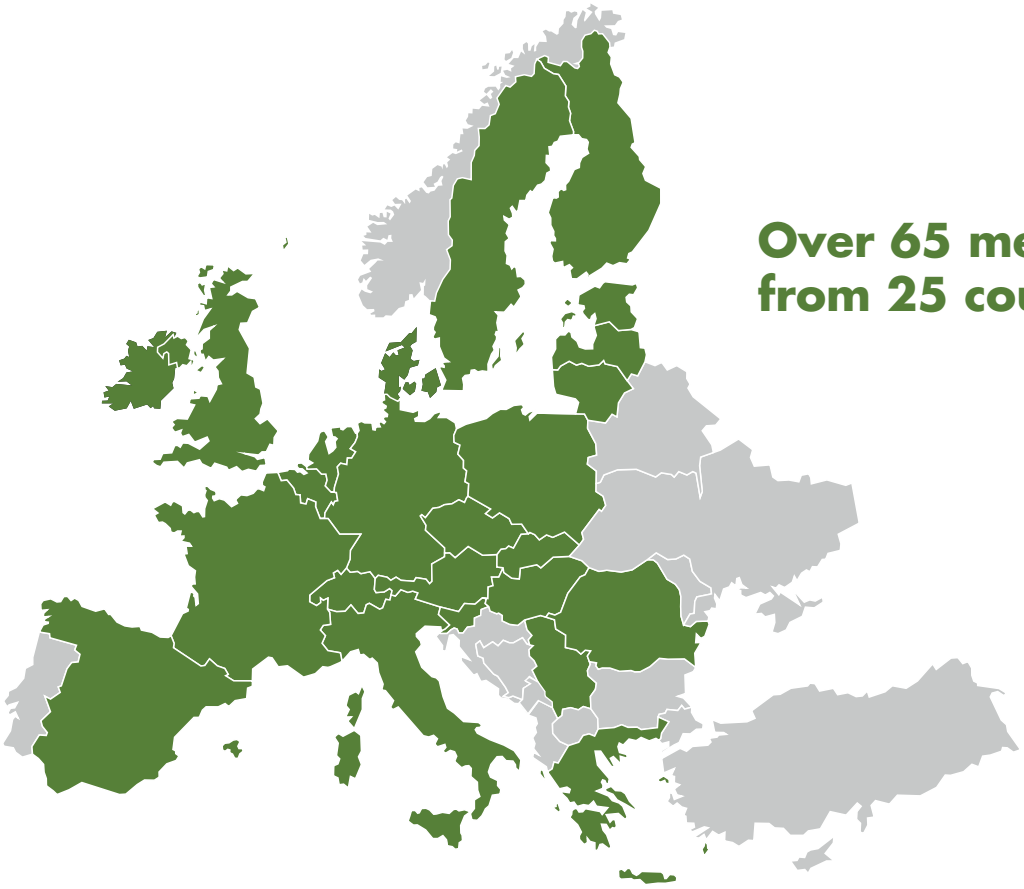
Events:

- *EBA Biogas Conference*
- *Thematic Workshops : REACH, digestate, sustainability, etc.*
- *EBA Pavilion at professional events*

Associated Members

In addition to national associations, the following companies and research institutes are Associated Members of EBA:

- AB Energy, Italy
- Agraferm Technologies AG, Germany
- AC Biogas GmbH, Germany
- Aprovis Energy Systems GmbH, Germany
- Awite Bioenergie GmbH, Germany
- Balmoral Tanks, United Kingdom
- BDI – BioEnergy International AG, Austria
- Biogest Energie- und Wassertechnik GmbH, Austria
- BTA International GmbH, Germany
- BTS Biogas Srl/GmbH, Italy
- Deutsches BiomasseForschungsZentrum GmbH, Germany
- DSM Biogas, The Netherlands
- Franz Eisele u. Söhne GmbH u. Co. KG, Germany
- Eneco, The Netherlands
- EUROTEC WTT, Italy
- Evonik Fibres GmbH, Austria
- Future Biogas, United Kingdom
- Gasunie, The Netherlands
- GrDF, France
- Greenfield AG, Switzerland
- Fraunhofer Institute for Wind Energy and Energy System Technology IWES, Germany
- University of Natural Resources and Applied Life Sciences, Vienna, Department IFA-Tulln, Institute for Environmental Biotechnology, Austria
- IES Biogas, Italy
- Institute for Biogas, Waste Management & Energy, Germany
- KWS SAAT AG, Germany
- Malmberg Water AB, Sweden
- MT Energie GmbH, Germany
- Parker Hannifin GmbH, Hiross Zander Division, Germany
- Pentair Haffmans, The Netherlands
- Sattler AG, Austria
- Schaumann BioEnergy GmbH, Germany
- Schmack Biogas GmbH, Germany
- Serge Ferrari S.A.S., France
- Streisal GmbH, Germany
- TNO, The Netherlands
- Vireo Energy AB, Sweden
- Xylem Water Solution AB , Sweden



Over 65 members from 25 countries

Become a member and make your company visible in the catalogue!

EBA
European Biogas Association

European Biogas Association

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