

## Biogas: *an all-rounder*

Biogas is an all-rounder among renewable energies. It can be converted to electricity and heat or be used as a fuel and natural gas equivalent. Germany is the undisputed market leader in this versatile and forward-looking industry. Biogas plants made in Germany are in global demand and are preferred because of their superior technology.

Biogas plants improve the independence and economic strength of municipalities and regions. The first part of this booklet contains important facts and figures concerning biogas production and use. The second part introduces over 50 companies, from full-line system suppliers to specialised equipment manufacturers and competent engineering firms. They represent the economic power and innovative potential of this young industry.

••• Biogas: *an all-rounder* – NEW OPPORTUNITIES FOR FARMING, INDUSTRY AND THE ENVIRONMENT

# Biogas *an all-rounder*

NEW OPPORTUNITIES FOR  
FARMING, INDUSTRY AND THE ENVIRONMENT



**sunbeam**

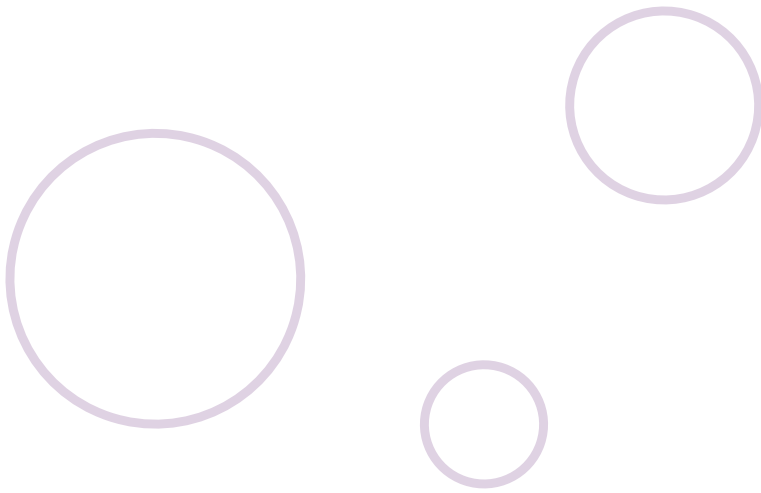




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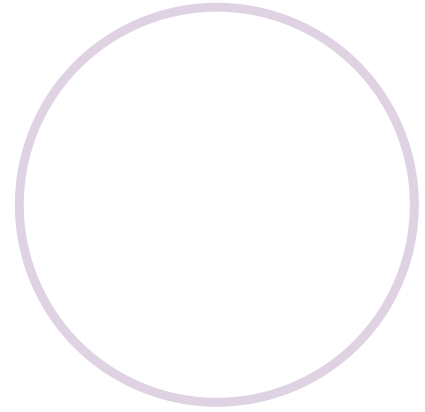


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# Biogas – produce locally, profit regionally, win internationally

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Word of welcome from the president of the German Biogas Association

The German biogas industry has set the course for continued success. The compensation for electricity from biogas which is payable under the amended Renewable Energies Act (EEG), with effect from 1st January 2009, marks the end of a very difficult period. The new general legal conditions make the construction of smaller biogas plants adapted to local sites more attractive. This is a return to the roots of the biogas industry and assists the development of local energy production in a regional environment.

However, the spectrum of the use of biogas as an energy source has become wider in recent years. Treated biogas has been fed directly into the natural gas network since December 2006. Since then over a dozen plants have followed suit, and the trend is unabated. The independent production of indigenous gas is an interesting option, mainly for the big energy supply companies and public utilities. They have all jumped on the biogas band wagon. An ever larger number of towns and villages is interested in fermenting bio waste in a biogas plant and in earning extra revenue from the sale of electricity and heat.

The heat produced in cogeneration units is a potential source of income, especially for owners of smaller biogas plants, which can improve the financial and ecological footprint of the system. Concept ideas abound – from heating apartments and stables to greenhouses and drying systems; they all reflect the imaginative scope of the biogas industry.

Germany has been the undisputed global leader in the use of biogas as an energy source since the introduction of the Renewable Energies Act (EEG) early in 2000. At the same time, it is a meeting place for many interested visitors, mainly from other European countries. Motivation in these countries is different: Whereas, for example, Italy and France – like Germany – concentrate on the production of biogas from energy crops, Spain focuses on waste as an energy source. Many German companies have already gone abroad, built biogas plants there or set up subsidiary firms. Exports make an ever larger contribution to the total sales of German firms.

In addition to hardware, the EEG itself is an export hit; the number of European countries adopting it and making it the basis of their efforts in the field of renewable energies is growing. As environmental consciousness is growing, renewable energy sources in general and biogas use in particular, are gaining in importance. Biogas occupies a particular place in the mix of sun, wind and water. It is versatile, both in generation and use: Biogas can be obtained from liquid manure, waste food, slaughterhouse waste and a variety of energy crops and can be converted into electricity and heat, directly fed into the natural gas network or used to power cars.

Credit should be given to the many pioneers and numerous firms, which started with only two or three people as late as at the beginning of this century and whose workforce has gone up to over 100. Their current level of competence has been achieved using courage, imagination and basic knowledge.

The cradle of biogas use was in Germany. Now the child is slowly growing up and is ready to go out to the world. Biogas use still has a large potential to tap – in Germany, Europe and the world. With German specialist knowledge, an innovative idea can be spread throughout the world that can help solve the pressing issues of reliable, environmentally sound and safe supply of energy for the future.

Yours,



Josef Pellmeyer



Josef Pellmeyer,  
President of the  
German Biogas Association

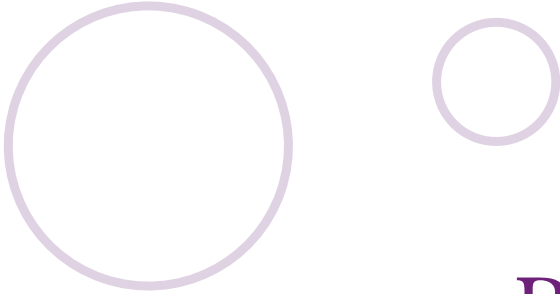




*» A biogas plant gives farmers an additional, reliable and environmentally-friendly financial leg to stand on. «*

Michael Ring, farmer, Waldmünchen





# Biogas: the all-rounder for energy change

Biogas is produced by the fermentation of biomass. Biogas contains methane; as a renewable and versatile supplier of electricity, heat and fuel, it is a major contributor to a safe and sustainable energy supply. Biogas can be stored or fed into the natural gas network, which adds to its flexibility of use. As an all-rounder, biogas will be able to supply around ten per cent of the natural gas requirements by 2020, without affecting food production.

Like natural gas, biogas is a mixture of gases with methane as its principal component. Microorganisms convert plants, liquid or solid manure into biogas via a metabolic process.

Biogas is also produced in sewage treatment plants and landfills.

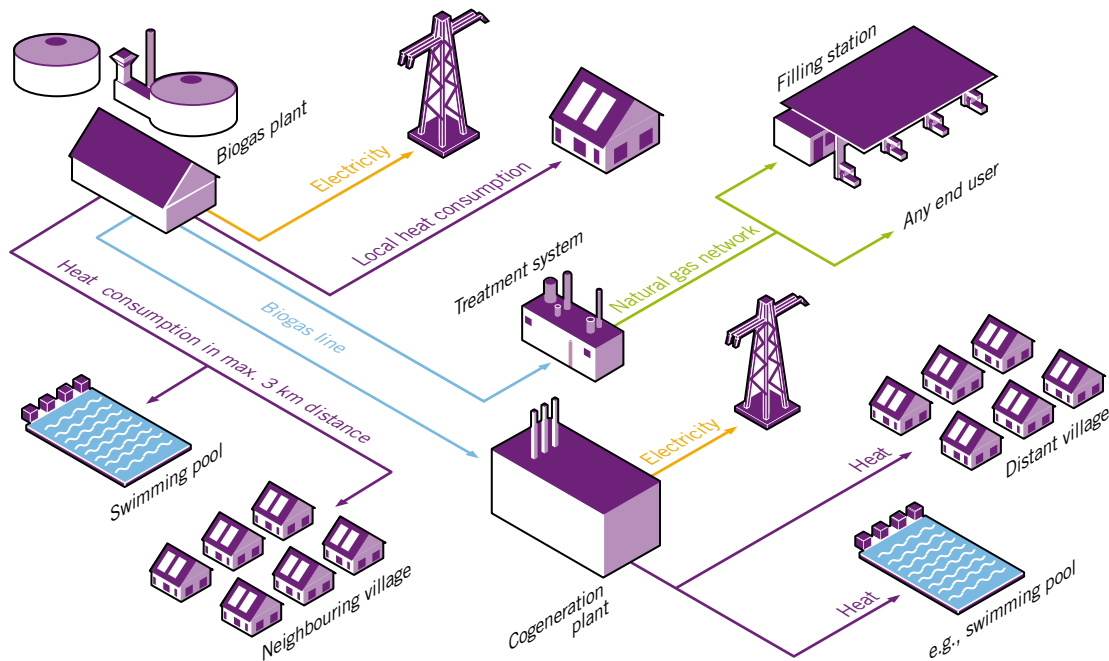
Today, biogas is converted into electricity and heat in cogeneration systems. The heat created heats buildings or can be used for other purposes. This makes double – and therefore especially efficient – use of the energy. Electricity and heat from biogas production systems are environmentally highly compatible because the quantity of carbon dioxide released through the production of biogas is the same as that consumed by the plants during growth, or as would be released by waste anyway.

## Heat and electricity from a single energy source

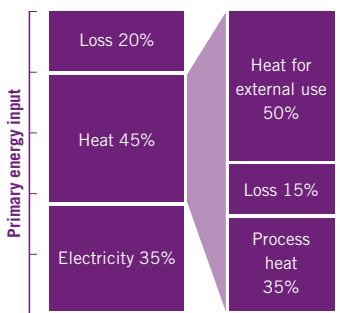
In 2007, biogas system operators in Germany produced almost nine billion kilowatt-hours of electricity from biogas and sold it to their respective energy supply companies at prices defined in the Renewable Energies Act. This accounted for ten per cent of the electricity produced from renewable energy. Carbon dioxide emissions were reduced by 8.5 million tonnes a year. Biogas production also benefits climate protection indirectly: The controlled fermentation of liquid manure or compostable waste avoids the escape of gases harmful to the climate, such as methane, which fuel the greenhouse effect much more than carbon dioxide, for example.







**All-rounder biogas:** Depending on the users of heat or the type of use, biogas can serve a number of purposes.



**Usable heat from biogas plants:**  
About half the heat generated by a biogas plant can heat buildings.

A typical biogas plant with an installed electric capacity of about 500 kilowatts (kW) produces up to four million kilowatt-hours of electricity and 3.5 million kilowatt-hours of heat per year from 2 million cubic metres of biogas. Theoretically, it replaces 1.2 million litres of fuel oil. This enables a farmer to produce as much electricity in his own power plant as about 900 family homes consume in a year. At the same time, the cogeneration system produces heat sufficient to supply almost 150 homes. Some heat is consumed for heating the fermenter, up to 50 per cent can be supplied to homes or businesses.

#### Heat transport: from the biogas plant to the public district heating system

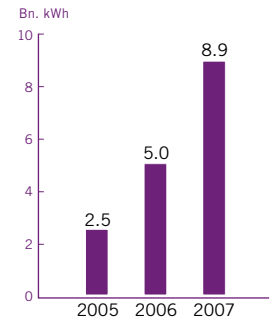
Whereas the sale of energy is regulated by law, the marketing of heat is left to the biogas plant owner. Few farms need all the heat they produce in the biogas plant. Instead, the heat can, for example, be fed into the public district heating system. In addition to residential heating, buyers requiring heat all year round, for example, swimming pools, such as those in Bad Königshofen, are of particular interest. The biogas plant in that climatic spa is located on the outskirts of the town and the heat is used in the health resort about one kilometre away.

#### Micro gas distribution systems: from the biogas plant to the cogeneration system

Heat transport is expensive if the heat users are located at a great distance from the site of the biogas production plant. In such cases, the cogeneration system can be set up where the heat is needed. The biogas is then simply transported through a private pipeline as is the case, for example, near Burgsteinfurt in North Rhine Westphalia. The biogas is transported to the cogeneration system through a 3-kilometre pipeline, where it is then converted into electricity and heat. The heat supplies several municipal administration buildings, schools and an old people's home.

#### Biomethane fed into the natural gas distribution system

After treatment, biogas can also be fed directly into the natural gas distribution system. In this case, the available infrastructure can be used and the biogas is consumed as natural gas equivalent. At the beginning of 2008, biogas was fed into the natural gas distribution system by six biogas plants in Germany, including Straelen (North Rhine Westphalia), Pliening (Bavaria) and Werlte (Lower Saxony).



**Electricity generation from biogas:**  
Electricity generated from biogas plants tripled within the last three years

### Storable energy available where and when needed

Biogas is easy to store and can therefore be used at any place and time. This feature is exploited, for example, by combined power plants. Combined power plants combine different renewable energy sources in such a way that they complement each other and the required amount of energy is available at any time. Storability makes biogas especially valuable: It compensates for fluctuations in other renewable energies such as wind or solar power.

### Biogas as fuel

Another possible use of biogas is as fuel. Fuel produced from one hectare planted with corn is sufficient to drive a car for distance of about 70,000 km, which is one-and-a-half times around the globe! A car powered by rapeseed based biofuel can cover a distance of almost 22,000 kilometers and bioethanol produced from one hectare of cereals is sufficient for over 40,000 km. Germany's first biogas station was commissioned in Jameln in 2006.

### Biogas could provide ten per cent of the natural gas need

According to a study undertaken by the Wuppertal Institute, in Germany some twelve billion cubic metres of natural gas grade biogas could be produced from liquid manure, solid manure and energy crops by the year 2020. This is equal to about ten per cent of the present consumption of natural gas in Germany. Based on these assumptions, the production of food will not be affected because only surplus farming land has been considered for the production of energy. It is a fact that biogas is still more expensive to produce than natural gas. However, experts from the Institute of Energy and Environment in Leipzig assume that biogas of natural gas grade will cost the same as conventional natural gas once the crude price reaches 150 US dollars per barrel (159 liters). Given the current price of around 100 dollars per barrel, this does not seem to be too far into the future.





*» Biogas means more independence for entire regions.  
Farming areas, in particular, can profit from  
the great economic potential. «*

Franz Löffler, First Mayor, Waldmünchen





# Opportunities for regional business and the environment

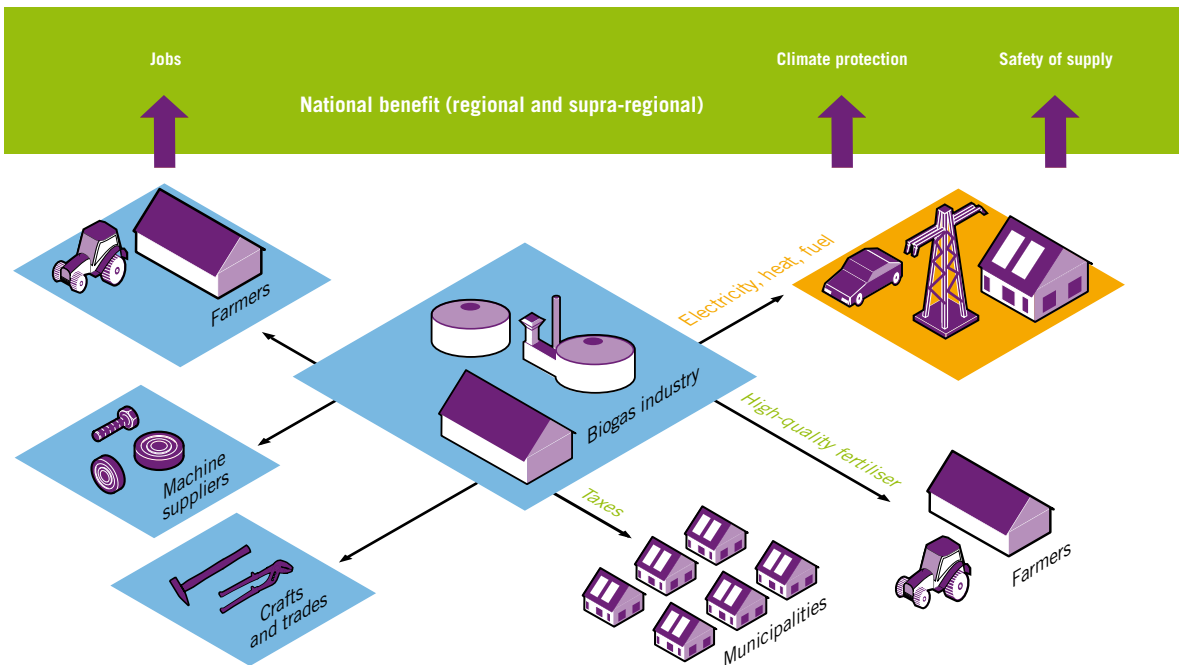
A biogas plant is an additional source of income for farmers, creates opportunities for local companies, creates jobs in an internationally successful, innovative industry, generates additional corporate tax revenue and replaces fossil fuels. Besides, the end products of biomass fermentation can be put to good use by the farmer: as low-cost, plant-compatible fertiliser.

A biogas plant creates jobs in various industries. Local earth moving and concreting businesses, pipeline builders and electrical firms can win extra orders. In total, 10,000 people had jobs in the biogas industry in 2006. These jobs were based in the manufacture and construction of biogas plant equipment, system operation, in service and consultation or as engine maintenance personnel.

Most of the 3,700 biogas plants in operation in Germany are owned by farmers and add a second string to their bow: A farmer who feeds electricity from biogas into the mains power supply generates income from food and feedstuff production.

The operator is not the only party to profit from the biogas plant. The village earns additional trade tax. As completed projects show, a biogas plant in Germany with an output of 600 kilowatts can generate trade tax for electricity at a five-figure level.





**Benefits of biogas plants:** Biogas plants not only benefit the owners and manufacturers but also the municipalities and the national economy

**Unaffected by rising energy prices – waste heat is used to heat entire villages**

The heat produced by biogas plants can be used for heating homes or public buildings, schools, nurseries, gyms and swimming pools. The regional production of heat can also attract new industries for which long-term calculation of the cost of heat is an important factor.

Thus, renewable energy substitutes fuels such as coal, fuel oil or natural gas. Home owners, municipalities and businesses become independent of the development of energy prices. In addition, the money for buying the energy does not leave the country but remains in the region.

Heat can be conveyed to the users through a local pipeline. This has given rise to the creation of several bioenergy villages, which converted all their energy needs to renewable sources. For example, biogas heat, together with a wood chips heating station, supplies over 70 per cent of the homes in the bioenergy village Jühnde near Göttingen in Lower Saxony. People there saved around 500 euros in energy costs per home in 2006.

The degree to which the administration itself can profit from biogas heat is shown by the example of Steinfurt in North Rhine Westphalia. Biogas is transported to the town through a 3-kilometer pipeline from the cogeneration unit outside the town. Pipelines from the cogeneration system run to the district administration center, the health center, an economics institution, the local vocational trade school and a sports hall. The rural district paid three cents per kilowatt hour of heat and thus saved about 34,000 euros in 2006 alone.





Cropping, animal breeding and biogas make a perfect match

### Added advantage for the municipality and the environment

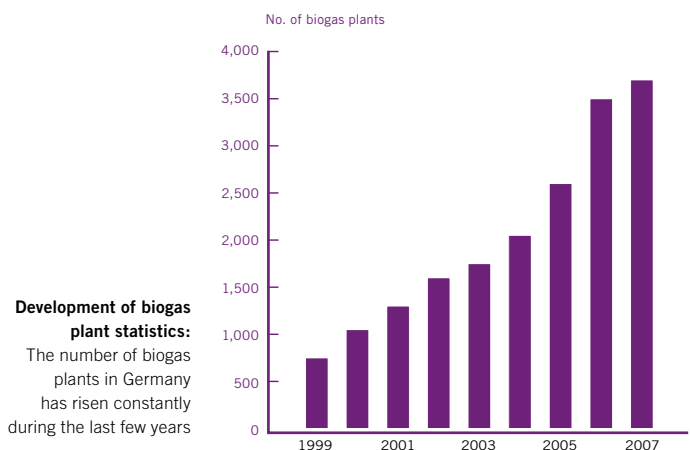
A biogas plant can also consume municipal waste. Biogas can also be produced from biological waste, lopping and other high-moisture biomass with little lignin. For example, growth from nature reserves can be converted to energy. At the same time, the costs of disposal are lower and landfill space is saved.

In addition to electricity and heat, a biogas plant also supplies fermentation residue similar to compost, which can substitute mineral fertiliser or potting soil made from peat, thereby closing the environmentally friendly loop of biogas production. Biogas slurry is substantially less odourous than fermented liquid manure from farming because fermentation reduces the concentration of free fatty acids. The free fatty acids are responsible for the odour of the untreated slurry. In addition, the fermentation residue is highly plant-compatible.

### Germany is the global leader in biogas technology

The German biogas industry sales topped 650 million euros in 2007. Of this, some 150 million euros were earned in countries other than Germany. Some firms already export over 30 per cent of their products. And the reason? German biogas technology is in demand the world over. No other country in the world uses more biogas plants in agriculture, so the technological advantage is correspondingly large. The European Forum for Renewable Energy Sources, Eufores, called the enormous growth of the production of electricity and heat from biogas in Germany a »German success story«.

The position of the gas industry as an international leader enables municipalities in Germany to take advantage of the most progressive technologies. Thus, biogas plants are indicative of sharing in a successful industry that is innovative and safeguarded against the future.

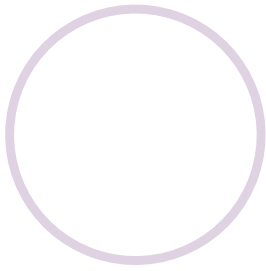
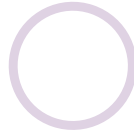




*» Biogas creates jobs. Local businesses, in particular, profit from orders placed by the owners. «*

Klaus Vetter, HVAC firm owner, Waldmünchen





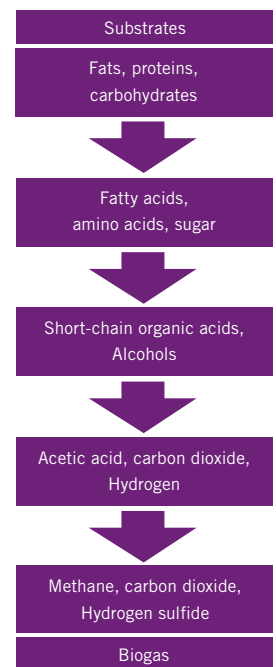
# Old principle provides new energy – how are electricity and heat produced from biogas?

Biogas is a natural product and is produced by anaerobic bacteria under exclusion of oxygen. Farmers have been producing energy from biogas for about 60 years. German producers exploit natural principles in modern biogas plants. Biogas plants convert energy crops into a flexible energy source by fermentation.

Although biogas is a renewable energy source, the concept is by no means new. Biogas, which contains methane, is produced naturally where biomass is degraded in absence of oxygen. The microorganisms responsible for this are called archebacteria. They already existed on earth at times when conditions for life were different. Today they live in swamps, stagnant water or in the stomachs of animals and humans – wherever there is moisture and no oxygen. Biogas plants exploit the special properties of archebacteria in order to generate electricity and heat at low cost and without harming the climate.

## The biogas plant simulates natural processes

Unlike natural processes, fermentation in a biogas plant is controlled and highly efficient. Biology and technology are honed to create a perfect match. Today, it is possible to generate up to 27,000 kilowatt hours of electricity and supply about six homes with a year's electricity from the yield of one hectare (10,000 square meters) of corn – and this is on a renewable basis. The efficiency of today's plants is striking: In addition to heat, one hectare planted with corn supplies five times the amount of energy that is needed for cultivation, harvest and conversion of the corn to biogas.



### Steps of the fermentation process:

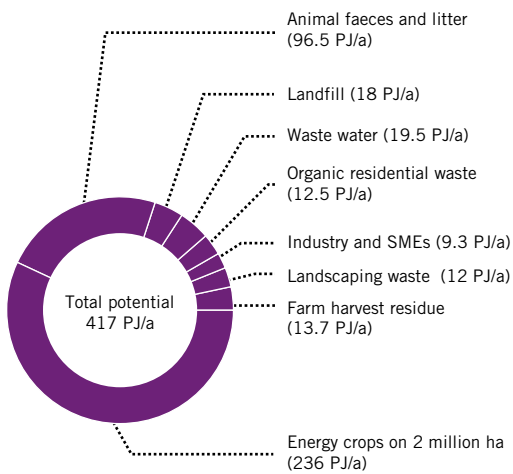
The natural fermentation process occurs in fermenters in an optimal environment



In addition to pure gas engines, there are also pilot-injection engines, which require an additional ten per cent of vegetable oil or biodiesel







Biogas energy potential in Germany and its source



View inside a fermenter with stirrer

### Fermenters at the core

A biogas plant consists of many parts, but all components in the systems, which are usually delivered on turn-key basis, are perfectly matched to one another and are highly automated in operation. Each stirrer, pump and tank can be monitored and controlled on screen.

The bacteria live in fermenters. A fermenter is a large, airtight container of steel or concrete in which biogas is produced. It contains organic mass as nutrient material for the bacteria. Formerly, farmers used mainly liquid or solid manure from the stables, but these materials do not yield much biogas. Today, residue material from farming, biological waste or special energy crops is used as feedstock instead.

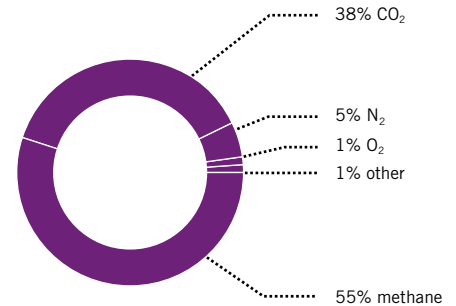
The degree to which the systems are matched is shown by the example of feeding: Specially developed metering systems feed the fermenters with exactly the amount of biomass they need. The metering systems can be controlled to feed small amounts of biomass automatically several times an hour. The feedstock added is weighed and the data saved in the computer. The owner knows exactly how much biogas is produced from the feedstock material.

Conditions in the fermenter are optimal for the bacteria. The tanks are heated to approximately 40 °C and heat-insulated. The bacteria convert carbon in the corn, grass, manure and other feedstock to biogas within a few days. Robust stirrers ensure the energy-saving mixing of the fermenter content and allow the gas to escape. The biogas is conveyed to the engines through a pipeline.





High-technology from Germany: Most equipment is installed in compact containers



**Composition of biogas from energy crops:**  
Typical biogas from energy crops contains mainly methane and carbon dioxide

### One half of the biogas is methane

Before it can be combusted, the biogas must be treated, i.e., the sulfur must be removed and the gas dried. Hydrogen sulfide or steam can damage the engines. Only about 50 per cent of the biogas is combustible methane. The rest is mainly carbon dioxide, with some oxygen and nitrogen. Methane is combusted in the engine whereas carbon dioxide escapes into the atmosphere. Because exactly the amount of carbon dioxide is released that the plant needed to grow, the combustion of biogas, unlike that of natural gas, is a neutral climatic process.

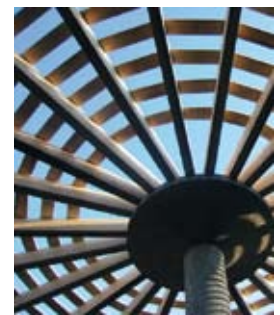
The engines are robust high-tech machines with controls that allow them to adapt with flexibility to different methane concentrations in the biogas. The efficiency of the engines has doubled during the last ten years and is over 40 per cent today. This means that 40 per cent of the energy is converted to electricity, but most of the rest can also be used.

The combustion engine powers a generator which produces electricity. This electricity is normally fed into the available mains system. The engine must be cooled with water. The heat from the cooling water, which heats to

80 or 90 degrees centigrade, and the heat from the waste gas flow are recovered in heat exchangers and heat the fermenters, as well as homes, swimming pools and other buildings.

### The biogas industry: a high-technology industry

The development of most advanced measuring and process equipment, intensive biochemical research and creative engineering ideas in machine building are the backbone of the success of German equipment makers. This is the only approach by which system operators can produce biogas of high quality from renewable primary products. The prices of the measuring equipment must remain reasonable so that biogas plant owners can afford to buy it, but it should also be failsafe and be able to detect even minute changes in the composition of the biogas. Temperatures, moisture and the composition of the vegetable feedstock to provide best living conditions of the microorganisms are topics of research. The miniature power plants are constantly honed to provide maximum performance and must be able to compensate fluctuations of gas composition without loss of performance.



# Message of Greeting

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by Michael Glos, MdB

Federal Minister of Economics and Technology



The massive challenges facing our energy policy mean that we will have to take new approaches. To this end, Europe needs a balanced energy mix in order to ensure an environmentally compatible and secure supply of energy. We should reduce our dependency on oil and gas as far as possible. After all, a high level of dependency on oil and gas also means a high level of dependency on increasingly expensive imports. In addition, we need to reduce the CO<sub>2</sub> emissions and to resolutely combat climate change. The use of regenerative and locally produced raw materials to generate bioenergy moves us a long way forward along this path.

The German Biogas Association and its members recognised this at an early stage and vigorously took up the issue. Operators of biogas facilities and innovative German firms have succeeded in developing biogas from Germany into a cutting-edge product which is sought after world-wide.

In recent times, the market opportunities for biogas have increased significantly. In March 2007, far-reaching targets to cut greenhouse gas emissions and to increase the proportion of renewables in total energy consumption were adopted under the German Presidency of the European Council. That was a significant milestone.

In order to implement the European targets, the German Cabinet adopted the Integrated Energy and Climate Programme (IEKP), a comprehensive pa-

ckage of measures which includes the promotion of biogas, in December 2007. On the basis of these decisions, my ministry has drawn up new rules in the Gas Grid Access Ordinance, the Gas Grid Fee Ordinance and the Incentive Regulation Ordinance, and these rules make it substantially easier to feed biogas into the natural gas grid. The changes have been in force since April 2008. The main points are rules on precedence for biogas when connecting up to the grid and feeding in the gas, and tangible help with the costs borne by the party feeding in the gas. Furthermore, on 1 January 2009, the revision of the Renewable Energies Act and the Renewable Energies Heat Act will enter into force; these will make the generation of biogas even more commercially attractive.

In Germany, almost 4,000 biogas facilities are being operated today; roughly a dozen are connected to the natural gas grid. The aim of the new rules is to make full use of the potential for biogas of 10 billion cbm by 2030.

The technologies developed by German firms are already making a decisive contribution towards implementing the European targets. The promotion of biogas is also creating new jobs and strengthening rural areas. Some 10,000 people are already employed today in Germany's biogas sector.

I wish the biogas sector and its employees every success for the future, and a market that continues to expand.

Sincerely yours,

A handwritten signature in blue ink, which appears to read "Michael Glos". The signature is written in a cursive style.

Federal Minister of Economics and Technology

# Building biogas plants

It takes about a year from the decision to build a biogas plant until the production of electricity and heat can begin. A major portion of the money invested benefits the region because local businesses can take over much of the work required.



First stage of completion of a biomass power plant consisting of two identical systems

Decisions concerning the site of a biogas plant are critical to later success. In well-planned systems, the entire chain is optimised: From the provision of feedstock to the generation of biogas and the conversion to electricity and heat. Dependent upon the local development plan, a biogas plant can be sited near a farm, in an industrial estate or on a site specially reserved for energy generating plants. To keep pipeline distances for heat transport short, the cogeneration unit should be sited near the heat consumers. Biogas can be generated at a place farther away from the cogeneration unit because biogas can be transported over longer distances via micro-networks.

Building can start as soon as the approval procedure is completed. The plant itself will be built within a few months by an experienced team. With most projects, the fermentation vessels with pumps, stirrers and pipelines are installed first, followed by the cogeneration unit. The electricity connection is made and the required heat piping installed as the last stage of the project.

In addition to logistics, administration and equipment, when building a biogas system the importance of informing those residents most closely affected by the project should not be overlooked, because prejudice based on a lack of information also exists in connection with biogas plants. System operators and planners should disseminate information together in good time, emphasizing the benefits of a modern biogas plant for the environment and the village and communicating all the important facts in simple, understandable language.



Postfermenter of the biogas plant under construction





Larger plants are often operated by several farmers together

## System types – the feedstock is critical

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There are two types of biogas plants, i.e., farming and industrial plants, depending on the type of feedstock. In addition to the reliability of the equipment of such plants, the process of matching the feedstock is critical – both are strong points in favour of German suppliers, who sell equipment of highest efficiency to buyers throughout the world.

To make cost-efficient use of the available biogas potential, German suppliers constantly improve their products and advance research in complex biochemical contexts of fermentation in their own laboratories.

### **Energy crops and organic waste**

The type of feedstock determines the appearance and function of a biogas plant. An industrial plant feeds on waste and industrial residue materials. These must be hygienised at high temperatures. To avoid odour during delivery and processing of these materials, the equipment is mainly installed in a closed hall. In most cases, the feedstock materials arrive by truck. Because the type and composition of the batches is different every day, the fermentation of these materials requires a lot of experience and expertise.

A biogas plant feeding on liquid manure and energy crops looks entirely different. The farmer harvests the crops and preserves them as silage. With most plants, the ready silage is moved to the hopper of the plant by wheel loader. In addition to energy crops cultivated for conversion to energy and heat, liquid or solid manure, litter and crop residue can be fermented in a farming biogas plant.

### **Different biogas plant sizes**

The size of a biogas plant does not depend on the feedstock material, it can be anything between 50 kilowatts and several megawatts. In selecting the size, the investor is guided by the amount of available feedstock and the possibility of using the heat. For example a 55-kilowatt biogas plant supplies about 400,000 kilowatt-hours of electri-



Litter and crop residue can be fermented in a farming biogas plant

Waste suitable for biogas generation	
Garden and park waste	mostly herbal waste from areas used as gardens or public greens and cemeteries
Biowaste	collected by type (e.g., kitchen refuse)
Market refuse	waste, e.g., fruit and vegetable waste collected from markets



The farmer harvests the crops and preserves them as silage

city and heat. A 500-kilowatt plant, by comparison, can supply some 4 million kilowatt-hours of electricity and 3.5 million kilowatt-hours of heat, which can be used outside the plant. This amount is sufficient to supply the electricity need of 900 homes and the heat consumed by 150 homes.

A farmer who uses his own feedstock material and needs the heat for his home, stables and a few neighbouring buildings will normally choose a 100-kilowatt plant. This plant can be readily integrated into the farm and does not require much operative attention.

The larger the biogas plant, the more time must be spent on feeding and daily monitoring. In many cases, several farmers run a biogas plant together, one of them being responsible for the operation of the system. Where possible, the others contribute capital and supply energy crops, liquid or solid manure.





Garden waste becomes increasingly important for the production of biogas

# Fermentation of biogenous waste

Waste is a versatile input material. Waste contains valuable raw materials which can be reused; and waste contains a lot of energy. This is also true of the different organic fractions in waste which were formerly disposed of in landfills. This development was stopped several years ago. Today, the fermentation of biogenous waste is playing an ever more important role.



Organic fractions contain high amounts of energy

The separate collection of biogenous waste began in Germany about 25 years ago. Since that time, the use of bio waste has seen a dramatic development. Germany produces well over 13 million tons of bio waste and loppings every year. Some experts believe that 16 million tons of waste are produced in the country between the North Sea and the Alps every year. How much energy is contained in these organic fractions can already be gauged from the enormous amounts of methane emitted by old landfills in Germany. Added to this are the sewage gases from waste water treatment and sewage sludge treatment, which easily account for thousands of gigawatt-hours of energy.

## Complex Biofractions

German homes dispose of approximately four million tons of organic waste in separate rubbish bins. In addition to this, garden and park waste, as well as loppings, accounts for another 4 million tons. Plus several million tons of bio waste and loppings found in residential waste (residual waste, bulk waste, etc.) and commercial waste, which provide a theoretical potential source of energy. However, these are not fermented but treated in mechanical-biological systems or mixed with sewage sludge. Finally, the varied assortment of bio waste is completed by energy-rich waste food, slaughterhouse waste and residual material from food processing with an estimated volume of three to four million tons.

## Taking a Different Look

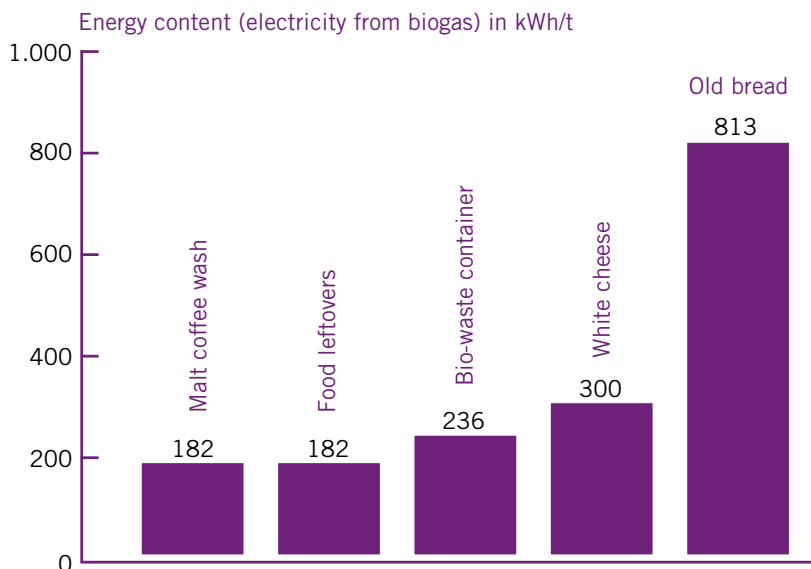
Looking at these structures, it can be seen that biogenous waste is a highly heterogeneous affair. Therefore, each type of waste must be considered independently. For example, organic material in residential waste which is not collected separately is not suitable for fermentation because the high concentration of pollutants in the fermentation residue means that it could not be returned to the field.

The situation in terms of its use as biogas looks much better for the other organic fractions. Already today, many biogas plants feed on waste from slaughterhouses, dairy factories, breweries or waste food from commercial kitchens, hotels, hospitals or expired food. Some operators ferment their substrates together with liquid manure or energy crops, others focus entirely on waste as input. »I believe that, in view of the high energy efficiency, monofermentation is a great opportunity, especially for small and medium-sized firms,« emphasizes Dr. Thomas Probst of Bundesverband Sekundärrohstoffe und Entsorgung e. V. (bvse).

## Fermentation and Composting

The largest untapped reserves are in bio waste collection, loppings and garden waste. Most of these fractions are still used for composting; the available processing capacity in Germany amounts to about 12 million tons. The Bundesgütegemeinschaft Kompost, an independent organisation evaluating composts and fermentation products, reports that there are over 800 composting centers in Germany but only 85 biogas plants, in which about 2 million tons of bio waste from homes, trade, gardens and parks is fermented. This is only about 15 per cent of the available organic waste; the rest is converted to compost instead of being used as energy source.

However, the disposal and biogas industries are working hard to improve the situation. For example, dry fermentation technology will be applied on a wider scale, in addition to wet fermentation, in the coming years. The residue from this fermentation can be readily composted. Because composting and fermentation are not mutually exclusive, backing is also available from science. »As far as waste from industry and homes is concerned, it should be noted that these volumes, which are by no means small, must be disposed of anyway«, says Prof. Dr.-Ing. Martin Faulstich of Sachverständigenrat für Umweltfragen (SRU).



**Average energy content of organic waste:**  
Suitably designed biogas plants produce energy from organic waste







# Electricity and heat from the cogeneration unit

The last element in the production chain of many biogas plants is a cogeneration unit, in which a combustion engine powers a generator to produce electricity and heat. Whereas, normally, electricity is fed into the mains supply, heat can be used in several ways.

The cogeneration unit is the compact unit within a biogas plant in which the gas is converted to energy. In most cases, it is set up in a container or a building near the biogas plant, which also contains the heat exchangers, heat distributors and the safety instrumentation of the gas pipeline.

Although the machines run around the clock, almost no noise is heard outside. The internal insulation of these rooms kills all noise almost completely.



Heat pipelines in a cogeneration unit

## Up to 90 per cent efficiency

The special feature of a cogeneration unit is that it produces electricity and heat by a parallel process. This improves the efficiency of these units in comparison with conventional large power plants that only generate electricity. In addition, the added value is higher for the operator, as he can sell both forms of energy separately.

The amount of electricity and heat a cogeneration unit can produce depends on its size and construction. The connected electric load of a cogeneration unit specifies the output of the biodiesel system as a whole. The total efficiency of a cogeneration unit is between 80 and 90 per cent. This means that between 80 and 90 per cent of the energy from the biogas is converted to electricity and heat by the cogeneration unit.



The electric efficiency is between 30 and 43 per cent, depending on the size and type of construction. Normally, large cogeneration units have a higher efficiency than small units. In the lower output range up to 200 kW, pilot-injection cogeneration units have a somewhat higher efficiency. Pilot-injection engines are converted diesel engines and require about ten per cent fuel in addition to the biogas. This »pilot fuel« is vegetable oil or biodiesel in most of today's plants. The other engine version is a petrol engine which runs entirely on biogas.

The largest amount of heat in the cogeneration unit is produced by the engine cooling water at a temperature level of between 80 and 90 degrees centigrade. Substantially higher temperatures of 460 to 550 °C are contained in the exhaust and can also be recovered by means of a heat exchanger. Therefore, industry operators are also strongly interested in biogas waste heat.

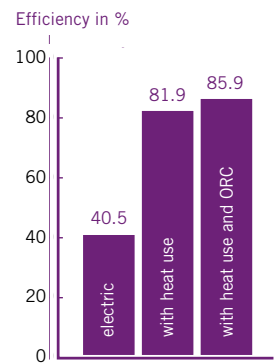
#### Gas pipelines over long distances

Today, the construction of one metre of gas pipeline to reach consumers costs about 150 euros. According to practical experience, about three per cent of the heat is lost from insulated pipes after a distance of 1,000 metres. On this basis, where longer distances are involved, it

is advisable to set up the cogeneration unit near the heat consumers and supply it through a separate gas pipeline. A gas pipeline costs about 70 euros to build per metre, which is much cheaper than a heat pipeline. Water must be extracted from the biogas and the gas compressed for transport in a pipeline.

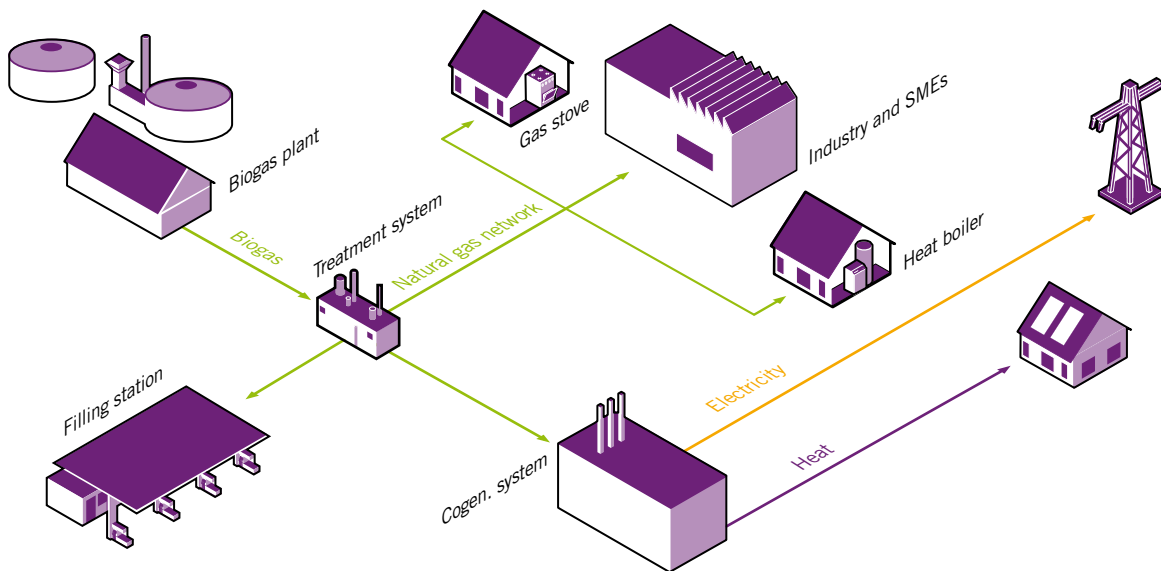
#### New technologies for higher efficiency

If there are no heat users in the vicinity of the biogas plant, the heat can also be converted to electricity. The most suitable system is an »Organic-Rankine-Cycle«, or ORC system. It is connected downstream of the cogeneration unit. The heat from the cogeneration unit heats a special fluid in the ORC system, which evaporates quickly. The steam operates a small steam turbine that generates electricity. ORCs have been used in biogas plants since 2006. A cogeneration unit of 600 kW electricity output supplies enough heat for a 70-kilowatt ORC system.



**Efficiencies of biogas plants:**  
The high efficiency of a biogas plant producing heat is increased by another five per cent using the ORC method





**Use of biomethane:**

After being fed into the natural gas distribution system, biomethane is a flexible energy source for industry, SME and end users

# The way into the natural gas distribution system

From the biogas plant into the natural gas distribution system: Modern cleaning methods are the key to local and flexible use of renewable energy sources.



By 2020, biogas will be able to provide at least ten per cent of the need for natural gas and be used with the same degree of flexibility as fossil fuels. After treatment, biogas has the same gas quality as conventional natural gas and can be fed directly in the natural gas distribution system. Feeding biomethane into the natural gas system is of particular interest where there are no local consumers of heat. This option makes the use of biogas more versatile. Farmers, municipal utilities and energy supply companies can share the profit of feeding biomethane into the natural gas distribution system.

**Treatment to obtain biomethane**

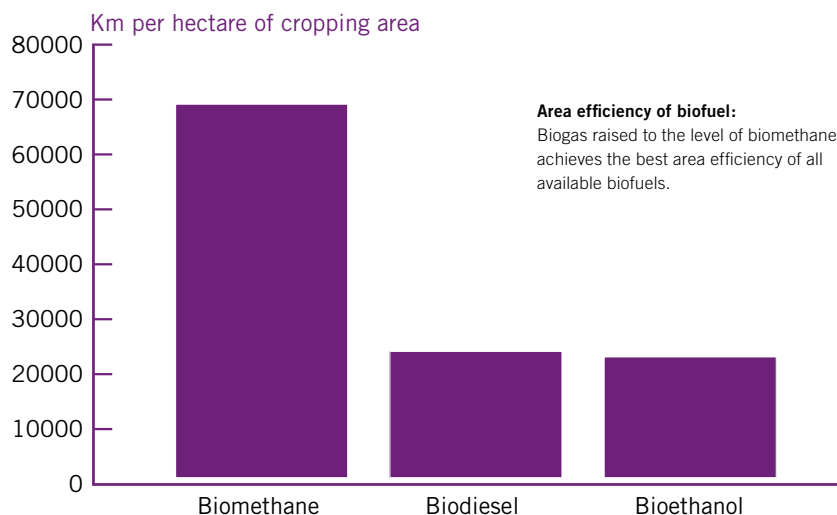
Sweden and Switzerland already have extensive experience with biomethane as a substitute for natural gas. In Germany, the feeding of biogas into the gas distribution system started at the end of 2006. Admittedly, biogas must be treated so that it matches the level of natural gas

before it can be fed into the distribution system. For this, carbon dioxide and sulfur are removed. This can be done by scrubbing, a process in which the gas passes a scrubbing fluid. Carbon dioxide can also be removed by activated charcoal, special pressure methods or chemically.

The concentrated biogas is called biomethane or bio natural gas. It contains at least 97 to 99 per cent methane. The pressure of the gas must be raised to the level of the pressure in the natural gas pipeline before the biomethane can be fed into the pipeline system. Depending on the gas quality in the distribution system, the calorific value and other characteristics must also be adjusted.

**Transport to congested areas**

The biomethane fed into the natural gas distribution system can be extracted from the system in towns, villages and other areas. Like natural gas, it can be burned in cogeneration units. Other uses of biomethane are as fuel or fuel gas.



## Biogas: Bio-fuel with high area efficiency

Biogas is among the most versatile energy sources. The gas is not only suitable for cogeneration units or gas burners but can also be used as car fuel. Not only that, biomethane treated to match the level of biogas as fuel has the best area efficiency of all biofuels available today. In addition, the natural gas pipeline system already available is an efficient distribution route.

One kilogram of biogas replaces about 1.4 litres of petrol. A car can drive about 70,000 kilometers with fuel from one hectare of corn.

Biomethane does not require new infrastructure. Gas can be produced locally, concentrated to biomethane level and fed into the natural gas distribution system already available. The German gas industry has decided to expand this option. It gave a voluntary undertaking to add ten per cent biomethane to natural gas as fuel by 2010.

Besides, biomethane can power vehicles running on natural gas. At present, there are about 55,000 such vehicles and 800 gas stations selling natural gas in Germany. A new gas-powered car costs between 1,500 and 3,500 Euro more than a conventional petrol powered car. Because the price at which the fuel sells is much lower than that of petrol, the extra outlay will be recovered after just 20,000 kilometers.

### Marginally more expensive than natural gas

Depending on the size of the biogas plant and the origin of the feedstock, biomethane is only marginally more expensive than the natural gas sold at gas stations. Liquid manure based biomethane can be produced at 5.8 cents per kilowatt-hour, which puts it almost on a par with natural gas. Biomethane from biowaste can be produced at seven cents per kilowatt-hour, and eight cents per kilowatt-hour from energy crops.

However, the natural gas distribution system is not the only route along which biofuel can be supplied. A Raiffeisen cooperative society in Jameln, Lower Saxony has been selling biogas at its own gas pump since 2006. The gas is treated to obtain biomethane directly in the biogas plant and transported to the filling point.



One kilogram of biomass substitutes about 1.4 litres of carburetor fuel





Treatment of the gas



Cogeneration unit



Fermenter

# Interview: Energy from Waste

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Bio waste is fermented in a biogas plant right in the centre of Hamburg, next to the Stellingen MVA waste incineration plant. The fermentation system is operated by BioWerk Hamburg GmbH & Co. KG, in which Hamburg Municipal Sanitation and the firms BioCycling GmbH and ETH Umwelttechnik GmbH are holding interests. Jörn Franck is the managing director.

Mr. Franck, you are the managing director of BioWerk Hamburg GmbH & Co. KG, the firm that has been operating a biogas plant feeding on waste food and waste meals since 2006. What were the reasons for setting up such a system?

The main reason for our entry in the fermentation market was that the feeding of waste food and food beyond its best-before date had been prohibited under a new law since November 2006. The law was based on a new EU regulation which forbids feeding animal waste to animals due to the epidemic risk involved. The other shareholders found this project reasonably interesting because they were also active in the energy sector, so the synergies were excellent.

How much energy do you produce in the biogas plant?

The plant produces electricity and heat. This means, it generates about seven million kilowatt-hours per year through cogeneration. The heat of the biogas plant is fed into the district heating system together with the heat from the waste incineration plant. Together, they supply heat to about 12,000 homes in the neighbourhood. In addition to

this, several nearby sport arenas are also supplied with heat. As we use the most advanced equipment, we can even use hot water to generate cold air for air-conditioning units.

Which inputs do you feed into the biogas plant?

We process waste meals and food which cannot be sold because the use-by date has expired. These are collected from restaurants, canteens and commercial kitchens or from retailers and supermarkets. They may be packaged or not. The energy-rich packaging material, i.e., paper and plastics, is incinerated at our nearby plant at Stelling Moor and provides even more energy.

How much CO<sub>2</sub> do you save with your plant?

Waste meals and expired food are biogenous materials and therefore come under the German Renewable Energies Act (EEG), this means that energy from our biogas plant is not harmful to the climate. We save the equivalent of about 5,400 tons of carbon dioxide every year.



Your biogas plant is blazing new trails in waste management. What experience have you gained?

A biogas plant is a living organism. You have to be patient because the bacteria working in the fermenter cannot be switched on or off. They want to be fed and well cared for. Besides, the mechanical removal of waste is a technical challenge for which no standard solution is available and in which we have invested much development work. I am sure that our efforts will pay off in the long run

Is the plant earning you a profit?

We needed the first year to get the biology right. As I said, you cannot simply press a button and set the plant going. After almost two years we can say the plant is where it should be to start working at a profit.

Where do you take the fermentation residue?

Fermentation residue is an ongoing topic for us. It has high concentrations of nitrogen and sulfur, which makes it a valuable fertiliser. But we cannot use it for legal reasons because the present fertiliser ordinance does not consider fertiliser from sources like these. We will only be able to market the fermentation residue after a revision of the national fertiliser ordinance.

Where do you see potential for technical optimisation in your waste system?

We continue to focus on mechanical treatment by which material that can be

fermented is separated from packaging material. Here, the waste system still has room for improvement and development is continuing. Besides, the German Renewable Energies Heat Law (EEWärmeG) prescribes that a certain share of renewable energy sources must be used for new residential buildings. This can be electricity, district heat or gas. This makes the treatment of biogas so that it can be fed into the gas network an interesting option for the future.

What potential do you see for the fermentation of organic waste in Hamburg and in Germany?

In Hamburg, there is substantial potential for biogenous waste from households, which goes into composting and is not used for the production of energy. As it is, however, waste of this type cannot be processed by wet fermentation. This needs a dry fermentation process. One of our shareholders, Stadtreinigung Hamburg, is active in this field and has plans for the long-term use of energy from bio waste.

What will be the strategy adopted by BioWerk in the coming years?

The further improvement of the system with the aim of increasing its output remains the focus of our attention. In addition to this, as a knowledge provider, we are promoting the concept of dry fermentation in cooperation with Stadtreinigung Hamburg.

The Biowerk Hamburg plant is located in the Stellingen borough of Hamburg. It processes about 20,000 tons of input: waste fruit and vegetable, expired food from retailers, waste meals from restaurants, nursing homes, hospitals and canteens as well as cooking fat and oil. Before fermentation, the materials are mechanically treated and about 2,500 tons of foreign material is eliminated. Bacteria in the fermenter produce about 330 cubic metres of biogas an hour. The methane content of the fermented bio waste is rather high at 65 per cent, so about 6.5 kilowatt-hours of energy can be obtained from each cubic metre. The gas is converted into electricity in a cogeneration unit with an electric output of a little more than one megawatt. Because all the waste heat is used, the efficiency of the cogeneration unit is 83 per cent.

<http://biowerk-hh.de/>



























































# Companies

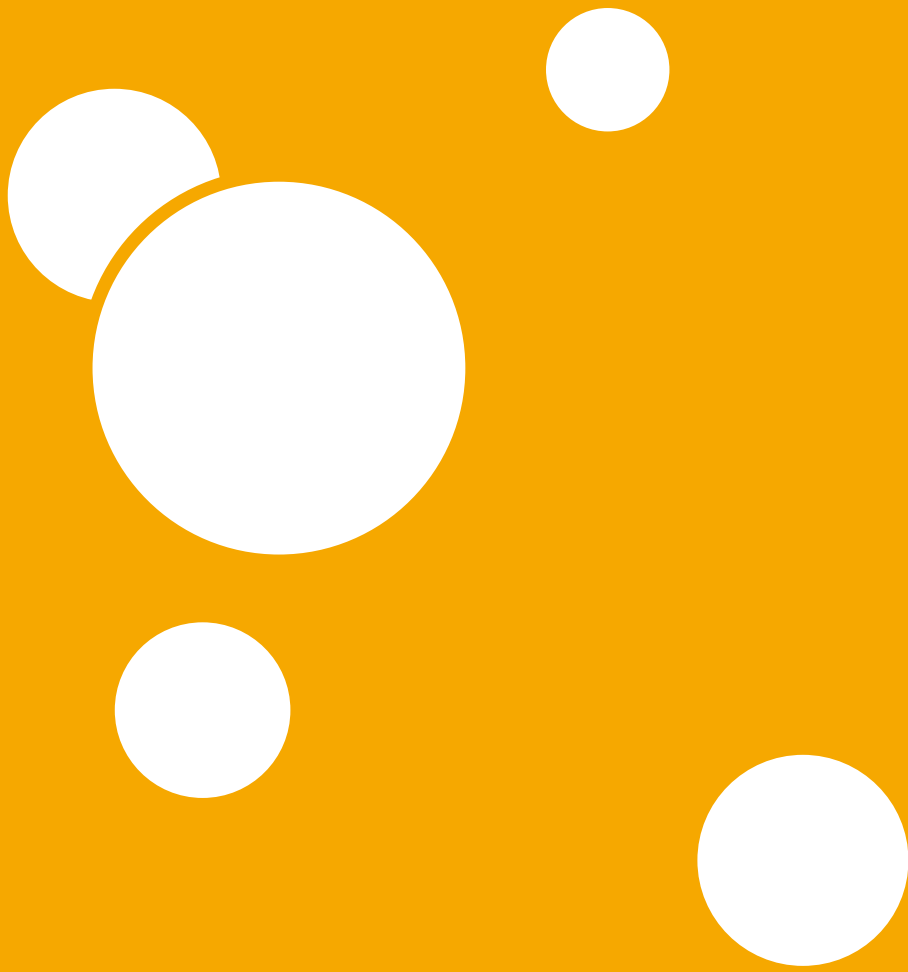


# Who's who?

The companies presented at a glance

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Companies

System  
providers

# AAT Abwasser- und Abfalltechnik GmbH

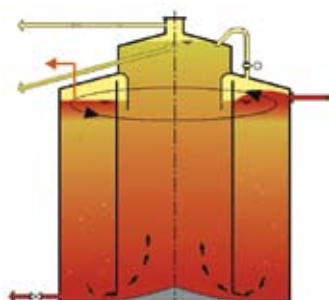
Biogas technology at the highest level! – Your experienced partner for complex projects



Plant for anaerobic whey-waste water treatment



Hydraulic reactor



Hydraulic reactor



Production residue disposal plant

The company AAT Abwasser- und Abfalltechnik GmbH was formed in 1993, but its experts have 27 years of professional experience in biogas plant construction.

AAT supplies anaerobic plants (biogas plants) for the treatment of organic production residue and the purification of highly polluted effluent combined with energy recovery.

The company's core competence lies in the treatment and processing of industrial and municipal sludge, production residue, waste food, energy crops and farming substrates. The work focuses on planning, consultancy, construction management, supply of equipment, start-up assistance and after-sales service.

We invest our knowledge in well-designed system concepts and technically mature standard solutions as well as in the sound development of bespoke solutions.

*The scope of products from AAT comprises the following main components:*

- Substrate pretreatment systems
- Anaerobic digesters
- Agitating equipment
- Gas tanks, gas conveying equipment
- Desulphurisation systems
- Gas flares
- Safety and control equipment.

Specifically designed for the field of whey processing, our (patented) MSB digester is particularly worthy of note.

The digester consists of a modified fluidised bed reactor (patented) which prevents the formation of floating sludge and ensures agitation of the sludge bed.

### Hydraulic reactor based on the AAT 2-chamber-system

*Unique system:*

- No mechanical equipment, such as agitators
- Mixing and substrate discharge are driven by biogas produced in the system
- Efficient discharge of sediment and floating material
- Defined flow without short-circuit flow

*The system has the following advantages:*

- Maximum process stability
- High degree of organic degradation and high energy yield
- Low susceptibility to faults
- Lowest operating & maintenance costs

*The reactor has been used successfully for various mono and mixed substrates: e.g. liquid manure, sewage sludge, energy crops, potato and food waste.*



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FORMED IN  
1993



# Agraferm Technologies AG

Modular biogas plants for private, industrial and municipal requirements



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FORMED IN  
2004

SALES  
~ € 18 m

EMPLOYEES  
65

Agraferm Technologies AG constructs and operates modular standardised biogas plants of the highest quality. Renewable primary products, in addition to organic waste and industrial residue, can be converted into biogas in these plants. Agraferm provides all the necessary services for biogas plants:

- planning and construction
- operation
- technical and biological monitoring
- system modernisation

In planning and constructing biogas plants, Agraferm uses a modular concept to prepare offers and construct plants that are cost-efficient and have a low error profile. Agraferm has developed and implemented a system partner model as a technical basis for the translation of biogas plant concepts.

In farming systems feeding on renewable primary products for fermentation, Agraferm has specialised in sophisticated dry fermentation technology. For example, the low moisture level of the substrates requires extremely robust and technically mature stirring and pumping technology.

Agraferm has acquired exclusive rights for use of the Biomar-AHP high-load fermentation system for the conversion of industrial residue. The AHP fermenter contains special internal parts for gas withdrawal in different reaction zones and a patented biomass retention system. The high concentration of active biomass in the fermenter makes short residence times and low reactor volumes possible.

The subsidiary firm Agraserv provides high-quality technical and biological service for the profitable operation of biogas plants. In particular, Metomex micronutrients improve the output of the biogas plants.

Agraferm makes use of many years of experience in operating biogas plants, as well as the successful cooperation between the system operation, biological and technical service and plant construction departments, to meet the high requirements of system refurbishment.



Vertically aligned stirrer



Success for the plant owner is the main target of the work carried out by the Agraferm Group

# BioConstruct GmbH

intelligent biogas technology – employees of BioConstruct GmbH have been constructing biogas plants under this slogan for many years



Biogas plant in Wittkiel



Managing directors Matthias Kief and Henrik Borgmeyer



Energy for the next generation

Farm-based biopower plants exclusively processing renewable energy sources, waste-fed fermentation systems for industry or cofermentation systems with liquid manure and organic residue – the references of BioConstruct GmbH provide a clear demonstration of the company's extensive experience. Since it was formed in 2001, BioConstruct has successfully put plants with a total capacity of over 25 MW into operation.

Only materials which can withstand the high stress of a permanently operating power plant are used. The equipment found in BioConstruct biogas plants meets the highest standards and is constantly monitored by a fault management program. The well-engineered systems require very little maintenance and therefore produce above-average yields.

Turn-key plant construction at BioConstruct: On request, all sixty employees of the company will take care of all aspects of a project. They work out a profitability forecast, design the bio-

gas system for the intended site and obtain all required approvals. A practised team of permanently employed assembly and installation specialists builds the biogas plant under the supervision of experienced construction engineers. The plant is only handed over to the owner after a successful start-up by BioConstruct electricians and once the operators have undergone extensive training.

However, our involvement doesn't end here because a biogas plant is a long-term investment. On request, the experts at BioConstruct GmbH will also assist the owner during the operation of the biogas plant by optimising yields. This is done as part of the technical after-sales service using biological process analysis or competent cropping consultancy for renewable primary products.

Systems for processing fermentation residue, as well as financing and shareholding schemes, complement the services provided by BioConstruct GmbH.



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**FORMED IN**  
2001

**SALES**  
€ 23 m/anno

**EMPLOYEES**  
60





Competent employees



Biogas plant at Kirchlengern

# BIOGAS NORD AG

Your future with biogas



Approval planning

As one of the largest technology suppliers in the biogas industry, BIOGAS NORD AG offers complete biogas plant solutions from a single source. We are a full-service provider and today have over 150 employees in all areas of biogas technology, from concept development and detail planning to plant construction, operation, service and after-sales care.

The strengths of BIOGAS NORD are based on many years of experience as well as proven and constantly improved equipment, tailored individually to the customer's needs.

The emphasis in the work of BIOGAS NORD is on the expansion of the application of available equipment. Particular focus is centred on improving energy efficiency and optimising the different system parameters at BIOGAS NORD.

Biogas plants fed exclusively by farming inputs, as well as cofermentation systems (i.e., systems for the joint conversion of municipal, industrial and farming waste, sludge and waste water) are connected with cogeneration units for the generation of electricity and heat.

The customers of BIOGAS NORD are highly satisfied with the ease of maintenance and the low repair rate of the equipment, as well as the cost efficiency of operation of the biogas plants. Cooperation with each customer is a valuable source of experience for BIOGAS NORD for the further optimisation of the biogas production process and the best possible composition of the different substrates.



Biological monitoring



Wetschen biogas plant



Neukirchen biogas plant



Biogas plant Fond du Lac, U.S.A.

**The products and services of BIOGAS NORD comprise:**

- operational analysis
- economic efficiency calculation
- project development
- conceptualisation
- planning
- approval
- plant construction
- technical start-up
- biological start-up
- biological monitoring
- laboratory analysis
- service and maintenance
- operator training
- insurance packages

The well engineered, tried and tested plant equipment from BIOGAS NORD is durable, efficient, flexible and reliable. The plant concept, which is tailored to the conditions of the intended site, in combination with the optimal use of high-quality and high-performance components ensures constant, high process stability. The fermenter equipment with flexibility concerning the feeding of substrate, in conjunction with low operating costs and high gas yield ensure optimal operating results. The integration of a heat utilisation concept can improve the profitability of a biogas plant enormously. A technical solution is also available for biogas treatment and feeding.

This company, which is based in Bielefeld, has been growing at a fast rate in recent years. In total, over 180 biogas plants have been planned, built or developed under the management of company founder and current chairman of the board Gerrit Holz since 1995. At present, around another 50 biogas plants are either under construction or in the planning or approval phases in Germany, the Netherlands, Belarus, the U.S.A., the UK, Italy, Spain, Cuba, India, Thailand, Poland and Romania. The installed electric capacity of biogas plants from BIOGAS NORD exceeds 75 MW, which is sufficient to supply about 200,000 homes with electricity or heat from renewable energy sources.

BIOGAS NORD has been quoted in the Entry Standard of the Frankfurt Stock Exchange since November 2006. The regular customers of BIOGAS NORD include, in addition to farms and industrial firms, energy supply companies, institutional investors as well as public utility companies and municipalities.



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**FORMED IN**  
2000

**SALES**  
€ 32 m

**EMPLOYEES**  
150



# BTA International GmbH

Bioenergy from wastes: Plants and systems for the hydro-mechanical treatment and the anaerobic digestion of MSW, commercial and organic wastes.



Foreign material is separated in the BTA® waste pulper



Rubbish as input material ...



... and as marketable compost at the end of the process.



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**FORMED IN**  
1984 as BTA GmbH & Co KG  
reformed in 2006

**SALES**  
€ 4 m

**EMPLOYEES**  
15

BTA was quick to recognise the facts: complete separation of waste into groups and the appropriate treatment thereof are a precondition for sustainable and profitable recycling. Therefore, BTA started the development and constant improvement of a pilot system for the combined hydromechanical treatment of waste with anaerobic fermentation of the organic fraction as early as the 1980s.

The efficiency at which the BTA® process eliminates foreign material and the flexibility with which different types of waste are treated is unsurpassed and has many advantages:

- flexible setting for biological waste, municipal garbage, waste food, industrial waste, etc.
- high operating safety and low costs due to elimination of foreign material before fermentation
- maximum biogas yield due to the reduction of the inputs to fiber state and concentration of more than 90 per cent of the degradable biomass as suspended organic matter
- valuable synergy for disposal and incineration due to the reliable elimination of organic material from light-

weight and heavy-weight fractions.

- high-quality, marketable compost can be produced.

Foreign materials, such as plastics, film, wood, stone and metal are eliminated in the BTA® waste pulper by means of process water in one single step. The organic material is dissolved and reduced to fibre and forms a valuable suspension. Any remaining small inert material in the suspension (sand glass <10 mm) is reliably separated in the BTA® grit removal system. After this preparation stage, the BTA® fermenters can be thoroughly mixed through biogas recirculation without moving parts, with little maintenance and with high operational reliability.

The strengths of BTA are 25 years of experience in the development and construction of processing systems and waste treatment equipment, in-house development work, many years of operating experience and over 40 reference systems in all parts of the world. In 2006, BTA was reformed as BTA International GmbH and became a member of the Agrafarm group.

# biogas weser-ems GmbH & Co. KG

reliable, profitable, trend-setting

*biogas weser-ems GmbH & Co. KG* was formed in 2000 by Dipl.-Ing. Klaus Hanneken and Dipl.-Ing. Johannes Gehlenborg. The company plans and constructs turn-key biogas plants of any size and configuration for industry and farming.

*bwe* provides cost-efficient solutions and has many years of experience, consolidated in the completion of over 150 projects. A competent team of experts in process engineering, environmental protection and building construction develops an individual, profit-earning and environmentally compatible plant concept and provides comprehensive support.

Cooperation with the customer starts as early as the preparatory planning stages and continues through financial consultation, the approval process and the construction of the plant. Process assistance is available after start-up of the plant to ensure optimal control of fermentation and production of maximum amounts of electricity and heat.

Our biogas plants are state of the art. Customer requirements are considered throughout the development of the plant as are recommendations based on prior experience.

The quality features of *bwe* biogas plants include the robust, coordinated and reliable method of construction which uses tried and tested system components. This includes the feeding of solid substrate, construction of halls and tanks, engines, gas and substrate pipelines, heat distribution, stirrer systems and process control. Safety equipment and gas treatment systems complement the product range.

*biogas weser-ems GmbH & Co. KG*

Demand for the comprehensive specialist knowledge of *bwe* is growing in the biogas technology sector the world over. *biogas weser-ems'* growth therefore focuses not only on Germany, but also on the international market. The company is already present in Spain, Italy and Poland through affiliated companies.



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FORMED IN  
2000



Ardorf natural gas



Consultation



Gehlenberg biogas plant





Consentis biogas plants operate with extreme efficiency and can therefore generate high profits for the owner.

# Consentis Anlagenbau GmbH

Consentis biogas plants: cost-saving, robust and high-yield



Dutch farmers also rely on the safety and efficiency of Consentis plants.

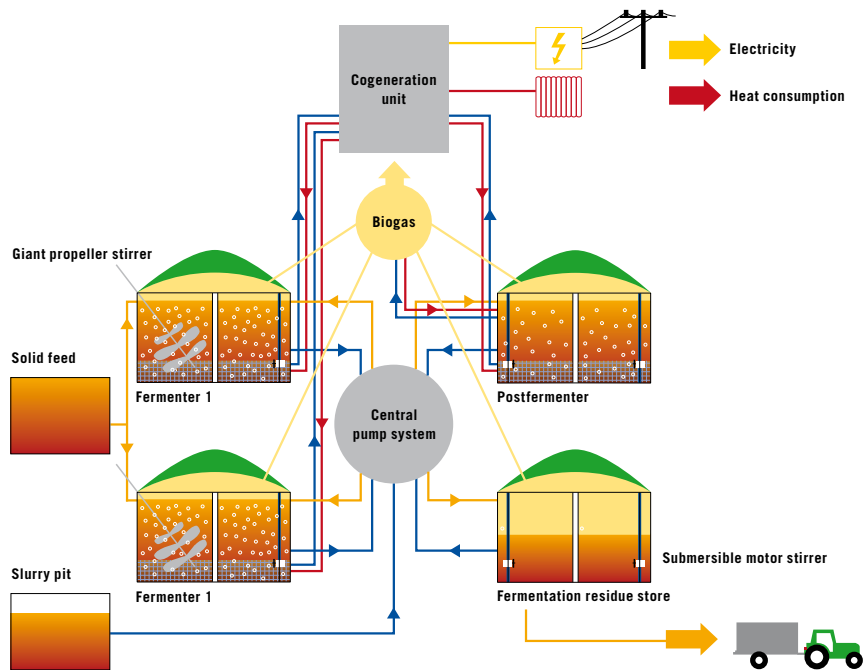
*Consentis Anlagenbau GmbH, Wietmarschen, has been developing and constructing turn-key biogas plants for the expanding international market for ten years. On average, these biogas plants operate at 97 per cent availability. This sets a new benchmark for efficiency and profitability.*

As a full-range supplier, Consentis relies on well-engineered process equipment and quality components which have proved their worth in continuous industrial operation. Long residence times of substrates in the fermenter, low digestion chamber load, large fermenter volume and appropriately sized gas storage tanks are among the critical elements of process equipment. The hydraulic push-floor system with tubular, stainless steel transport screws provides a constant feed flow of solids to the fermenters. All parts are reliable, low-wear and consume little energy. The central pump system with distribution beams is designed so that material can be pumped between the two fermenters, the post-fermenter and the fermentation residue storage area in

any direction. This ensures optimal control of the fermentation process. A rotary piston pump recirculates the substrates through all fermentation steps.

The industrial valves have an extremely long operating life. They ensure smooth pumping of the substrate, even at maximum load. The stirrer equipment for each of the two fermenters consists of a large-vane stirrer and a submersible motor stirrer, made of stainless steel. The elements of the wall heaters, mounted on the internal walls of the fermenters, and the post-fermenter are also made of stainless steel. All internal fermenter parts are made of corrosion-resistant material.

The system operation is computer-controlled and can be activated and monitored at any time. Remote diagnosis is possible around the clock. Maintenance contracts from basic to full 24-hour service ensure optimal monitoring.



A typical Consentis concept consists of two fermenters, a post-fermenter and a fermentation residue storage area of robust construction.

### Multifeed maximises substrate availability

In addition to the traditional inputs, e.g., renewable primary products, solid and liquid manure, the Consentis Multi-feed systems also process raw-fibre rich biomass and organic residue with optimal results. Because these systems have two fermenters, each fermenter is smaller than usual. The fermenter content can therefore be mixed more thoroughly with lower stirrer intensity. Homogeneous mixing accelerates the degradation processes. The fermenters and post-fermenter can be isolated for maintenance work without interrupting the operation of the biogas plant or loss of output. A biomass residence time of about 140 days ensures maximum yield from the input material. This high performance level is obtained due to the stability of the biological processes. Every day, around 3 kg of organic dry matter per cubic metre of fermenter volume is added and processed. This generous dimensioning compensates for higher fluctuations in the substrate quality without any problems.

### Efficiency innovation for higher profit

An important yardstick for the profitability of a plant is its availability. The tailor-made Consentis systems for defined input reach around 97 per cent availability on a monthly average. This was shown in the logs of seven systems that were inspected. System A worked for a total of 8,692 hours during a period of 12 months at an average of 99.2 per cent availability per month. During the same period, the cogeneration unit generated 4,544,600 kWh of electric output which corresponds to a monthly 98.6 per cent of its rated capacity. The energy yield amounted to 765 cubic metres of biogas from each single ton of dry organic substance, with an energy content of 5.5 kWh per cubic metre. In addition to electricity, some 12,000 tons of organic fertiliser were produced.



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FORMED IN  
1999

SALES  
€ 27 m

EMPLOYEES  
52



Biological maintenance through taking constant measurements on site ensures optimum yield.



# CTU – Conzepte Technik Umwelt AG

For responsible energy use



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UMWELT AG**  
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**FORMED IN**  
2002

**SALES**  
CHF 20.1 m (2007)

**EMPLOYEES**  
~ 50 (2008)

*CTU's technologies for energy production from biogenous raw materials include fermentation of organic wastes, energy crops or agricultural residues. The gas produced is pretreated and can be utilised directly as gas fuel or indirectly for combined heat and power production. Typical capacities are between 0.5–5 MWel.*

## **Biomass fermentation**

CTU is a world-wide licensee of Kompogas® Ltd. We design and build high-quality fermentation plants based on our own vast experience and that of the licensor, with more than 40 plants in Switzerland and world-wide.

The process stands out for its simplicity, for its high degree of automation, for its low operation costs and for its extremely high reliability. However, the biggest advantage is its versatility. Due to its robust and durable construction, it is suitable for the fermentation of a large variety of substrates, such as biowaste or energy crops including corn, grass, whole crop silage, etc.

One main technical advantage is the horizontal design which allows the safe extraction of foreign matter such as sand and stones. Another is the dia-

meter and suspensionless design of the shaft which makes it insensitive to fibrous feedstock.

Kompogas® capacities are multiples of 10000 or 15000 t/a of biomass.

The plug-flow-reactor operating in dry thermophilic conditions at approx. 55 °C has the following advantages:

- no process short-circuits
- defined residence time
- low volume with large surface area
- optimised inoculation
- high volumetric capacity resulting in low space requirements

Kompogas® plants can be used for:

- Biowaste (separately collected biological waste fraction)
- Energy crops (corn, grass, whole crop silage)
- Biological fraction from mechanical-biological waste separation plants

Owing to the extensive operating experience gathered since 1989, this technology assures:

- guaranteed availability
- low maintenance cost due to absence of moving parts in the fermenter
- high flexibility due to compact and modular design



Dry fermentation of energy crops  
in Gröbern, Germany



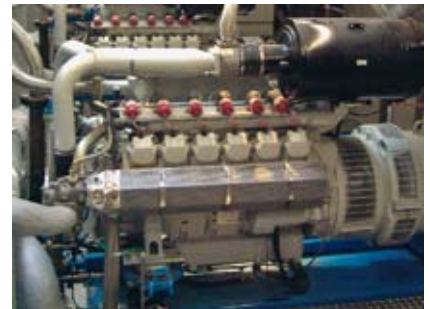
## High-efficiency biogas plants



Hammlar biogas plant for the fermentation of production residues from a herbal drying facility



Detailed view of the heavy-duty fermenter



Cogeneration unit for the generation of electricity and hot drying air from biogas

### Everything from consultation to project implementation

With our experience in the areas of machinery and plant construction, building and architecture, operating cost calculation and financing, we act as the best possible advisers to our customers, provide reliable services and successfully fulfil our customers' wishes. Disposal and/or energy concepts are tailored to the individual needs of the customer and therefore obtain the highest level of profitability.

### New opportunities for food and beverage producers, brewers, distillers and farmers

Our high-efficiency biogas plants convert waste to energy. Residual material formerly disposed of as waste, is converted by anaerobic fermentation into a source of energy. An intelligent and simple design concept makes our biogas plants cost-effective, profitable and environmentally compatible at the same time.

Our range of products and services comprises the following:

- Biogas plants for industrial waste, biowaste and food waste
- Anaerobic waste water treatment
- Energy production from solid biomass and industrial use of biomass
- Energy concepts for municipalities, SMEs and industry
- Briquetting and pelleting of residual and waste material
- Biodiesel and bioethanol systems

### A list of successful projects

Our list of customers includes large industrial firms, SMEs and farming cooperatives as well as individuals. The critical factor behind the success of INNOVAS is customer focus, the commitment of all our employees and the understanding of the job we do for our customers. Partnership and responsibility towards our customers are fundamental requirements for us.



**INNOVAS**  
**Innovative Energie-  
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**Anselm Gleixner und**  
**Dipl.-Ing. (FH) Stefan Reitberger**  
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FORMED IN  
1994

EMPLOYEES  
10



EISENMANN biogas plant with horizontal main fermenter

# EISENMANN AG

Biogas plants from the well-known supplier EISENMANN



EISENMANN Holzgerlingen technology park and assembly centre

EISENMANN is one of the global leaders among system suppliers of surface treatment equipment, environmental technology, material flow automation and numerous specialised technologies. The EISENMANN workforce at the factories in Böblingen and Holzgerlingen, coupled with subsidiaries in the U.S.A., Brazil, China and several European countries, numbers about 2,400.

With more than 50 years experience in plant construction and as an international system supplier of process, thermo-process and environmental technology, EISENMANN is your competent partner for turn-key biogas plants. Whether concept development, building applications, implementation or biological process monitoring – you can rely on us. We also offer inspections, maintenance and technical services.

### Standardised module design or individual solutions

EISENMANN standard biogas plants consist of a horizontal main fermenter, a thermal disintegration stage and a vertical postfermentation vessel. The

plants are fully automated and have process control for measurement, control and regulation.

In addition to standard systems, we also develop bespoke designs. These will be matched to your specific requirements and substrates, e.g., energy crops and liquid manure, residue material from food production or waste disposal.

### Main fermenter

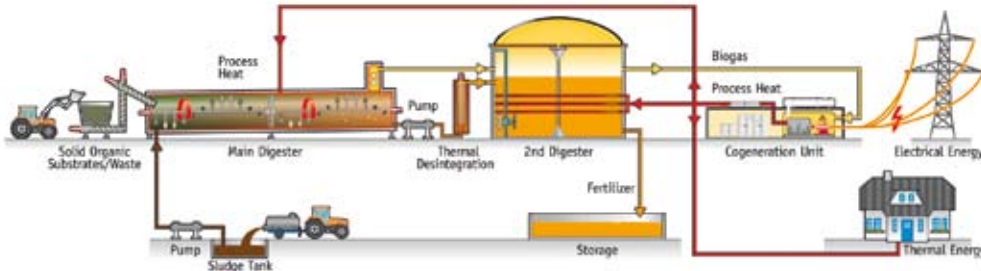
The first fermentation step in the EISENMANN process is conducted in a heat-insulated, steel tubular reactor with a horizontal stirrer shaft and sand and sedimentation discharge. The fermenter is fed with solid feedstock via a separate hopper, liquid fermentation substrate is pumped. The substrates in the main fermenter are fermented at a constant temperature range of 30–55°C. 60–70% of the usual gas yield will be released at this stage.

The main fermenter is delivered pre-assembled. This reduces installation time and the steel fermenter can be dismantled and removed to a different site if necessary.

Thermal disintegration stage for higher gas yield



Individual biogas plant with fermenters made from reinforced concrete



Schematic of a typical EISENMANN biogas plant with horizontal main fermenter

### Thermal disintegration

After fermentation in the main fermenter, the substrate passes to the thermal disintegration step. Here, the substrate is heated to at least 70 °C. This means that even substances which are difficult to digest can be made available biologically. These can then be fermented further, even during short residence times, which increases the gas yield. This makes the operation of your biogas plant more profitable and efficient.

### Postfermenter

Following thermal disintegration, the substrate enters the postfermenter, where fermentation continues. The methane produced is stored under the gas-tight cover of the postfermenter and withdrawn as and when needed. The postfermenter is a vertical stirrer vessel.

### Advantages of EISENMANN biogas plants

Our biogas plants are made of standardised components, which saves a substantial amount of time with regard to design, installation and start-up.

The high quality of the products made in-house, cooperation with traditional suppliers and our decades of experience in plant construction give you the reassurance of high operational reliability – for the life of the plant.

The EISENMANN standard biogas plant we design makes us largely independent of local construction contractors. All our plants need is a compact concrete foundation with a small footprint area. Our global presence enables us to manufacture and deliver high quality EISENMANN biogas plants to customers at home and abroad.

### Biogas plants exactly as you need them

Higher capacity plants, in particular, need individual planning. Whether plants with large horizontal fermenters of reinforced concrete or conventional plants with vertical fermenters, we can adapt the equipment to your individual requirements and wishes. Simply contact our engineers.

## EISENMANN

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**FORMED IN**  
1951

**SALES**  
~ € 700 m (2007)

**EMPLOYEES**  
approx. 2,400





# LIPP GmbH

Automatic and rational installation of high-quality plants with a long service life



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## FORMED IN

1958

## EMPLOYEES

50

LIPP was formed in 1958 and has its headquarters in Baden-Württemberg, Germany. As a specialist company, LIPP GmbH is a world leader in many areas of plant construction, including agricultural, municipal and industrial waste disposal as well as the treatment of organic waste material/biomass for generating power (biogas production).

Its self-developed and patented LIPP construction technology enables the automatic and rational installation of high-quality plants that have a long service life. Thanks to their numerous advantages and considerable reliability, LIPP biogas plants have been built worldwide for 35 years. This has led to LIPP receiving several commendations and awards. Many products and technologies are patented and represent a high standard of quality for applications in industry, farming and municipal waste water and waste treatment systems.

For the treatment of liquid manure, sewage sludge, bio waste and energy crops, LIPP offers its customers a fully developed system for biogas generation. Thanks to its modular construction,

complete units (from substrate input to storage and biogas utilisation) and single components can be offered.

The central unit is the KomBio reactor, developed and patented by LIPP, which consists of a stainless-steel digester with integrated gas storage and all the necessary safety and functional devices.

The LIPP-KomBio-Reaktor (fermenter with integrated gas storage) is an innovative and cost-saving solution in energy generation and anaerobic stabilisation, from small, compact biogas units to large energy production systems with an electricity output of several megawatts. Rapid installation, low investment, high functional reliability and long life are just some of the advantages of LIPP systems, which are delivered to buyers in many countries.

Furthermore, LIPP was the first company to be honoured with the RAL quality mark for biogas plants in July 2002.



# MT-Energie GmbH & Co. KG

Efficiency through variety: MT-Energie is one of the leading German companies in the biogas industry with branches in several European countries



Technical service



MT-Genius biological process monitoring



A typical MT-ENERGIE biogas digester system



MT-Energie stirrer

In the mid-1990s, when the success story of renewable primary products was only starting to take shape, Christoph Martens was already working intensively on cost-efficient biogas plants. On the property of his parents' farm, the young engineer developed innovative solutions for biogas use.

His enthusiasm culminated in the formation of MT-Energie GmbH & Co. KG, one of the leading suppliers of biogas technology. Today, the company has close to 250 employees and is performing with an untamed pioneering spirit, and is therefore still a trend setter in the industry. By the end of 2008, MT-Energie had completed some 160 turnkey biogas projects with a total electric output of 90 Megawatts.

This biogas specialist from northern Germany entered the international market in 2006. The company set up branches in several southern and eastern European countries and the first biogas plants have since started production there.

The performance portfolio comprises the development, planning and construction of biogas plants and special components, as well as intensive technical and biological monitoring. Numerous components which are standard in any biogas plant today were developed and improved to common industry standards by MT-Energie. One example is air-inflated membrane covering. This is not only used for MT-Energie projects but is also sold to other producers of biogas plants – as many as 1,500 to date.

The primary target in the development of biogas plants and components is to create a simple, efficient and safe process. This ensures that MT biogas plants perform at great cost-efficiency and maintain the outstanding reputation they have gained in the market.

The latest development is an innovative biogas purification system which the MT Group supplies through MT-Bio-Methan GmbH. The BCM® process, under license from DGE GmbH Wittenberg, purifies the gas to natural gas grade preparing it to be fed into the public natural gas pipeline.



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GMBH & CO. KG**

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**FORMED IN**  
1996

**SALES**  
€ 65 m (2007)

**EMPLOYEES**  
250



# NQ-Anlagentechnik GmbH

The biogas professional – from the farmstead biogas plant to large-scale projects  
Our experience is your success



## NQ-ANLAGENTECHNIK GMBH

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FORMED IN  
1993

EMPLOYEES  
56

Our company is proud of its record of 310 completed biogas plants throughout Germany. This makes us one of the most experienced full-line suppliers in the biogas industry. NQ-biogas plants are designed and planned individually, based on our customers' requests and their operational situations.

NQ-Anlagentechnik provides the full scope of consulting services at the beginning of the project, followed by planning and construction as well as biological and 24-hour-maintenance services after start-up. We help you to choose a suitable site for your biogas plant, dimension it and handle all aspects of approval planning and construction. The one-year free NQ-service package includes the start-up of your plant to full capacity level and lab analyses of your substrate.

Our corporate philosophy is to achieve the highest quality and to give customer satisfaction. This is why we develop and manufacture components in-house.

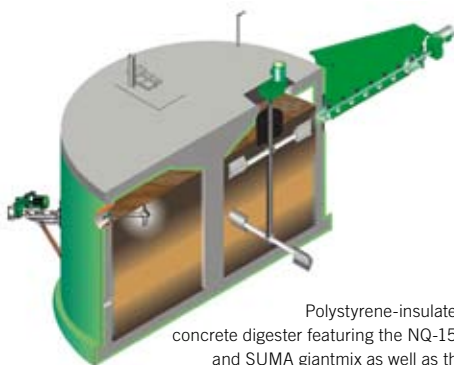
Our agitator type NQ-150, made in our workshops, features a float connected

to its upper propellers. This enables it to adapt to varying substrate levels in the digester thus preventing the formation of swimming layers. The NQ-150 ensures low-wear and a thorough homogenisation of digester contents.

In addition to the NQ-150, feeding equipment and pump distributors are manufactured in our workshops.

NQ-BioControl is a piece of monitoring software from NQ-Anlagentechnik, developed to store and visualise process data. It deals with all aspects of documentation for mandatory records. In addition, NQ-BioControl is an efficient cost control tool and assists in the monitoring of the biological process.

In accordance with the 2009 Renewable Energy Act, NQ-Anlagentechnik offers modular, farmstead biogas plants with output ratings of 30/100/190 kW<sub>el.</sub>. The 15/30 kW<sub>el.</sub> cogeneration unit (VW industrial gas engine, 2l swept volume) used in the 30 kW<sub>el.</sub> biogas plants is robust, of simple design and has proven its reliability over many years in the biogas and sewage treatment industries.



Polystyrene-insulated concrete digester featuring the NQ-150 and SUMA giantmix as well as the NQ-feeding and heating systems (14 independent circles).



NQ-biogas plant (1.1 MW) with adjoining grass drying facilities. During the cold seasons, surplus heat is used for heating the houses in the nearby village. Gas storage and engine house are external.



NQ-Anlagentechnik GmbH: The biogas professional  
Our experience for your project



# PlanET Biogastechnik GmbH

Driven by pure energy

PlanET Biogastechnik GmbH is among the global leaders in biogas plant manufacture



PlanET biogas plant in the Netherlands



Unikipp: New solid feeding plant from PlanET



PlanET biogas plant

The portfolio of PlanET supplies and services comprises all areas of biogas technology, from design to planning, plant construction, service and biological monitoring in the company's own laboratory. At present, over 140 employees work at the company headquarters in Münsterland. Additional employees are located at the company's international branches in the Netherlands, France and Canada. PlanET has successfully planned and built over 130 biogas plants throughout the world.

Since the company was formed in 1998, PlanET has focused on producing plants of the highest quality. Many years of experience are the basis for reliable planning and high plant performance. Important components, such as feeding systems for solid inputs, are developed and constructed in-house.

As an experienced full-line provider, PlanET offers a range of services that is without rival in Germany. The complete service concept of PlanET is designed to ensure that intelligent safety mechanisms prevent failure in an optimal manner. In most cases, our experienced technicians can locate and repair all faults in a system. If a mechanical problem is encountered, our service team will be on site within a few hours.

Fermentation and substrate samples from the plants are analysed by a team of experts at PlanET laboratory in Vreden, and the results are evaluated on the basis of latest scientific findings. The data obtained guarantees quick start-up and optimal plant operation.

The number of international projects planned, constructed and serviced by PlanET is increasing. PlanET is convinced that focus on the customer is also important abroad. The company has therefore set up branches in Europe and overseas and has thus built a successful network that reaches far beyond national borders.



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GMBH**

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**FORMED IN**  
1998

**SALES**  
€ 30 m

**EMPLOYEES**  
160



# Schmack Biogas AG

Leader in energy efficiency: Trendsetter in technology – progress in industrial biogas feeding – innovative concepts for energy crops



Bio natural gas to be fed into the natural gas network



Microbiological centre



Farm biogas plant



## SCHMACK BIOGAS AG

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FORMED IN  
1995

SALES  
€ 140 m (2007)

EMPLOYEES  
560 (2007, group)

Schmack Biogas AG, Schwandorf, is one of the leading full-line suppliers of biogas plants in Germany. The range of products and services comprises the complete biogas value-added chain: harvest logistics, system construction and start-up, service and operation. Since it was formed in 1995, Schmack has built over 220 biogas plants with a total output of more than 75 MW in Germany and other countries.

In order to secure its position as a technological leader in plant construction, Schmack has acquired interests in different leading companies with key technologies in the biogas market. Through its subsidiaries, Köhler & Ziegler and Stelzenberger Metallbau, Schmack integrates the specialist knowledge of these component suppliers into the development and manufacture of technically advanced cogeneration units, ORC systems and stirring equipment.

The subsidiary, Hese Biogas, a specialist in waste fermentation, complements the product portfolio of the Schmack Group with special plants for the fermentation of organic waste.

### *Market leader in gas treatment*

The treatment and cleaning of biogas is a central factor if the intention is to feed biogas into the gas network on an industrial scale, thereby substituting imported natural gas.

The subsidiary, CarboTech Engineering, from Essen is a specialist in technologies and processes for the treatment, cleaning and generation of technical gas, especially biogas. The majority of gas-feeding projects rely on technology from CarboTech.

### *Rooted in agriculture*

The focus of Schmack Biogas lies in the fermentation of energy crops, liquid and solid manure. Standardised plant components are a particular feature. The latest product is the small farmstead plant, COCCUS® Farm, for the fermentation of liquid manure. The company believes that there are great prospects for the optimisation of process biology and therefore has its own research and development laboratory.



# Schwarting Biosystem GmbH

Your partner with many years of experience in plant construction and biotechnology: waste fermentation, biogas plants and sewage sludge digestion (high-performance digestion)

Schwarting Biosystem GmbH was formed in mid-2006 through the merger of Bio-System Selecta GmbH in Constance with Schwarting Environmental Systems GmbH in Flensburg.

Both companies have a long tradition in the construction of biogas and fermentation systems. In addition, the company markets high performance processes for sewage sludge digestion which are developed in-house.

Special knowledge is available in anaerobic process biology and the fermentation of different organic residual materials, e.g., waste food, food beyond the best-before date, and slurry. The microbiological and chemical laboratory of the company carries out anaerobic degradation tests and control of biological processes.

We also have many years of experience in industrial plant construction. Highly qualified engineers handle every project – from design to detail planning, construction, installation and start-up. The company has the optimal organisation for the construction of biogas plants, fermentation and digestion systems of industrial scale and can also overcome greater challenges at home and abroad. A long list of references for fermentation of different organic waste materials is proof of the success of our concept. Our customers benefit from the value added by the operation of these systems through generating energy from renewable energy sources, and from the revenue earned from the cost-saving and environmentally compatible treatment of waste.

Schwarting Biosystem GmbH is your partner for the construction of high-quality biogas plants optimally adapted to requirements – from planning to turn-key systems.



## SCHWARTING BIOSYSTEM GMBH

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### WEB

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### FORMED IN

2004

### SALES

€ 5 m

### EMPLOYEES

15



Schwarting biogas plant in France



Waste food and food past best-before date as inputs



Schwarting biogas plant in Klein Eichholz



Piping: many years of experience in industrial plant construction



Fermenter with stirrer



# UTS Biogastechnik GmbH

Reliable biogas technology. This statement reflects over 15 years of experience and equipment supplied to more than 1,500 biogas plants



UTS Biogastechnik GmbH

## UTS BIOGASTECHNIK GMBH

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84419 Schwindegg  
Germany

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### FAX

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### WEB

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### FORMED IN

1992 as U.T.S. Umwelt-Technik-Süd GmbH  
since 2007 UTS Biogastechnik GmbH

### EMPLOYEES

> 60 (2008)

Founded on innovative products and concepts, UTS has become one of the leaders in the biogas sector over the last 15 years. UTS's high quality and highly reliable solutions are guaranteed by numerous internationally patented products and processes.

In 1992, UTS started delivering robust equipment for liquid manure treatment (pumps and mixers) in close cooperation with farmers. During the years thereafter, UTS designed and supplied standardized compact biogas plants in a range of different installed electrical capacities. In addition, UTS has constantly strengthened its competence in the conversion of organic waste into energy using substrates such as dry poultry feces, slurry, food waste, slaughterhouse waste and sugar beet pulp.

To operate a biogas plant efficiently and treat the associated substance flows (primarily waste water, sludge or fermentation residue with a heavy organic load) effectively, UTS has developed a specific product series "made in Ger-

many". Rugged submersible pumps and hydraulic /electric mixers have formed part of the UTS supply range for some time.

A newly developed range of separation technologies produced in-house, such as screw presses, hydrocyclones and dissolved air flotation tanks (DAF), completes the portfolio.

Whether you want to establish a new biogas plant or expand, adapt or refurbish an existing plant, whether the plant is small or large (several MWs), whether farm-based, industrial or municipal: the knowledge and experience of UTS Biogastechnik GmbH will ensure that you benefit from high level services and products.

From a detailed feasibility study and concept design to commissioning your biogas plant, UTS applies mature and reliable solutions that are state of the art. UTS's experts also assist you as technical and biological consultants for the operation of your biogas plant around the clock.



UTS Service Box



Biogas Plant Hohen Wangelin (840 kW)



Agitator Blade



Biogas Plant Gut Borken (740 kW)



# WELtec BioPower GmbH

Innovative company with extensive experience:  
Complete biogas plants in stainless steel for the whole world



Internal view of a stainless long arm agitator, submersible agitator and double-membrane roof



Cogeneration unit inside a building

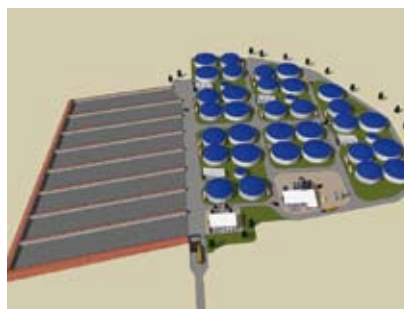


Fermenter, feedstock vessel and fermentation residue storage

WELtec BioPower® plans and manufactures complete biogas plants in stainless steel and sells them throughout the world: 54 employees have sold over 200 plants throughout Europe (Sweden, the Netherlands, UK, Scotland, France, Czech Republic, Luxembourg, Greece, Lithuania), the U.S.A. and even Cyprus and Japan. WELtec BioPower® is so successful that it rose to become the market leader in this segment. No other supplier has been more successful abroad than WELtec BioPower®.

To strengthen this success further, subsidiary companies were set up in several countries, e.g., the UK, the U.S.A. and also in eastern European countries to look after our customers' requirements directly. WELtec BioPower® was formed in 2001 – but the parent companies, Stallkamp and Weda, have several decades of experience in the industry to their credit. This combination of traditional experience and a modern approach enables us to supply biogas plants from a single source. WELtec Bio-Power® engineers design the plants and major components are manufactured by the parent companies.

The advantage: Globally uniform high quality with bespoke solutions for every individual requirement. For example, traditional systems for renewable primary products or systems handling waste food or slaughterhouse waste can be supplied without problems. Another innovation from WELtec BioPower® is the treatment of biogas to achieve a natural gas grade. This is done using a special process and the biomethane is then fed into the natural gas network. WELtec is building one of the world's largest biogas parks with direct feeding of treated biogas into the natural gas network in Könnern (Saxony-Anhalt).



Biogas park Könnern



## WELTEC BIOWPOWER GMBH

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### WEB

www.weltec-biopower.de

### FORMED IN

2001

### SALES

€ 33.5 m

### EMPLOYEES

54





# agriKomp GmbH

Energy generation from biogas – the cost-efficient alternative for the farmer



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**WEB**  
www.biogastechnik.de

**FORMED IN**  
2000

Michael Engelhardt und Robert Bugar, founders and managing directors of agriKomp GmbH, have been closely involved with the production of biogas plants since the 1990s. With the development and construction of high-performance and energy-saving components – tested to commercial level in its own biogas plants – this company from Central Franconia has defined new standards on a European scale.



Vielfraß feeding system and Biogene gas storage facility



Paddelgigant stirrer equipment

agriKomp GmbH offers farmers more than just perfectly working components; it supplies reliable, high-efficiency biogas plants (40 kW to 1.5 MW), dependable service and competent laboratory work. In addition to this, well-conceived concepts for the use of heat ensure low loss rates and make good economic use of the heat produced.

# Hese Biogas GmbH

Energy production from renewable resources and biological-waste in biogas plants



**HESE BIOGAS GMBH**  
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Germany

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**FORMED IN**  
2007

Hese Biogas plants are designed for the digestion of various organic input materials and the production of renewable energy. We can offer you the appropriate technology for your specific requirements:

- Cofermentation plants for organic residues and manure
- Biowaste plants for kerbside collected organic waste or municipal solid waste
- Plants for food waste (packed or unpacked)

In addition to our plants we can amend



Example Hese biogas plant

digestate processing and depacking units.

### *Everything from one source*

Biogas plants can only be efficient and economical if the process technology is from one source. This avoids unnecessary 'middle-men' and ensures fully coordinated project management. We analyse the project conditions and specific requirements and design the plant accordingly.

After commissioning and during the operation of the plant we offer a comprehensive service and intensive biological support in order to stabilise, control and optimise the biological process and maximise the gas yield.

### *Our services:*

- Technical concepts and planning
- Profitability consultation and optimisation
- Construction of turn-key systems as a general contractor
- Full after-sales service





Companies

Component  
providers  
& suppliers



Engine inspection



Outdoor tanks



Logistics

# ADDINOL LUBE OIL GmbH

Longest life and maximum safety with gas engine oils from ADDINOL



**ADDINOL LUBE OIL GMBH**  
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ADDINOL Lube Oil GmbH has been a specialist in the development and production of high-performance lubricants for over 70 years. Lubrication of permanently installed gas engines, in particular for operation with special gases, is one of our core competencies.

A gas engine powered by biogas places the highest demands on gas engine oil; the gas quality of every production system is different and is rarely constant. The output of the gas engine with varying gas quality and individual operating conditions depends essentially on the engine oil. Only with oil of the highest quality, specifically developed for use in these engines, can the advantages of a biogas plant be enjoyed in the long term.

ADDINOL MG 40-Extra Plus gas engine oil is based on the latest additive technology and selected mineral base materials. Due to the extraordinary results achieved in laboratory and field tests, the oil has been released by Deutz Power Systems, GE Jenbacher, MAN und MDE for biogas, sewage gas, landfill gas and mine gas. In addition,

ADDINOL MG 40-Extra LA gas engine oil has been registered by Deutz Power Systems for use with all gases.

ADDINOL gas engine oils proved their excellent capabilities in controlled field tests of over 100,000 operating hours and based on more than 15,000 parameters as well as numerous engine inspections:

- Excellent protection from mechanical and corrosive wear
- Outstanding engine cleanliness
- Neutralizes aggressive contaminants
- Excellent stability against oxidation due to heat
- Long-life characteristics of oil and engine

ADDINOL monitors the use of MG 40-Extra Plus and LA by regular evaluation and oil analysis. Based on results and an internally developed matrix which reflects field test results, the oil change intervals are defined for every cogeneration system to ensure maximum oil life.



# 2G Bio-Energetechnik AG

2G Bio-Energetechnik wants to optimize the entire energy generation process

2G Bio-Energetechnik AG is a specialist in the conception, manufacture and installation of high-efficiency cogeneration units. The company has the installation of more than 530 systems with a combined output of over 115 MW to its credit and is respected throughout Germany as a technology leader in the industry.

In addition to cogeneration systems (50 to 3000 kW, larger systems on request)



for the efficient conversion of biogas, 2G also provides complete solutions: from gas treatment and the installation of gas micro-networks to the use of local heat and the conversion of fermentation residue to energy. The programming of the cogeneration units and the construction of operator-friendly control systems for the complete biogas process incorporate the know-how of more than ten years in this industry.

2G has been operating a distribution and service firm in Spain since the beginning of 2008. Branches in other countries are in preparation. The company also has service agencies throughout Germany.

Series production in Heek: 2G produces cogeneration units between 50 and 370 kW electric output.

**2G** Bio-Energetechnik

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**FORMED IN**  
1995

**SALES**  
€ 28.7 m

**EMPLOYEES**  
60

## Awite Bioenergie GmbH

Intelligent biology – process analysis and automation

Process analysis and automation are of central importance to the smooth operation and financial success of your biogas plant. Process-specific data obtained on-line reflects the microbiology in your fermenters. Only if you have this information can you then control the processes and adjust optimal environment conditions.

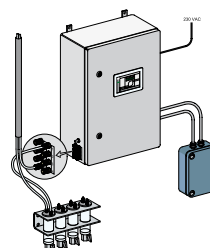


Biogas plant

The automation of the processes ensures the highest operational safety with low staffing levels. Visualisation and remote control allow intervention in the processes at any time without the necessity of being on site.

Share in our many years of experience in gas analysis, automation and measuring equipment. Awite has been a supplier of process analytical systems of the highest quality based on individual requirements since the year 2000. At present, approximately 600 of our process analysis systems give reliable service in different areas of biogas technology.

Process analysis



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**FORMED IN**  
2001

**SALES**  
approx. € 2 m (2007)

**EMPLOYEES**  
12



# BAG Budissa Agroservice GmbH

AG BAG – preservation in plastic film bags: lowest loss, flexible and no approval necessary



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AGROSERVICE  
GESELLSCHAFT MBH**  
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**FORMED IN**  
1994

**EMPLOYEES**  
16

The method of ensilage in plastic film bags, known in Germany as the Eberhardt silo press in the 1960s, was reintroduced by BAG Budissa Agroservice GmbH in 1993. Silage preserved in film bags is of very good fermentation quality, durability and has low silage loss. Different bag diameters and bag lengths ensure the best solution for systems of all sizes. Depending on requirements, this flexible and efficient method is suitable for throughputs of 1,000 to over 30,000 t/a. Grass and corn silage, whole plant silage, high-moisture grain products and industrial waste products (e.g., chips, spent malt grain) can be stored.

As no buildings are needed and no machine capacity must be utilised, the break-even point of the method is reached after 2 to 5 years. Storage in the plastic film bags is an environmentally compatible method, as proven by

a state-funded research project. A precondition is the availability of suitable storage areas.

In addition to a wide range of products, the company BAG Budissa Agroservice GmbH, whose registered office is in Saxony, acts as consultant backed by 15 years of experience in more than 20 European and non-European countries, and in close cooperation with scientific institutions in several states.



AG BAG silo press M 7000

# BIOGASKONTOR Köberle GmbH

Reliable biogas equipment founded on 20 years of biogas experience



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GMBH**  
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**FORMED IN**  
1994 GmbH since 1999

**SALES**  
€ 1.6 m

**EMPLOYEES**  
9

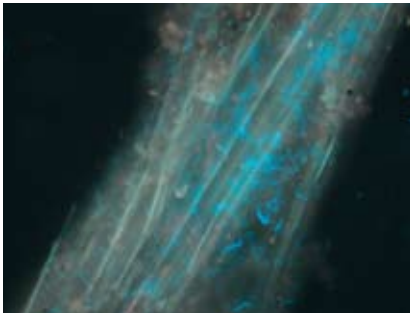
BIOGASKONTOR has designed and designed more than 140 biogas plants with a total generating output of 20 Megawatts.

The owner of BIOGASKONTOR, Diplom-Ingenieur Erwin Köberle, is a founding member of the German Biogas Association and has 20 years of experience in the planning and construction of biogas plants. He was also instrumental in the development of safety standards.



2 bull's eyes with wipers, wash nozzle and lamp built into the fermenter

Through constant exchanging of experience with operators, BIOGASKONTOR has been successful in the development of equipment for biogas plants. For example, the use of double film covers on fermentation vessels, the dashpot seal of stirrers or the pivotable rod stirrer are results of the pioneering activities of BIOGASKONTOR. As a result of constant striving for improvement and the high level of care taken in engineering, the standard components of BIOGASKONTOR are known in the market as easy to handle and highly reliable. Bull's-eyes and sight glasses are DLG-tested, as are under-overpressure relief valves. Measuring units for fermenters, air feed units for desulphurisation, ammonia scrubbers for biogas and overflow channels are other components from BIOGASKONTOR.



MethaTrace® – optimisation of the fermentation process



MethaPlus® – up to 30% higher biogas yield



MethaServ® – analytical services and consultation

# Biopract GmbH

MethaConcept® – success with biogas

Biopract GmbH is a biotechnology company situated at the Berlin Adlershof Science and Technology site. Biopract's core competencies lie in biogas process additives. Biopract offers MethaConcept®, a product range covering requirements for the improvement of energy gain and resource efficiency from state of the art biogas processes.

MethaConcept® ensures higher biogas yield and an improvement in biogas plant productivity.

MethaConcept® includes the plant biomass-targeting enzyme preparation, MethaPlus®, the process stabiliser, MethaTrace® and the biogas process care system, MethaServ®.

MethaPlus® is an enzyme concentrate which accelerates the destruction of plant fibre material and thereby makes it available for bacteria growth. The microorganisms propagate at a faster rate, biological activity is substantially increased and more biogas is produced. The viscosity of the fermenter content is reduced. MethaPlus® is based on the fermentation product of the high yield production strain *Trichoderma reesei*. The specific combination of different en-

zyme activities makes MethaPlus® a high-activity biocatalyst.

MethaTrace® – Process failures due to a lack of trace elements in the substrate occur relatively often, especially in biogas systems operating without manure. As a result, the concentration of acids increases constantly whereas the gas yield drops. The trace element concentrate, MethaTrace®, stabilises the biological process and improves the performance of the fermenter.

MethaTrace® activates the methane-producing microorganisms and accelerates their growth. With MethaTrace®, the biogas system obtains maximum output and stability of the biological process.

MethaServ® – Biopract GmbH offers a wide range of laboratory services which allow the early detection of process disorders and enable a high stability of biogas plant to be achieved. The expertise provided by the company's analytical service has been recognised for 16 years.

*BIOPRACT GmbH – partner of DSM*



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www.methaconcept.de

**FORMED IN**  
1992

**EMPLOYEES**  
16



# Dreyer & Bosse Kraftwerke GmbH

Dreyer & Bosse power plants – cogeneration competence since 1997

## Dreyer & Bosse Kraftwerke



### DREYER & BOSSE KRAFTWERKE GMBH

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FORMED IN  
1997

SALES  
> € 10 m

EMPLOYEES  
> 60

Dreyer & Bosse Kraftwerke GmbH, formed in 1997, is one of the leading suppliers of biogas and vegetable oil cogeneration units.

The systems supplied by Dreyer & Bosse are among the most innovative products in this industry. The highly advanced engine control reduces exhaust emission of some cogeneration series to less than three-quarters of the limit permitted by the German clean air act, TA Luft.

Dreyer & Bosse has also developed a special oil management system for the engines, which ensures high operational safety due to optimal lubricant quality and substantially longer oil change intervals.

Particular attention has always been given to gas treatment. Following the introduction of biogas chillers developed by the company and the integration of activated-charcoal filters, the »AMIN-select« project is now being driven forward. The target of this ambitious project is to upgrade biogas to the level of natural gas so that it can fuel cars or be fed in the natural gas system. In 2006, Germany's first biogas filling station started operation in neighbouring Ja-

meln with professional assistance from Dreyer & Bosse.

Over 300 biogas plants (figures from 2008) with cogeneration units from Dreyer & Bosse operate in all parts of the world. The total installed electric output is over 50 Megawatts. Customer service for the complex system equipment is mainly provided by the company's own experienced service experts. Program changes can be made and problems analysed via remote control. This reduces downtime. Tailor-made maintenance contracts secure the customer's investment and ensure a high level of availability for the highest yields over many years.

### Products and services:

- Biogas cogeneration units between 70 and 1030 kW<sub>el</sub>
- Vegetable oil-fired cogeneration units between 65 and 300 kW<sub>el</sub>
- Gas treatment components (activated-charcoal filters, biogas chillers)
- Control equipment
- Maintenance and service
- Planning and design
- Financing



Finished system with six pilot-injection cogeneration units



Maintenance



# Baur Folien GmbH

Biogas storage and tank covers – delivery and installation

The company Baur Folien was formed by Peter and Josef Baur in 1991. In view of its extremely positive development, the firm moved to a new site in Wolfertschwenden in 2006. More generous facilities there make it possible to meet the requirements for products, quality, service and logistics better than before.



Air-inflated structures and silo covers of the feedstuff drying Kaufbeuren biogas plant

Today, the manufacturing range comprises a wide array of film material processed on modern machines. Leak control systems, biogas storage systems as cushion or cylinder stores and tank covers as simple or double film covers with or without integrated biogas storage are produced. A comprehensive range of accessory products is also available.

Well-known plant and system suppliers to whom we supply or for whom we install our products, are among our traditional customers. With the technical equipment, creativity, innovation, flexibility and speed available, Baur Folien is well prepared to meet the requirements of its customers and the market, now and in the future.



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**FORMED IN**  
1991

**EMPLOYEES**  
20

# Börger GmbH

Create a global impact!

A little over 20 years ago, we became known as the regional supplier of a rotary lobe pump that won many patents. A particular feature of the pump, which has remained unique to this day, is that quick access can be gained to the internal parts of the pump. This enormous advantage has now made us the global market leader. To become ever more successful with our core product, over the last few years we have also developed the universal chopper, multichopper and rotor rake. The Powerfeed system, developed especially for the biogas sector, was also added to the range. It controls the feeding of fermentable material, e.g., corn, into liquid carrying pipelines.

Another newcomer to our product range is Bioselect. This is a pump-assisted system for separating solids from liquid. Our products are very popular with our customers. For this reason, we have set up a global distribution system for our products, with six independent branches and another 20 outlets where our products are explained and demonstrated. Our success is not only due to our products, customers appreciate that we are available to them whenever they need us.



Börger company building

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**FORMED IN**  
1975





# Franz Eisele u. Söhne GmbH u. Co. KG

Swabian pump and machinery factory with experience and tradition



**FRANZ EISELE U. SÖHNE  
GMBH U. CO. KG  
PUMPEN- UND  
MASCHINENFABRIK**

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**FORMED IN**  
1887

Pumps and stirrers in biogas plants must comply with demanding quality requirements. EISELE meets these requirements with stainless steel products, wear-resistant control leakage shaft seals, special cable protection, high overload resistant insulation systems for motor windings and products for potentially explosive atmospheres.

EISELE's submersible motor stirrers for installation in biogas plants are available with output ratings of 7.5, 11 and 15 kW; the 11 and 15 kW stirrers are also supplied with an ATEX certificate for potentially explosive atmospheres. The submersible motors are built by EISELE.

Customers require self-priming pumps or vertical pumps as distributor pump stations. The vertical submersible motor and rotary pumps from EISELE are suitable for many applications and en-

sure thorough mixing and pumping of the fermentation substrate.

Our product range also includes a combined stainless steel overpressure/underpressure guard and a combination of macerator and rotary pumps for crushing and pumping different coferments. These could be waste food, slaughterhouse waste or long-fibre materials, such as hay, straw and silage.



## ETW Energietechnik GmbH

Energy solutions – economical, environmentally friendly and sustainable.



**ETW ENERGIETECHNIK  
GMBH**

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**FORMED IN**  
1997

**SALES**  
€ 17 m

**EMPLOYEES**  
35

We have been developing and producing energy equipment at our site in Moers, Germany since 1997. CHP units and biomethane purification systems are our core business. We provide added value through ideas, quality and service. Technical knowledge, a capacity for innovation and customer orientation make us a big player in the market for independent energy supply. Our customers include major energy suppliers and companies of all sizes. They require environmen-



Biogas CHP Unit ETW540BG

tally friendly and cost-efficient energy production. Qualified staff, specialist knowledge and years of experience lie at the foundations of our tried and tested solutions for the use of renewable and fossil fuels.

We focus on plants that are designed to be economical and sustainable in the long term, individually planned and tailored to your needs. Our qualified service team ensures that the plant functions reliably and at the highest possible operational availability.

Trouble-free order processing, high product quality and reliable service form the basis for a long-term, collaborative relationship. As a family-run, medium-sized company we are particularly conscious of our responsibilities to both our customers and our employees.



# HeGo Biotec GmbH

Reactant binds hydrogen sulfide

Hydrogen sulfide (H<sub>2</sub>S) is an undesired component of biogas. In addition to acidifying the oil of engines in cogeneration systems, a large number of corrosion symptoms in biogas plants are due to the action of H<sub>2</sub>S. In high concentrations, hydrogen sulfide also has a toxic effect on methane-forming microorganisms.

By developing the extensively tried and tested reactant FerroSorp® DG, HeGo Biotec GmbH has been able to provide

owners of biofermentation plants with a safe and cost-effective product to bind hydrogen sulfide in the fermentation reactor.

The 20 employees of Produktions- und Umweltservice GmbH in Lauta produce FerroSorp® DG from ferric hydroxide, exclusively for HeGo Biotec GmbH.

The reactant, a harmless powder, is easy to handle and to store.

The addition of FerroSorp® DG binds hydrogen sulfide in the fermentation reactor and converts it chemically in such a way that the formation of methane is not inhibited. H<sub>2</sub>S-related corrosion problems are also reliably prevented.



Samples of FerroSorp®-products



**HEGO BIOTEC GMBH**  
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Germany

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**E-MAIL**  
info@hego-biotec.de

**WEB**  
www.hego-biotec.de

**FORMED IN**  
1990

**SALES**  
approx. € 3 m

**EMPLOYEES**  
10

# Vogelsang Maschinenbau GmbH

Pumping, crushing and feeding systems for your profit

Environmentally compatible products and methods are part of the philosophy of the Vogelsang group. Products specifically adapted to biogas plants were developed at an early stage. BioCut, a combination of a rotary lobe pump and wet cutter, ensures the smooth flow with the option to feed numerous digesters and increases the gas yield by additional crushing and homogenising of the biosuspension.

QuickMix is the name of an ingenious combination of a 2-shaft screw conveyor and a rotary lobe pump. It mixes the li-

quid phase and the coferment to a homogeneous, mashed biosuspension and feeds it into the digesters. Solid material is fed in a single operation to optimise the process.

In addition to development and manufacturing, service plays a central role in the company. From attendance during the planning phase to close cooperation throughout installation and global maintenance, Vogelsang is your reliable partner.



**VOGELSANG**  
**MASCHINENBAU GMBH**  
Holthöge 10-14  
49632 Essen Oldb.

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+ 49 5434 – 830

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+ 49 5434 – 8310

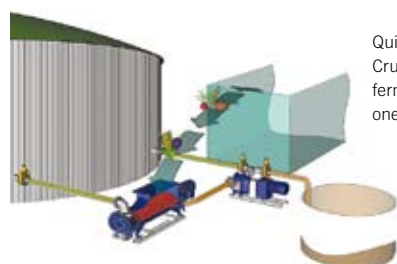
**E-MAIL**  
info@vogelsang-gmbh.com

**WEB**  
www.vogelsang.info

**FORMED IN**  
1929

**SALES**  
€ 40 m

**EMPLOYEES**  
300



QuickMix:  
Crushing, mashing &  
fermenter feeding in  
one operation.



BioCut: A combination of rotary lobe pump  
and RotaCut® wet cutter adapted to the  
requirements of biogas plants



# ITT Water & Wastewater AB

ITT Water & Wastewater develops high quality Flygt submersible motor pumps and mixers for efficient mixing and clog-free transportation of substrate materials.



Flygt series 4600 mixer for efficient mixing of fermentation substrates, e.g., in the fermenter



Flygt series F chopper pump with cooling jacket and patented N hydraulic system for cutting fibrous components and conveying substrates

## Submersible engines to meet the highest requirements

As the world's largest producer of submersible motor pumps and mixers, ITT Water & Wastewater is the leading developer of wear-resistant, low-clogging and energy-efficient technologies for biogas plants.

Intensive mixing of the substrate is necessary at several process stages in a biogas plant. This is accomplished with the compact Flygt mixers in the 4600 series and the slow-speed Flygt Banana mixer from ITT Water & Wastewater. These machines maintain the homogeneous nature of the substrate for optimal distribution of active bacteria and heat, and avoid floating and sediment layers. Optimal mixing and movement at the surface are ensured throughout the process. ITT Water & Wastewater supplies Flygt mixers in the 4600 series with a nominal output from 2.5 kW to 25 kW and a propeller diameter of 368 mm to 766 mm. The energy-saving Flygt

Banana mixer is available in the output range from 2.3 kW to 5.7 kW with a propeller diameter between 1400 mm and 2500 mm.

Liquid manure, fermentation substrate and fibre material can be pumped and cut by Flygt pumps in the F series. Using robust, cutting wheel technology, fibre material in the feedstock is cut into small pieces making it easier to pump. The chopper pumps have a wide output range both in flow volume (up to 9 m<sup>3</sup>/min) and delivery head (up to 70 m water column).

ITT Water & Wastewater offers high-quality products for optimal results at every process stage of a biogas plant.



Slow-speed Flygt Banana mixer for circulating large amounts of liquid



## ITT Water & Wastewater AB

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174 87 Sundbyberg  
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WEB  
www.ittwww.com

FORMED IN  
1901

SALES  
approx. € 1.8 bn

EMPLOYEES  
6,000



Illustration of the different applications of Flygt pumps and mixers in a biogas plant.

# KSB Aktiengesellschaft

International leader in pumps, fittings and associated systems –  
Improve the profitability of biogas plants with KSB



Amaprop in a farming biogas plant in Brome-Benitz, Lower saxony, Germany



KSB administration building



KSB Amaprop

Slow-speed submersible motor agitators in the Amaprop series from KSB, which have proven their worth in waste water treatment for many years, are today making great progress in the biogas plants sector. The reason is their low energy consumption in comparison with high-speed units that have smaller propellers.

Because the flow speed of the medium causes low loss in slow-speed agitators with large propellers, they make much better use of the energy they consume. Numerous practical tests have shown that the ratio of axial thrust produced and electricity consumed is optimal with this design. The systems which were fitted with this unit have a propeller diameter of 2.50 m.

The Amaprop is installed with a recess in the tank and ensures that fresh substrate is quickly stirred into the fermentation medium. The thrust feed at this point avoids what we call the »tea cup effect« with annoying deposits at the centre of the pond. In addition, the position of the Amaprop at the centre produces an energy-efficient circular flow

and there is no floating or sediment layer. Gas production with this configuration is clearly higher than with the uncontrollable mixing obtained with high-speed discontinuous agitators.

In the exceptional case of over-acidification due to incorrect feeding or high temperature fluctuations in the main fermenter or the post-fermenter, an additional Amamix agitator is installed. With a 16 kW output and a propeller diameter of 800 mm it quickly stabilises the medium. The robust agitators only require maintenance every 16,000 operation hours or every two years.

The site in Halle/Saale is the company's competence centre for waste water pumps. At present, around 440 people work there.



**KSB AKTIENGESELLSCHAFT**

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info@ksb.com

WEB  
www.ksb.com

FORMED IN  
1871

SALES  
€ 1.8 bn (group)

EMPLOYEES  
14,000 (group)



# KÖSTER BAUCHEMIE AG

Waterproofing Systems – Concrete Protection Systems



## KÖSTER BAUCHEMIE AG

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### E-MAIL

info@koster.eu

### WEB

www.koster.eu

### FORMED IN

1982

Concrete protection is an absolute necessity in biogas plants, sewage systems and sewage treatment plants as well as in farming facilities and power plants.

Concrete is attacked e.g. by sulfur-(thio-)bacteria which develop due to the hydrogen sulfide (H<sub>2</sub>S) present in these environments.

Fatty acids, butyric acid, propionic acid, acetic acid, carbonic and other acids are also present or used in the above mentioned industries. Their attack on concrete can have dissolving or expanding effects.

KÖSTER's concrete protection systems are modular systems which supplement each other and also build on each other. These systems are:

- KÖSTER concrete protection I
- KÖSTER concrete protection »plus«
- KÖSTER concrete protection »PhO«
- KÖSTER concrete protection »Silo-SR«

Demands on the watertightness of the system are high. For these cases, KÖSTER has also developed products and systems which can withstand high mechanical, thermal and dynamic stresses.

KÖSTER also offers concepts for restoration projects. To date, KÖSTER concrete protection systems have been used in more than 1,000 biogas plants, sewage systems and power plants etc. in Germany and worldwide.



Köster Betonschutz I concrete protection also available for service fitting

# NETZSCH Mohnopumpen GmbH

For your media in biogas plants – NEMO® progressing cavity pumps and TORNADO® rotary lobe pumps

## NETZSCH

### NETZSCH MOHNOPUMPEN GMBH

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Germany

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info.nmp@netzsch.com

### WEB

www.netzsch.com

### FORMED IN

1952

### SALES

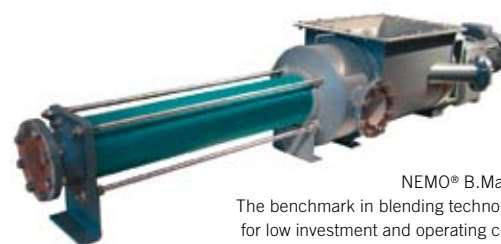
€ 160 m

### EMPLOYEES

1,300

Today's trend shows an increase in the fermentation of organic matter for the economical production of energy. As a world market leader in progressing cavity pumps and a specialist in biogas technology, we offer matched mixing and conveying systems for all process stages in the production of biogas. For centuries rotating positive displacement pumps have been used as conveying systems for all kinds of fluids in wastewater treatment. Due to their inherent characteristics these pumps guarantee a reliable, safe and efficient process.

TORNADO® rotary lobe pump:  
High output from limited  
installation space



NEMO® B.Max™:  
The benchmark in blending technology  
for low investment and operating costs  
with maximum customer benefit

Our NEMO® progressing cavity pumps, TORNADO® rotary lobe pumps and NETZSCH grinding systems can mix, convey and crush material. With more than 1,300 employees at four development and production sites, as well as 20 sales offices, a cooperation partner (in Japan) and another 200 NETZSCH representatives, we are close to wherever you are. Uniform standards based on DIN EN ISO 9001 in development and production at all sites ensure the highest quality synonymous with the NETZSCH name.





Fermenter analytics



Maximum yield from substrate



Tailor-made mixture

# Miavit GmbH

Leading through knowledge and flexibility  
Individual trace element and micronutrient mixture for more power from biogas plants

Formed in 1972, MIAVIT GmbH based in Essen (Oldenburg) is a producer of trace element and vitamin premixes for the feedstuff and biogas industries.

Our products are used for all farm animals and in biogas production. With an annual output of 35,000 tons of premixes, MIAVIT GmbH is the market leader in Germany. In addition to this, around 20,000 tons of minerals, special feeds and 750,000 litres of liquids are manufactured.

MIAVIT GmbH produces customised trace elements and micronutrient mixtures (MiaMethan and MiaMethan liquid) for optimising the yield in biogas plants.

The formation of biogas is a complex biological process. The process can only be optimal if all microorganisms participating in the process are fed the required amounts of trace elements and micronutrients. Many biogas plants with a high volume of renewable primary products and small amounts of livestock waste can suffer from the depletion of special micronutrients, which reduces the gas output of such plants.

As a result, the fermenter starts acidifying. As the acid concentration rises, the risk of the fermenter failing and needing to be restarted also increases.

To ensure the highest yield of a biogas plant, the trace elements and micronutrient content should be optimally matched to the fermenter biology and the substrates. Supported by many years of practical experience in the biogas industry, MIAVIT GmbH has developed recommendations for the supplementation of trace elements and micronutrients in biogas plants. After analysing the fermenter substrate and making a detailed calculation of the requirements of the biogas plant, MIAVIT GmbH optimises the supply by proposing a tailor-made mixture of trace elements. Our trace element and micronutrient mixtures can be supplied as solid MiaMethan or MiaMethan liquid, depending on the customer specifications and facilities available. Both products can be combined with iron for the precipitation of sulphur.



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www.miavit.de

**FORMED IN**  
1972

**SALES**  
€ 90 m

**EMPLOYEES**  
150



# Pro2 Anlagentechnik GmbH

Pro2 Anlagentechnik – the future of energy



## PRO2 ANLAGENTECHNIK GMBH

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FORMED IN  
1994

SALES  
€ 45 m (2008)

EMPLOYEES  
140 (2008)

Pro2 Anlagentechnik GmbH, founded in 1994, has its headquarters in Willich near Düsseldorf. Pro2 has been a leading system supplier of local energy equipment and bioenergy with a strong international bias since the end of the 1990s. The core competence of Pro2 is the development and construction of turn-key projects for energy supply, gas treatment and gas use. The product range comprises cogeneration units and systems for biogas, sewage gas, mine gas and landfill gas, as well as ve-



getable oil. Pro2 provides cogeneration systems which have engines with between 200 kW and 2,000 kW of electric module output for local energy supply.

### Biogas

The conversion of biomass and organic waste to electricity and heat is ecologically valuable and creates new fields of activity while generating more revenue in farming. Pro2 develops and builds system solutions for biogas use, e.g., gas conveying and gas treatment systems, flare systems and biogas cogeneration units. The system concept offers advantages in building a plant and also for the subsequent operation and maintenance of the plant: no interface problems, minimum engineering expenditure and high availability of the system comprising biogas treatment – flare – biogas use.

# PRONOVA Analysentechnik GmbH & Co. KG

Increased safety and improved cost-efficiency through reliable analysis of the biogas process



## PRONOVA ANALYSENTECHNIK GMBH & CO. KG

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13347 Berlin  
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FORMED IN  
1998

EMPLOYEES  
15

PRONOVA is a supplier of the following key products for the control and optimisation of biogas plants:

- SSM 6000 for online biogas analysis
- FOS/TAC 2000 for the assessment of major substrate variables: Concentration of volatile organic acids (VOA) and buffer capacity (TAC).

Since the launch of the first gas analyser especially designed for biogas plants in 1998, PRONOVA has been the global leader in biogas analysis with over 1,000 systems of the SSM family sold to date. PRONOVA also develops solutions for specific and new applications, for example, the upgrading of biogas to be fed into natural gas networks.

In addition, PRONOVA supplies other measuring instruments for biogas plants, e.g., gas alarm equipment and instruments for liquid analysis (pH, ammonia, etc.). The automatic titrator FOS/TAC

2000 is an instrument for simple control of the VAO and TAC major substrate variables in plants, without any loss of time.

PRONOVA has incorporated the specialist knowledge of AEG and is active in many areas of gas analysis today. As a group of firms, PRONOVA also supplies water analysis equipment under the trade names of iRAS and STELZNER® farm measuring equipment.



SSM 6000 for online biogas analysis (right) and FOS/TAC 2000 for the assessment of VOA and TAC major substrate variables.





Fermenter heating using the RAUBIO system



RAUBIO gas condensation manhole



RAUTHERMEX district heating pipe

## REHAU AG + Co.

Energy from nature – pipe systems for biogas plants from REHAU

REHAU AG + Co. is a supplier of complete pipe equipment for biogas plants. The RAUBIO system from REHAU is suitable for fermenter heating. The heating pipes are either installed directly in the biomass or in the fermenter wall using the RAUBIO Fix innovative mounting system. The pipes have a special blocking layer to prevent the entry of hydrocarbons, and are resistant to acid, temperature and pressure.

The REHAU RAUTHERMEX pipe system was developed for heat supply within biogas plants and the connected heat network. The PE-Xa media pipes have an orange safety barrier layer and are designed for high hydraulic performance, temperature resistance up to 95°C and long service life. The insulation of closed-pore polyurethane foam ensures optimal thermal insulation.

RAUPROTECT I is a piping concept developed specifically for biogas plants. The special construction of the wall makes these pipes suitable for direct burial in the ground without a sand bed. No

expensive soil exchange is required. As a complementary product, REHAU also supplies a special gas condensate chamber.

In addition to the above, REHAU has transportation pipe systems for different applications. The high-load sewer pipe AWADUKT PP SN10 from REHAU is an ideal pipe system for pressureless transport of liquid manure. The RAU SIKKO system from REHAU is optimal for drainage and seepage of paved areas. Pressure tubes of RAU-PE 100 with an extensive assortment of moldings complement the product range.

In addition to innovative, complete solutions from a single source, REHAU provides an extensive range of services to customers and partners. This includes assistance in planning heat networks or designing fermenter heating systems, a global service and sales network as well as the development of custom solutions.



**REHAU AG + CO.**  
**GESCHÄFTSFELD BAU**  
 Ytterbium 4  
 91058 Erlangen  
 Germany

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 + 49 9131-925-191 00

E-MAIL  
 biogas@rehau.com

WEB  
 www.rehau.de

FORMED IN  
 1948

EMPLOYEES  
 15,000







State of the art laboratory diagnostic facilities to define the critical volume and trace elements of the fermenter content are the fundament of fermenter evaluation.

The BC.PRO micronutrient mixtures are tailor-made on the basis of detailed analysis and scientific requirement standards, and raise the fermenter to full performance.



A system with 70 batch fermenters allows extensive research in the field of biogas production.

# Schaumann BioEnergy GmbH

Expertise in biogas – optimal generation of energy from substrate and system-specific feeding of fermenter bacteria for more methane

## SCHAUMANN BioENERGY

**SCHAUMANN  
BIOENERGY GMBH**  
An der Mühlenau 4  
25421 Pinneberg  
Germany

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info@schaumann-bioenergy.eu

**WEB**  
www.schaumann-bioenergy.eu

**FORMED IN**  
2007

Schaumann BioEnergy, the newest member of the internationally successful SCHAUMANN Group, is a specialist in the conservation and pre-treatment of organic substrates as well as optimisation of the fermentation process for the production of biogas. All the activities of the group in the field of agricultural energy production were concentrated and intensified in the new company. Nevertheless, the extensive experience of the other companies and research institutes of the SCHAUMANN Group in related areas greatly benefits Schaumann BioEnergy.

Schaumann BioEnergy offers two product groups in the area of substrate conservation: The SILASIL ENERGY series, which includes various specific biological silage additives, and the BC.ACID group of conservation agents for all types of organic substrates. The aims of these products are optimal energy conservation during the storage of all kinds of different organic substrates and maximum biogas yield during fermentation.

With regard to the optimisation of the fermentation process, the BC-Concept was developed by Schaumann BioEnergy. The fundamentals of the BC-Concept are tailor-made micronutrient mixes combined with plant-specific active agents. The products are composed after a detailed analysis of the fermenter content based on the scientific requirement standards of micronutrients for methanogens. The evaluation of plant-specific process parameters and qualified product consultation are part of the concept to raise the biogas process and methane yield to an optimum level.

The unique research network within the SCHAUMANN Group gives Schaumann BioEnergy a leading position in biotechnological knowledge and product innovation.



# SCHMITT ENERTEC GmbH

Your competent partner for compact energy solutions

SCHMITT ENERTEC GmbH was formed in 1976 from an engine repair station with 2 workers. Since then it has developed into a medium-sized, machine building firm with a workforce of over 70.

The first exports were made in 1999. In total, 70 % of all its plants operate in Ireland, the U.S.A., Japan, Korea, Belgium, Italy, Spain and India.



SCHMITT ENERTEC cogeneration units are service-fitted for biogas, sewage gas, natural gas or wood gas as fuel.

ENERCARB wood gas thermal power units were developed especially for the efficient use of energy from wood. During this process, which has been optimised over the course of time, wood is converted to combustible gas through oxygen deprivation and converted into electricity and heat in a specially designed cogeneration module.

ENERCARB wood gas thermal power units are delivered on a turn-key basis. Gasifiers, gas filters and cogeneration modules are made in-house and shipped to the customer as prefabricated components. Owing to the modular design, units between 250 and 1,000 kW are available.

Biogas plant



## SCHMITT ENERTEC GMBH

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WEB  
www.schmitt-enertec.com

FORMED IN  
1976

EMPLOYEES  
> 70

# Schnell Zündstrahlmotoren AG & Co. KG

Innovative equipment for the highest efficiency in pilot-injection engines

The firm Schnell Zündstrahlmotoren is considered to be one of the pioneers in biogas plants. From being a full-line provider, the company redefined its role and became the market and technology leader for pilot-injection engines. The specifically developed injection method is the core of the Schnell units. It ensures constant output and optimal combustion of gas and oil of varying grades.



## SCHNELL ZÜNDSTRAHLMOTOREN AG & CO. KG

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E-MAIL  
info@schnellmotor.de

WEB  
www.schnellmotor.de

FORMED IN  
1992

SALES  
approx. € 45 m (2007)

EMPLOYEES  
160



Hans-Jürgen Schnell

Electric efficiency of up to 45 per cent can be obtained. The units are equipped with engines from Scania or Sisu. These engines can be fuelled by biogas or vegetable oil. Over 2,000 Schnell pilot injection engines in the output ranges between 40 kW and 340 kW give reliable service in all parts of the world. The market share in pilot-injection engines held by Schnell is over 80 per cent.



# SES Energiesysteme GmbH

Time for change. Cogeneration systems from SES. Your partner for local energy systems.



SES plans, manufactures and finances supply systems for alternative forms of energy. We rely on environmentally sound cogeneration with biogas and natural gas.



Plug'n'Play: The compact cogeneration modules can start operation directly.



Cogeneration unit in Kassel: Many years of experience in industrial plant construction.



Would you like references? We will be glad to send you our list of customers.

  
Specialist for Decentralized  
Energy Systems.

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12435 Berlin  
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**FORMED IN**  
1998

**SALES**  
€ 22 m

**EMPLOYEES**  
60

SES Energiesysteme GmbH designs, develops and produces complete cogeneration systems and emergency generating units that use gas engines, as well as specialised, containerised cogeneration units for biogas plants, sewage treatment systems, municipal facilities and industry. You can order our supplies and services as complete packages, from the project concept to turn-key construction, including maintenance and repair.

SES Energiesysteme GmbH was founded in 1998 and is registered in Berlin. We also have branches in Rackwitz (near Leipzig), Raisting (near Munich), Essen and Lüneburg. From there, we provide service to about 350 gas-engine fired cogeneration units throughout Germany.

In addition to the market in Germany, SES Energiesysteme GmbH also operates in Italy, Spain, Poland and Russia. We design new cogeneration systems and provide a comprehensive service

for existing systems in these countries, either with our own specialists or through distribution partners.

SES Energiesysteme GmbH supplies cogeneration units in the output ranges from 50 kW to 2,000 kW. We can supply compact modules, sets, containerised systems or complete plants according to customer requirements. Our cogeneration systems are equipped with high-efficiency gas engines from MWM and MAN.

The cogeneration systems of SES Energiesysteme GmbH have high energy efficiency, low operating costs, are easy to maintain and have high availability, especially in the renewable energy sources segment.

A team of motivated and experienced specialists is available to the customers of SES Energiesysteme GmbH, providing progressive cogeneration system solutions which are optimally matched to the customers' needs.



# SILOXA Engineering AG

Systems for gas cleaning and gas treatment

SILOXA Engineering AG is active in the fields of gas cleaning (desulphurisation, elimination of formaldehyde) and gas treatment (gas drying, gas heating, gas compression). Innovative, modular technologies, wide-ranging competence and a clear customer focus form the foundations of SILOXA's position as a market leader.

## Products and services

### *Biogas treatment*

Treatment comprises the removal of solid and liquid components and the drying of the gas. Biogas contains water vapour which condenses in the pipeline system when the temperature of the gas is reduced. This causes corrosion. In addition to this, the water vapour has a negative effect on the efficiency of the gas engines. For these reasons, it must be removed from the biogas.

### *Gas treatment*

Gas treatment filters to eliminate  $H_2S$  are available for any system size and can be service-fitted. SILOXA's system reliably reduces the emissions and investment is recovered after a short time.

### *Cogeneration in biogas use / gas micronetworks*

As only 35 per cent of the energy in biogas can be converted to electricity, efficient use of the heat produced by combustion is a necessity. Cogeneration improves the efficiency of the energy obtained by up to 90 per cent. Some 25 to 40 per cent of the heat produced is used for the fermentation process. The remainder can then be sold (to businesses, municipal properties, etc.).

### *Service and maintenance*

Maintenance and repair of all system components. Supply and disposal of activated carbon as well as maintenance and repairs to operating systems.

### *Gas analysis*

Performance and evaluation of gas analyses to ascertain the quality of the gas.

### *Engineering*

All SILOXA systems are planned and built according to EU directives and are delivered with manufacturers' and EC conformity declarations.



SILOXA

SILOXA ENGINEERING AG

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Wolfgang Doczyck  
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FORMED IN  
1998

SALES  
> € 35 m

EMPLOYEES  
> 50



Standardised gas supply container



1-chamber gas treatment module



SILOXA gas drying module



Micro gas networks schematic



2-chamber gas treatment module



# SUMA GmbH

Independent manufacturers of agitators for the good of our environment and your returns anywhere in the world



## SUMA RÜHRTECHNIK GMBH

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Germany

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### E-MAIL

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### WEB

www.suma.de

### FORMED IN

1957

### SALES

€ 5 m

### EMPLOYEES

28

We have been specialising in agitators for liquid manure and biogas substrates since 1957. All of our expertise and decades of experience go into ensuring the quality and efficiency of our agitation systems. And this is precisely what makes us experts.

We can provide you with advanced technology and individually tailored solutions to meet the challenges of modern energy management. First-class quality, superb performance, long agitator life and an accommodating service are the principles on which we work.

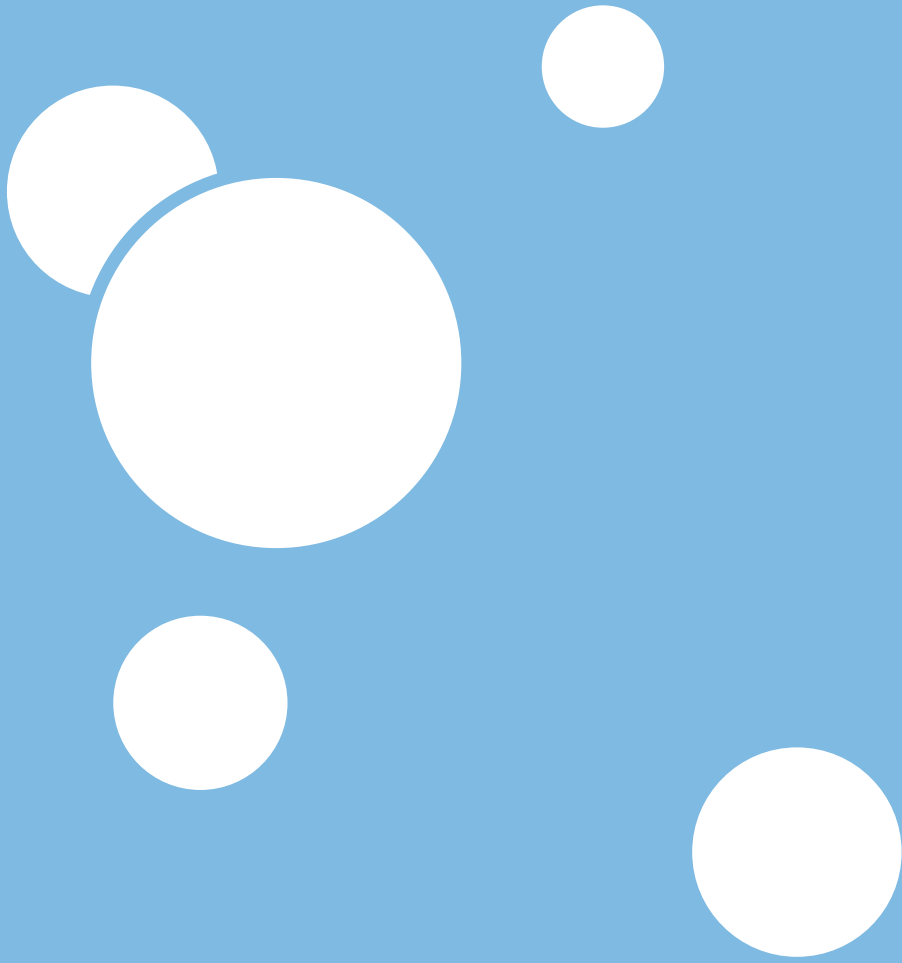
The final product is the result of a process that takes place almost entirely in-house. We design nearly all parts ourselves and manufacture them on modern equipment. Whether machining, metalwork or making our own tools and devices for manufacturing

parts, the high degree of vertical integration at Suma allows us to determine not only the quality of the entire process but also enables us to meet specific customer requirements quickly and cost-effectively.

Our customers in Europe and overseas have come to rely on perfected technology from Suma. We are an independent company with no outside shareholders and institutions to consider. This is why we can afford to act and decide solely with our customers' interests at heart.

Giantrnix FR – more power in the fermenter for more biogas





Companies

Operators,  
planners,  
advisors



Agraserv offers technical and biological services to all owners of biogas plants which process renewable primary products, organic waste or industrial residue.

# Agraserv GmbH

Technical and biological services for biogas plants



## AGRASERV GMBH

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FORMED IN  
2006

SALES  
€ 440,000

EMPLOYEES  
5

Agraserv offers technical and biological services to all operators of biogas plants processing renewable primary products, organic waste or industrial residue materials.

The profitable operation of a biogas plant is founded on the optimal coordination of high-level equipment with a stable biological process. Any biogas plant can profit from high-quality service. This is provided by the Agraserv subsidiary of the Agraferm Group. Agraserv offers service packages which are optimally matched to the respective biogas plant:

- Initial start-up and recommissioning of biogas plants
- Basic and micronutrient analysis
- Biological process monitoring and micronutrient supply
- Laboratory analysis of process samples and provision of data to secure the dry fermentation bonus
- Evaluation and interpretation of the analytical results
- Development of feeding plans and recommendations for the fermenter
- Technical service for cogeneration units and system equipment

The profitability of a biogas plant is also substantially affected by the downtime of the equipment. To minimise scheduled and non-scheduled downtime, preventive maintenance of the equipment and an optimal substrate and micronutrient supply in the biological process are essential. Preventive maintenance means that parts more quickly susceptible to wear and tear are replaced before they fail, and maintenance work is carried out strictly to schedule where possible.

The stability of the biological process is critical to optimal gas yield. As a rule, poor reactions occur when the micronutrients essential to the metabolic activity of methane-forming bacteria are depleted. Agraserv supplies a special micronutrient product which contains all micronutrients that can be lacking in the fermentation reactor. This optimises the process of degradation and ensures that the largest possible volume of biogas is obtained from the enriched substrate.



# ATRES engineering biogas

Analytics, independent consultancy, research and development, trace elements, enzymes

ATRES, Anaerobic Techniques and Renewable Energy Systems, was founded in 2006 as a spin-off from Munich Technical University.

The team of engineers at ATRES offers project partners much more than interdisciplinary national and international specialist knowledge. The site in Freising-Weihenstephan contains a laboratory for chemical and technical analysis and several lab-scale biogas plants which use the most advanced equipment.



Biological process control

ATRES acts independently of any particular supplier and is therefore a competent partner for interested parties, investors and operators of biogas plants with regard to:

- biological process monitoring,
- regular analysis of substrates and fermenter content,
- optimisation & expansion of plants,
- mono and co-fermentation.

For industrial applications, ATRES focuses on organic residue and waste water: spent malt from beer production, old bread, whey, slurry from bioethanol production and other feedstock.

ATRES NUTRIMENT PLUS, one item in the company's product range, ensures the correct supply of liquid trace elements in biogas plants, for stabilising the degradation processes, improving biogas yields, shortening the start-up phase and other aspects of system operation. Carefully matched enzyme mixtures complement the product portfolio.



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**FORMED IN**  
2006

**EMPLOYEES**  
4

## eutec ingenieure GbR

Engineers for a clean environment

We are experts in the field of biogas engineering and are one of the industry's leading engineering firms in Germany. The firm was formed in 2002, however, the owners have been working in this field since 1991. This means that we have 17 years of experience in the biogas sector.

As an independent engineering firm, we work strictly without affiliation to any particular supplier. This enables us to plan and implement biogas plants which exactly meet your needs. An individual plant concept is developed around the available feedstock and the conditions on site.

We provide the full range of engineering services from a single source: Development of initial ideas, preliminary and design planning, approval planning, execution and construction planning, tendering, selecting construction contractors and supervising the construction and

start-up of the plant – we remain your competent partner throughout all stages of the project.

We also assist you after start-up so you can make the most of your biogas plant. We offer a wide range of services, especially in monitoring the process biology. Remote monitoring of important process parameters, data analysis and system feeding recommendations are amongst the services we provide.



Wooden ceiling of a fermenter under construction



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**FORMED IN**  
2002

**EMPLOYEES**  
16







Biogas plant for food waste and restaurant waste in Malchin, Germany

# entec biogas gmbh

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## Ecological conversion

*entec biogas gmbh specialises in the generation of electricity and heat from food and slaughterhouse waste.*

No two biogas plants are alike. Whereas many system suppliers rely on the fermentation of renewable input materials such as wheat, corn or rye, entec biogas gmbh in Fussach near Lake Constance concentrates on technical improvements to systems converting food and slaughterhouse waste into electricity and heat. Today, the expensive investment in research work by this high-tech company is bearing fruit. The prices of renewable raw materials are going up, whilst at the same time, thousands of tons of food waste require disposal. Formerly, waste from the food and slaughter industries, as well as food leftovers from hotels and restaurants, was consumed as feedstuff, mostly for fattening pigs. Today, this is forbidden in all EU member states because it involves the risk of hygiene epidemics. Instead of simply being burned, these materials are now converted into energy in entec biogas plants.

### **Complete service.**

entec biogas provides specialist knowledge for biogas plants of all kinds. Our employees handle all matters of approval planning and calculate the costs. They prepare the technical and biological design of the plant. The experts from Austria will define the size, output, equipment and control of the plant according to the owner's requirements. They invite bids for all aspects of a project and take over building supervision, project management and purchases for the customer. In the final stages, they start the biological operation of the plant and train the operators. All the main components for biogas plants from entec biogas are Austrian-made. The contractors are selected from the respective region. Nearly 100 per cent of all orders the high-tech firm wins are from outside the home country. In addition to the European countries, entec personnel have made repeated deliveries to markets such as Korea, Japan and Taiwan as well as Russia, Malawi, the U.S.A. and India.



Biogas plant for liquid cattle manure in Ravenna, Michigan, USA



Pasteurization plant



The two CEO's of entec biogas gmbh: Bernhard Schulz and Brigitte Maier

### In high demand.

The demand for biogas plants is increasing. The entec specialists' planning and commissioning record lists as many as 40 large projects. The emphasis is on industrial systems requiring an investment of five to 30 million euros. entec is the market leader in the construction of industrial biogas plants for farms in Spain. Two plants have been completed here with another three under construction and three more under negotiation. Plants for converting food waste are clearly the right market for entec biogas. Only recently, the company won a large order from a U.K. investor. Four such large technical systems have already been built by entec biogas – two in Japan and two in Germany. Orders for other plants have been received or are being negotiated.

### Flexible process.

The plants are divided into different sections: substrate arrival and hygienisation, fermentation, fermentation residue storage and delivery, and gas treatment. The process developed by entec biogas is flexible. Modification at the pretreatment stage makes it possible to use different types of food waste as feedstock, such as market or kitchen refuse and food industry waste. The innovative method can also be adapted to different collection channels.

Normally, the material is delivered in liquid state. It is crushed, cleaned and fermented in CSTR fermenters via a complicated technical process. The fermentation residue is then screened and can be spread in the field as fertiliser. If sufficient biogas is available, it is extracted from the storage vessel and converted into electricity.

The customers of entec biogas represent many industries. The company makes equipment for the farming industry, e.g., for animal breeders, for energy crop farmers tilling their own fields to grow feedstock for biogas plants, for the food industry and for municipalities intending to use waste products from sewage treatment plants as an energy source.



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#### FORMED IN

2005

#### EMPLOYEES

8



# L.e.e. s.à r.l.

Your planning office for bioenergy



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**FORMED IN**  
2000

**EMPLOYEES**  
13

L.e.e. is a service-oriented company whose core competence lies in the planning, development, construction and operation of farm-based, municipal and industrial biogas plants.

We also plan energy plants which convert different kinds of solids (wood, straw, sewage sludge, etc.) using either fermentation, incineration, or gasification processes. The combination of biogas technology with other conversion methods ensures the maximum profitability of all projects implemented.

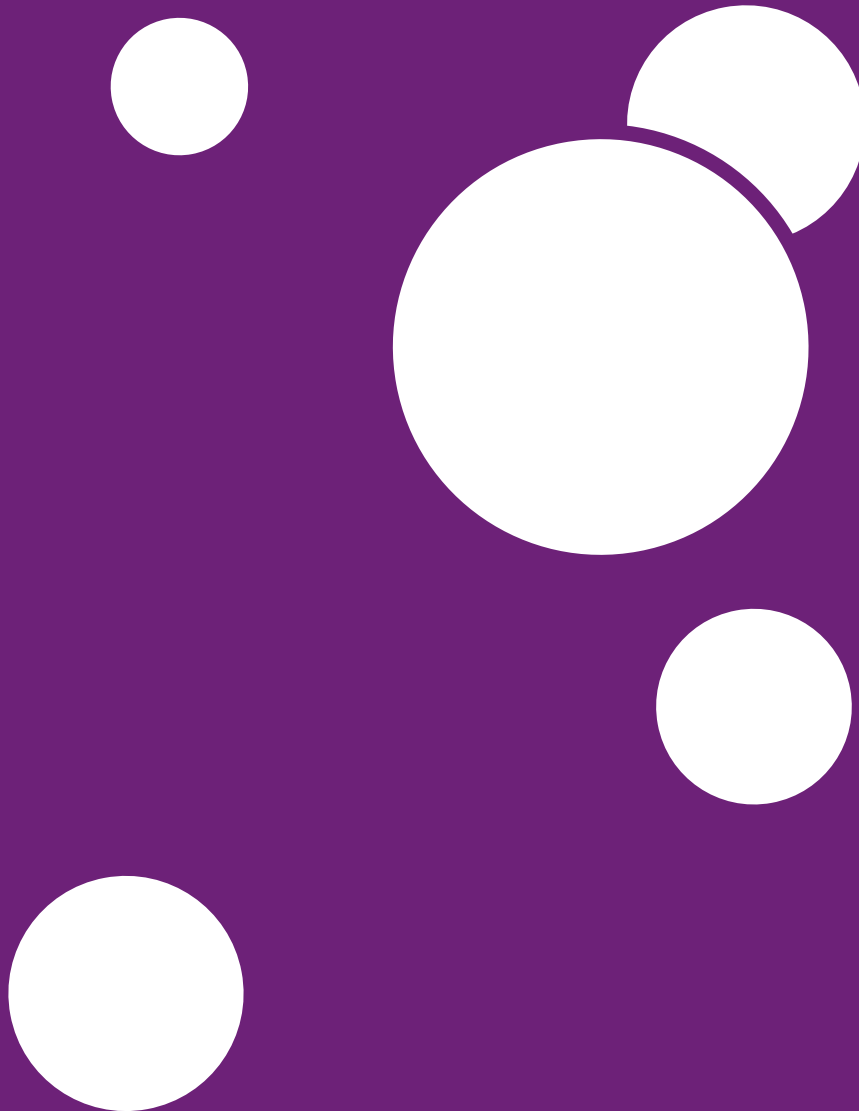


Municipal biogas plant in Germany: 795 kW<sub>el</sub>  
Input: 35,000 tons of farming biomass  
Hygienisation of the biogas substrate

L.e.e. develops tailor-made, sustainable solutions for you. We combine applied research and development in the fields of biogas, material flow management and biomass utilisation with engineering services.

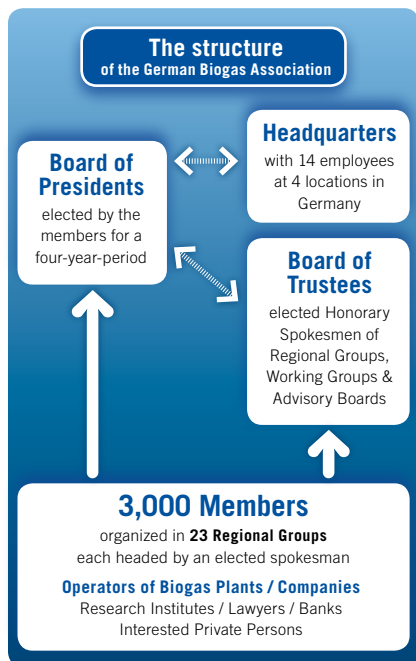
Waste recycling system in Turkey: 5.6 MW<sub>el</sub>  
Input: 154,000 tons/year of organic waste  
from municipal rubbish  
2 fermenters with a capacity of 11,700 m<sup>3</sup> each



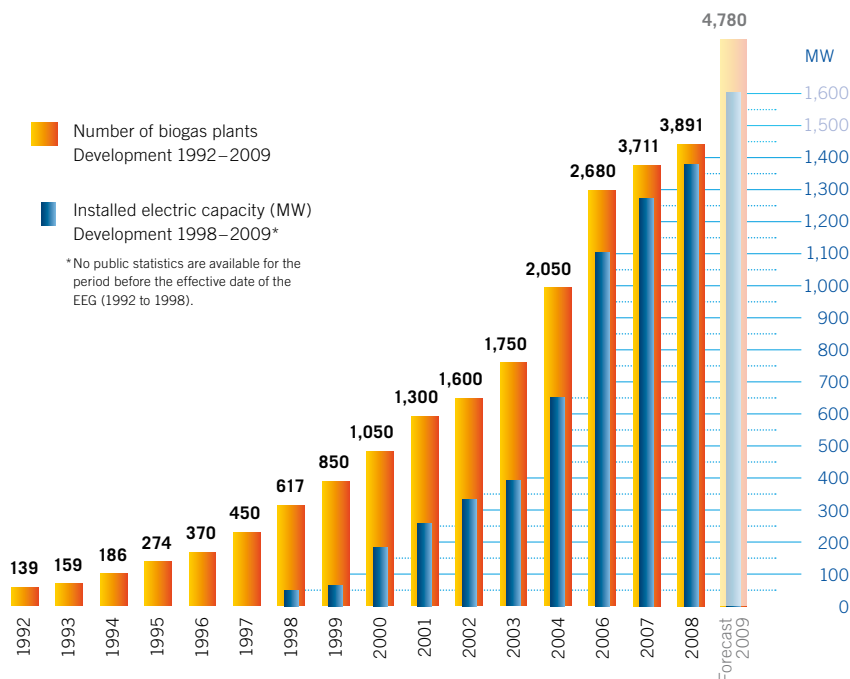


# German Biogas Association

Europe's strongest organisation in the biogas sector



Number of biogas plants & installed electric capacity in Germany



## GERMAN BIOGAS ASSOCIATION

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The two headquarters in Freising and Berlin and their two regional offices in Hannover and Bräunlingen.

The German Biogas Association unites owners, manufacturers and planners of biogas plants, representatives of science and research as well as interested parties from all over Germany.

Since it was formed in 1992, the Association has grown into Europe's strongest biogas organisation with a membership of over 3,000.

### Tasks of the Association

The German Biogas Association promotes the extensive use of biogas technologies at European, national and regional levels, and to this end acts as a powerful political pressure group.

In addition, the Association promotes the exchange of experience in the biogas sector, e.g., by collecting and communicating scientific findings and practical experience as well as organising conferences, exhibitions and other events.

Through participation in European projects and its membership of the European Renewable Energies Foundation (EREF) umbrella organization, the German Biogas Association is an active initiator and promoter of the international pooling of experience.

The German Biogas Association is represented by a committee which is elected by the general meeting of members. Over 3,000 members of the Association in Germany are organised into 23 regional groups. This ensures efficient networking of competent contacts regionally, nationally and internationally.

Working groups and advisory boards are allocated to one of 10 departments within the headquarters and are attended by one responsible staff member

Advisory Boards	Working Groups
<ul style="list-style-type: none"> <li>▶ Operators Advisory Board</li> <li>▶ Companies Advisory Board</li> <li>▶ Legal Advisory Board</li> <li>▶ Scientific Advisory Board</li> <li>▶ Finance Advisory Board</li> </ul>	<ul style="list-style-type: none"> <li>▶ Approval Requirements</li> <li>▶ Safety Technologies</li> <li>▶ Biomethane grid injection</li> <li>▶ Future energy supply strategies</li> <li>▶ Biowaste and fertiliser requirements</li> </ul>

Advisory boards and working groups of the German Biogas Association

# Solarpraxis AG

Engineering & Practical Expertise for Renewable Energies



Solarpraxis AG focuses on the engineering, conferences and publishing segments.



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**FORMED IN**  
1998

**SALES**  
€ 3.38 m (2007)

**EMPLOYEES**  
36

## Knowledge connects

Solarpraxis was formed by Karl-Heinz Remmers und Kay Neubert as a non-trading partnership in 1998. Within a few years, the small engineering office became one of the biggest consulting and service companies for renewable energies in Germany. Now, around 40 experts focus on the segments of Engineering, Conferences and Solarpraxis Publishers.

Engineering services have remained the core competence of Solarpraxis AG. The experts of the Engineering department plan solar systems for suppliers, wholesale firms and specialised craft businesses, undertake profitability studies, yield studies and forecasts, optimise systems and carry out acceptance tests and start-ups.

More than 60 books, CD ROMs and loose-leaf collections are being published in nine languages by the books department of Solarpraxis Publishers, the focus being on renewably energies, energy efficiency and environment. The »Technical journals« section publishes *SOLARES BAUEN*, *solarBOULEVARD* and the English-language B2B *pv magazine*.

The Conferences department has been organising conferences on the solar industry, network integration and heat pumps in Germany, Spain, Italy and the U.S.A. since 1998. These 2-day conferences focus on non-technical topics, such as marketing, finance, market development and sales.

In 2000, Solarpraxis was converted into a public stock company (AG) and has been quoted since August 2006. In 2007, it acquired an interest in Sunbeam GmbH, which focuses on communications services for customers in the renewable energies sector. In addition, Solarpraxis AG, together with Alfons W. Gentner Verlag GmbH & Co. KG, set up a joint publishing firm which publishes the *photovoltaik* technical journal. It also holds an interest in the Renewable Academy (RENAC) AG which offers training and further education services in the renewable energies and energy efficiency sectors.



# Sunbeam GmbH

Communications agency for renewables and energy efficiency



Sunbeam is responsible for the concept, text, photo, illustrations and layout of this brochure.

## sunbeam

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### FORMED IN

1998

### SALES

€ 1.2 m (2007)

### EMPLOYEES

20

Is your business in renewables or energy efficiency? Do you want to enter the German market? Or do you already have a market presence but want to expand?

Sunbeam is your communications specialist for the German-language market. We have been working in the renewables field since 1998.

We know how the market here works, have excellent contacts with the press, the political world and industry associations, and have in-depth knowledge of the legislative environment surrounding the industry. Added to which, we work side-by-side with the engineers of the knowledge provider Solarpraxis, our parent company. This means that our comprehensive specialist knowledge remains state of the art.

#### *Public Relations*

We deliver high-quality communication and consultancy services for businesses and associations. Since our speciality is renewables, we can bring our intimate knowledge of the industry to communication issues. We understand the political processes in the renewable and energy-efficiency fields, both

at a German and an EU level. Sunbeam has excellent contacts with the German parliament, ministries, industry associations, governmental agencies, NGOs and the press.

#### *New Media*

At Sunbeam, we have extensive expertise in the conception, design and implementation of websites and on-line content databases. Sunbeam has in-depth experience of TYPO3, one of today's leading open-source content management systems. We specialise in website accessibility; in 2005, we won the BIE-NE award – Germany's most prestigious award for barrier-free design.

#### *Communication Design*

Your external image is one of the most vital factors in your company's success. We develop clear and comprehensible printed products including business reports, catalogues and flyers. Our infographics depict complexity in a simple way and make technical details understandable. Our illustrations can simplify even the most complicated subjects.

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