



Biogas projects – Operators and their plants

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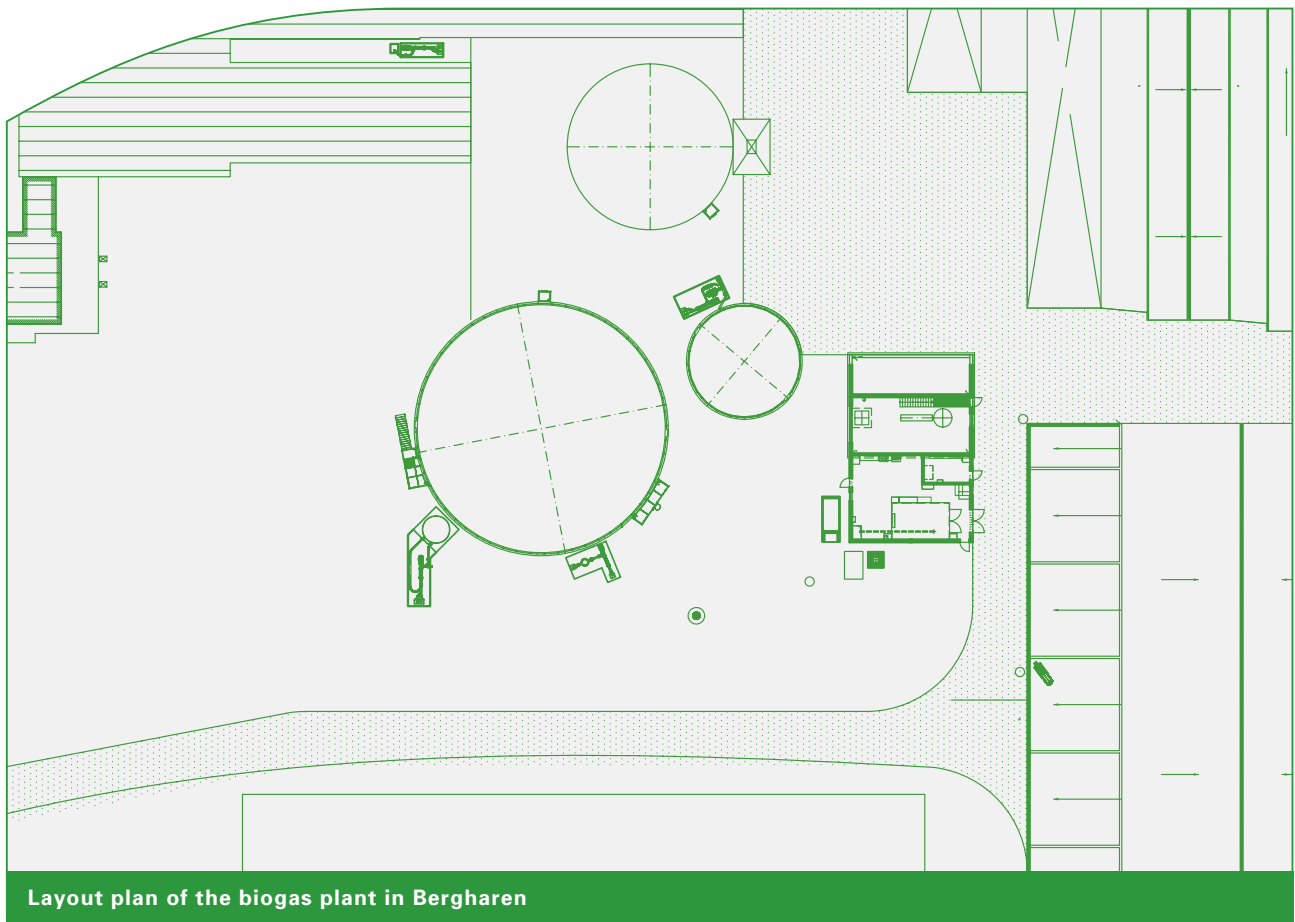
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- > International premiere with the first own plant operation in the Netherlands
- > First plants successfully put into operation in Italy
- > Technical novelties and advancements being used in Bohmte



Pieter Theunissen: EnviTec partner in first own-operated biogas plant abroad

In 2008, EnviTec built the first biogas plant of its own-operation outside of Germany in Bergharen, a small town in the centre of the Netherlands. Its partner is Theunissen Holding, owned by local farmer Pieter Theunissen. This project is uncharted territory for both partners and the business model is equally profitable for both as well: Theunissen delivers the input material and EnviTec provides the technical and biological service. Together, they profit from the regular turnover and attractive margins.



Layout plan of the biogas plant in Bergharen

The biogas plant at Theunissen

The plant in Bergharen has a capacity of 625 kW_{el} and 675 kW_{el} and about 2 million Euro have been invested. 4.9 kW of electricity per year are produced since December 2008. The excess heat is used by Theunissen partly for providing heat and warm water for his house. As input material the family business supplies cattle manure, maize- and whole plant silage. Poultry manure and leftovers from the milk industry are added.



← In 2009, the feed-in tariff in the Netherlands has been set to 15,2 cent per kWh

→ The farmyard has 185 cattle, 130 young cattle, 5 bulls and 300 hens

→→ 65 hectares of arable land and grazing land are cultivated



»The Netherlands is in the early stages of biogas. The momentum from Germany is good for us!«

For EnviTec, the biogas plant in the Dutch town of Bergharen is a milestone in its company history, because it is the first plant that the company has built abroad as a plant operator. The expansion of own-operated plants as a second lucrative business segment is the declared goal of the company, and the Netherlands is particularly suited for this:

There is no experienced plant manufacturer in the Dutch market and therefore no know-how to successfully operate a plant. For this reason, many plants in the Netherlands are used well below full capacity due to a lack of technical and biological expertise; this in turn can endanger their whole financial basis. When dealing with the bank, farmer Pieter Theunissen soon learned that his negotiating position was much stronger when he had an experienced partner from Germany.



The technical building and the fermenter. It has a net volume of 3,4000 cubic meters.

The construction and operation of a biogas plant in the Netherlands is also particularly attractive at the moment from the perspective of environmental and energy policy. After the early years, in which on the one hand the level of state in-



This container is used to store poultry manure.

centives fluctuated considerably, and on the other hand were considerably less than in other EU countries, the feed-in tariff was set in 2009 to 15.2 Cent per Kilowatt hour and the guaranteed period for receiving the

subsidy was increased to twelve years – good premises for investments that pay off within the foreseeable future. Operators also receive an additional payment of 2.7 Cent for heat use. Furthermore, processing biogas to the quality of natural gas also provides good prospects as this is currently being redefined legally and should be much more attractive in the future.

Farmer Pieter Theunissen is optimistic - he assumes that the number of economically run plants in the Netherlands will increase considerably within the next few years. „After all, our farming and food industry supply a huge amount of input material. And biogas technology provides interesting employment opportunities!“ The level of interest that biogas technology has now generated, thanks to increased subsidies and its success in the neighbouring countries of Belgi-

um and Germany, can be seen in an open day held in the yard of Theunissen, which attracted more than 1,000 visitors. In addition to farmers from the region, many operators and interested parties also came from further afield to inform themselves on time before the biogas market really takes off in the Netherlands.

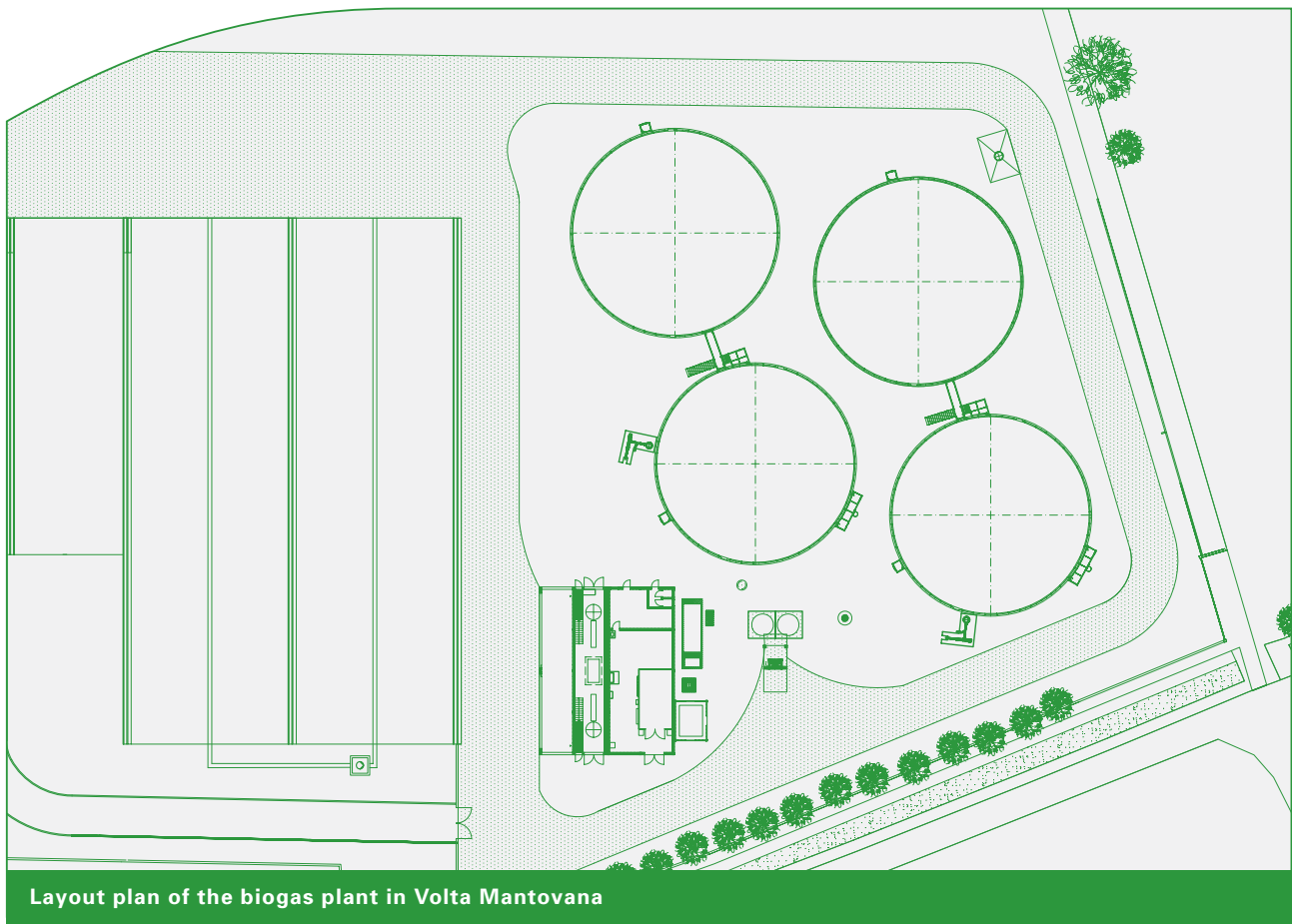


Separator (above) and walking floor



Italy's first EnviTec biogas plants

As farmer Imerio Galetti and his son Alberto purchased their farm with cattle breeding facilities and some 200 hectares of arable land in Volta Mantovana a few years back, he hadn't considered a biogas plant. However, the economical and ecological advantages of these systems soon convinced him to do so. In July 2009 – simultaneously with the publication of law n. 99, which, among other things, determines the currently highest feed-in tariff for electricity produced from biomass in Europe - the 999-kW electricity-plant was commissioned as Italy's first biogas plant from EnviTec. The plant will feed-in some 8 million kWh annually into the public electricity network. In addition, the waste heat is used to heat the domestic buildings, thereby saving heating costs.



Layout plan of the biogas plant in Volta Mantovana

The biogas plant in Volta Mantovana

The operator of the high-tech plant Volta Energia Società Agricola s.r.l. has two fermenters with a net volume amounting to 5,120 cubic metres. Cattle slurry, manure, maize and whole crop silage serve as input substances. Special features of the plant include residue separation and the redundant intake and mixing technology. The combined heat and power plant with an installed electrical capacity of 999 kW_e and 645 kW thermal output is accommodated in its own room in the technical building, well-protected against atmospheric influences, acoustically enclosed and is easy to maintain.



The famous wines of Colli Mantovani grow in the vicinity of the plant.

From farmer to energy supplier

The historical village of Volta Mantovana in the Lombard province Mantua is located 15 km to the south-east of Lake Garda. Here the Azienda Agricola Galetti is situated with approximately 250 head of cattle and some 300 hectares of arable land. Imerio Galetti feeds slurry and energy-producing plants from his own operation into the biogas plant, of which he is a shareholder. For this purpose, he has leased his arable land to the investors on a long-lease and operates the plant on their behalf for a fee. In doing so, Galetti has taken an uncompromising step from farmer to energy supplier. In Italy he is considered a genuine trend-setter, as "green

economics" is an increasingly important topic both publically and politically. Currently there are less than 200 recognised biogas plants in operation in the agricultural industry. The government plans to increase the proportion of all renewable energy sources feeding the national grid from 17% to 25% by 2020. For this reason, they are offering subsidies of 0.28 euros per kilowatt hour for biogas plants up to 1 megawatt and tax breaks for 15 years as incentives to facilitate realisation of this ambitious national goal. As a result, Volta Energia and Azienda Agricola Galetti are profiting from this.

The operator Volta Energia Società Agricola s.r.l. decided for an innovative high-tech plant manufactured by EnviTec Biogas equipped with performance-enhancing extras. The residue separation system enables part of the dry solid matter to be separated from the liquid phase exiting the fermenter, which is then fed back into the process at a later stage. This advanced process control system guarantees a consistent level of dry matter content in the fermenter, under which conditions the fermenter's agitators are able to operate optimally. An additional feature of the plant is the 100% redundant intake and mixing technology, which serves to increase availability of inputs to the plant and further increase its efficiency.

→ The heat is used in the residential buildings

→→ The cattle at the Azienda Agricola Galetti produces up to 3.500 t of manure, which is used in the input mix





The fermenter separation guarantees a constant amount of dry matter.

The total investment for the plant amounts to some 4 million euros, which will have paid for itself in just a few years thanks to the subsidy of 0.28 euros per kilowatt hour and the advantageous cost structure. "We now finally have clear political general conditions for our biogas plant. It is a worthwhile and future-proof investment which also provides a contribution to protecting our environment", explains Alberto Galetti. "Even during the initial phase, the plant achieved an excellent 95% efficiency, which bodes well for the future."

»Italy currently offers Europe's highest feed-in tariff for electricity from biomasses.«



The biogas plant in Casaleto Ceredano.

An additional model plant

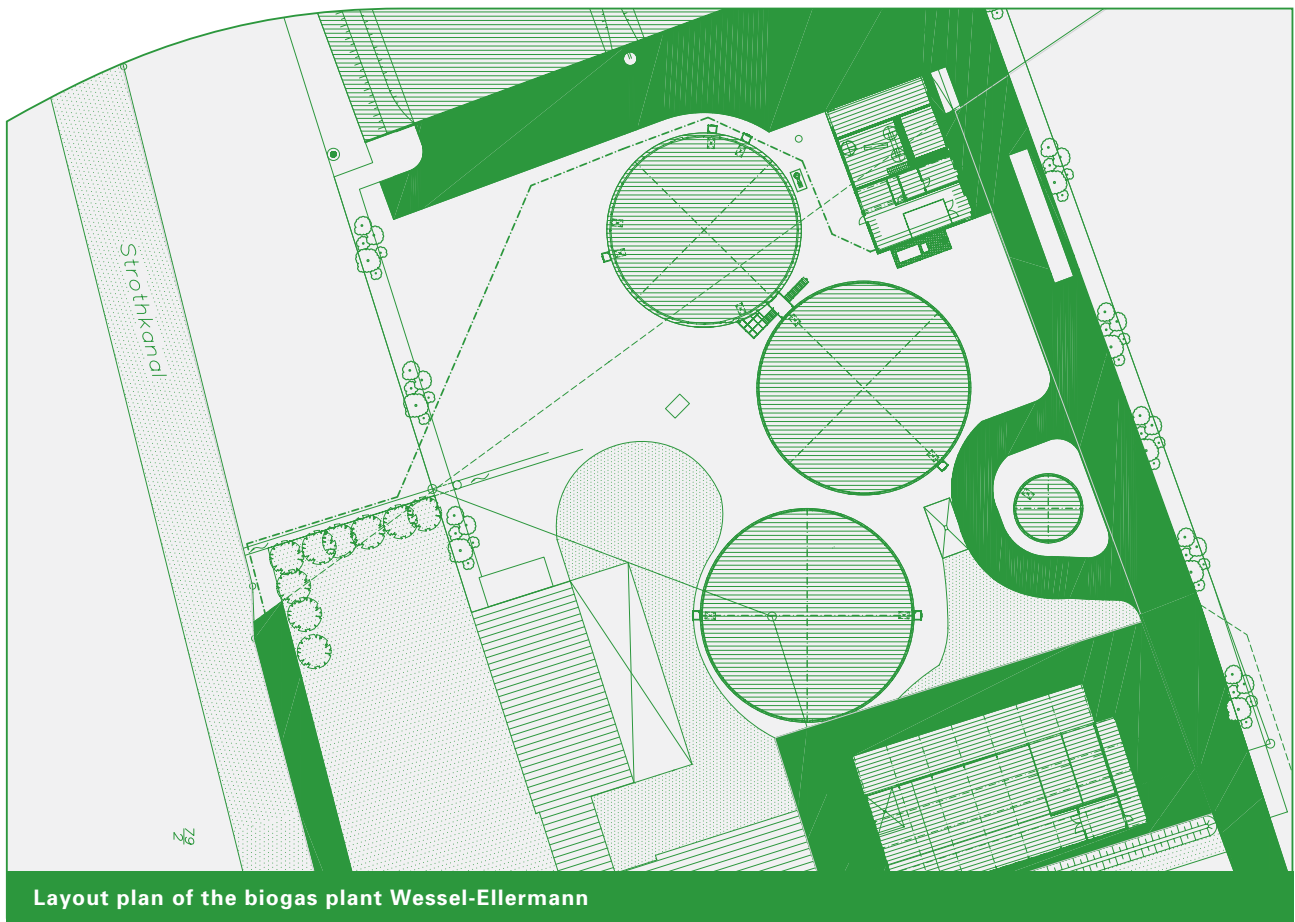
An additional EnviTec biogas plant is located in Casaleto Ceredano, Lombardy, between Lodi and Crema, approximately 60 km away from Volta Mantovana, Italy. The input material for the 249 kW_{el} electricity plant is supplied by approximately 25,000 pigs from farm operations – some 45,000 cubic metres of slurry per year, which is stabilised and optimised for energy production with small amounts cornmeal and residual feed. This means that the farmer can dispose of his organic waste sensibly and in an economically viable manner in his own plant, by means of feeding all of the electricity produced into the public grid.





Ulrich Wessel-Ellermann: Operator of a local microgas network

Farmer and businessman Ulrich Wessel-Ellermann has created his own small gas network in Bohmte, Lower Saxony - providing a pathbreaking example for the decentralized supply of energy: Three combined heat and power plants (CHPs) at various locations in Bohmte supply his own farm, an engineering shop, an agrobusiness and the sports center of Bohmte with heat. What makes the Wessel-Ellermann plant so exceptional is not only its highly efficient energy recovery concept, but also its sheer abundance of technical novelties and advancements.



Layout plan of the biogas plant Wessel-Ellermann

The Wessel-Ellermann biogas plant

The plant in Bohmte has two closed mixing tanks that prepare the input materials for the fermentation process. Liquid pig manure is pumped from its own container and water is pumped from its own well as required. The maize silage reaches the mixing tank from the maize bunker via a walking floor and a reversible screw. Grain and rye silage are prepared in a vertical mixer and then conveyed by the reversible screw. The additional equipment in the operation includes the fermenter, drainage connection, digestate storage facility, aggregates and the plant control system.



The technical standards of the Wessel-Ellermann biogas plant are state-of-the-art. The plant manufacturer and the plant operator both had a common goal: to exploit and use a maximum of energy. Some newly developed technologies were therefore used even before fermentation to receive high-quality input material with a high fermentation potential.

»Thanks to various techniques, our plant is a real all-rounder.«

The plant has two mixing tanks which can be charged in parallel and which weigh, control and determine the amount of material to be fed by means of weighing feet. Grain, rye silage, manure and wet grain are fed by the reversing screws from the walking floor and vertical mixer in exactly dosed volumes. The vertical mixer ensures that mixing and grinding of materials is fast and homogenous. After the mixing procedure, the fermentation substrate is pumped from the mixing

tanks into the fermenter via a substrate line. This procedure is also controlled by special weighing systems as well as by an output-regulated, variable feed. This technique – the EnviTec Feedcontrol – ensures that the CHP is used at full and optimum capacity.



This container is used as an intermediate storage for manure

← At Wessel-Ellermann, EnviTec examines the results of using a gas-proof and heatable liquid residue storage tank

→ The agricultural corporation lies outside Bohmte



Additional distinctive features of the plant in Bohmte are the biogas cooling and drying system, an earth-laid microgas network to the two CHPs and the first gas-tight, heatable digestate storage facility, which EnviTec has built for testing. From there, the fermentation residue is conveyed to a screw-press separator by a pump. The screw-press presses the fermentation residue elements that can not be separated from the substrate. The pressed cake is then dried by a feed-and-turn drier. The liquid remains are used in the fields as liquid fertilizer and in the future the dried material will be pressed into pellets and then sold.

The digestate storage facility has even more benefits: An examination is being made into how much gas is contained in the fermentation residue after the fermentation process. "Not just the fermentation residue, but our entire plant is characterized by sophisticated computer management and is willingly used by EnviTec as a research facility", explains Wessel-Ellermann. "Thanks to three-dimensional visualization and numerous ways of recording results, we really are in an ideal position to precisely examine biogas production and to continue to perfect it."



Exact quantities of the input substances are brought from the walking floor and vertical mixer into the mixing tank.

The Wessel-Ellermann farm is outside of town – typical for an agricultural plant. And in fact, almost all biogas plants in Germany are located several kilometers away from the nearest heat consumers and therefore potential customers who might use the heat produced in the plant. However, the longer the transport paths, the more the water (as an energy carrier) cools down and therefore more heat is lost in transit. The setup of a microgas pipeline is worthwhile in this case. The heat is thereby not transported from the CHP of the plant operator to the heat consumer, but part of the biogas is fed to



The compressor increases the gas pressure to 90 mbar, so the biogas can later be used in the CHP.

»With a microgas network, I can optimally use the heat from my plant.«

an additional CHP and only converted there into electricity and heat.

The microgas network of the WEB GmbH & Co. KG was gradually created in this way:

The first components were put into operation in November 2007: the biogas plant and the CHP on the farm's own grounds. They supply two apartment buildings, stables and a hall as well as the fermenter and the fermentation residue drying plant with heat. But the potential of the plant is not even remotely exhausted by this! The Oelgeschläger engineering shop as well as an additional agrobusiness, both located a few kilometers away, were the first heat customers.



← A newly build gas pipeline supplies the sport centre and the swimming bath in Bohmte with heat

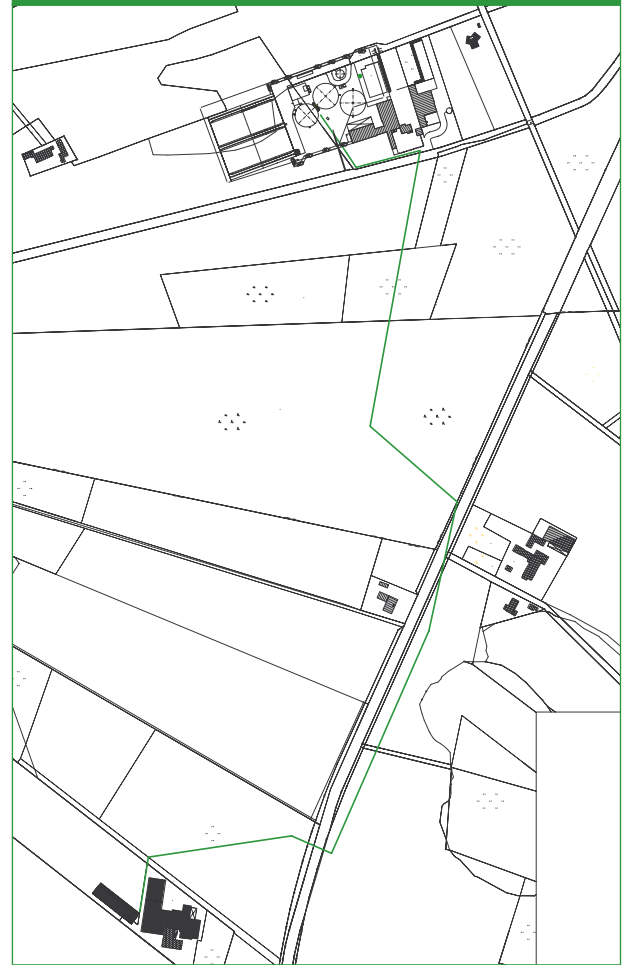
→ Maize silage is a good energy source for the biogas plant in Bohmte

Wessel-Ellermann therefore had a microgas line laid and then installed a second CHP on the grounds of the mechanical engineer. Since the start of 2008, it now supplies both the Oelgeschläger engineering shop and the agrobusiness with heat. The gas network grew once more in 2009. A newly constructed gas line leads to the Bohmte sports center, where a third CHP with a combustion capacity of 1 MW has been supplying the indoor swimming pool, the sports hall and the open air pool with heat. The WEB GmbH & Co. KG provides a total of around 2 million kWh per annum to the sports center. Other facilities within the community have already indicated their interest as well.

A microgas network has a whole range of benefits:

- > Biogas can be transported cheaply and with energy savings over gas lines.
- > Heat losses during transport are reduced to a minimum.
- > The economy and the overall energetic efficiency of the biogas plant are increased.
- > The goal of a decentralized, local supply with environmentally-friendly energy can be implemented without any technical obstacles standing in the way.

The microgas network to Oelgeschläger



The microgas network is laid over a distance of several kilometers and supplies heat to several locations including the Oelgeschläger engineering shop, on whose grounds a CHP is installed.



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