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SMALL-SCALE ANAEROBIC DIGESTION

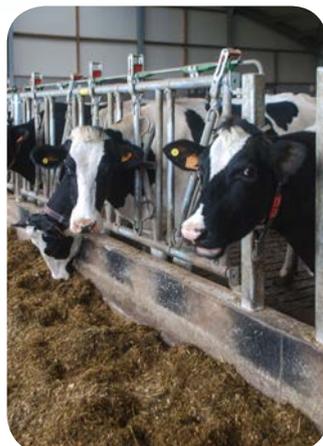
Case studies in Western Europe



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The case studies in this brochure show that small-scale anaerobic digestion can be a profitable investment.

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An introduction to **SMALL-SCALE ANAEROBIC DIGESTION**

WHY THIS BROCHURE ?

This brochure is intended to meet farmers' demand for more information concerning the current market situation of the small-scale anaerobic digestion technology. The authors aim to quickly guide those who are interested in the technology so that they can adopt a targeted approach in their search for information.

This brochure elaborates on how the implementation of small-scale anaerobic digestion can take place at the company level, based on five practical examples. A broad market study in a second part of this brochure shows that there are already many European providers that focus on small-scale digestion. Some are still in a pilot phase, while others have already realized full-scale operational installations.

WHAT IS SMALL-SCALE ANAEROBIC DIGESTION ?

Small-scale or pocket digestion is a technology where the anaerobic digestion process is applied to **proprietary biomass** flows for the on-site production of **renewable energy**. This energy is made available in the form of electricity and heat after combustion of the biogas in a combined heat and power (CHP) installation and is used to a maximum on-site.

Although there is no internationally accepted legal definition for pocket digestion, there is a consensus that the term "pocket digestion" is applicable to installations with **a proprietary biomass supply** that produce energy in function of the proprietary energy demand. "**Mono-digestion**" is applicable for installations that use only one type of biomass input. The smallest installations are also called **micro digesters**.

The popularity of pocket digestion has increased greatly in the last few years in the Flemish region of Belgium and a number of neighboring countries. In Flanders there are about 80 active pocket installations to this date and it is expected that this number will increase significantly over the next years.

WHY SMALL-SCALE ANAEROBIC DIGESTION ?

In the first place, pocket digestion is a tool for agricultural companies to increase **self-sufficiency** in terms of energy demand and thus to be less dependent on fluctuating energy market prices.

In addition, the farmer is able to produce **renewable** energy using **residual (waste) streams** inherent to the daily operation of his agricultural company, and at the same time actively help achieve the European **goals** for **renewable energy**. By the year 2020, 20% of the energy demand in the EU should be covered by renewable energy sources and new routes for renewable energy production are mapped for the years to come after 2020. Next to the sun, wind and water, biomass is an important source for renewable energy. Through anaerobic digestion renewable energy is produced from biomass. In comparison to other techniques for the production of renewable energy (such as solar panels and windmills) anaerobic digestion has the advantage that the production of energy can be controlled and can take place throughout the day, independent of the weather conditions.

By using residual biomass streams, the environmental **impact of agricultural activities** can be decreased significantly:

- Manure storage is a major source of greenhouse gas (GHG) emissions in livestock farming. Total emissions from global livestock represent 14.5 percent of all anthropogenic GHG emissions. Manure storage and processing represent 10 percent of total greenhouse gas emissions from livestock farming¹. Anaerobic digestion of manure on a farm level has a high potential to mitigate greenhouse gas emissions from manure storage². For this reason small-scale diges-

tion was also included in the list of measures of the Flemish Climate Plan. Pocket digestion is currently technically implementable in cattle farming.

- An additional reduction of the environmental impact might be the use of crop residues for pocket digestion: nutrient leaching from crop residues on the land can be avoided and unpleasant odors from vegetable residues at vegetable suppliers can be reduced.

WHAT IS THE DIFFERENCE WITH LARGER ANAEROBIC DIGESTERS ?

The **proprietary nature** of the pocket digesters is what **distinguishes the small-scale installations from the large-scale anaerobic digesters**. Large-scale anaerobic digesters are subject to external price fluctuations in the biomass market. The larger installations are generally also subject to low market fees for the amount of electricity they inject into the power grid. Most of the large installations are co-digesters, which means that they are fed with a combination of manure, energy crops and waste from both vegetable and animal origin. According to the current (2014) Flemish (e.g. also German) legislation even the slightest input of manure implies that the residual digestate has to be considered completely as animal manure, resulting in higher (treatment) costs. This is not the case in all European countries, but similar legislative provisions also increase operational costs for the installations in other European countries.

HOW DOES ANAEROBIC DIGESTION WORK ?

Anaerobic digestion is a process where micro-organisms – in the absence of oxygen – break down complex biomass components to smaller, less complex molecules. The anaerobic digestion process takes place in a reactor, where biogas and digestate are produced. Digestate is what is left of the biomass after anaerobic digestion and can be used as an organic fertilizer. The principal components of biogas are: methane (CH₄) and carbon dioxide (CO₂). The biogas is collected separately, and then sent to the cogeneration installation (also called CHP – Combined Heat and Power installation). The methane that is present in the biogas is combusted in the CHP-engine, which in turn drives the generator that produces electricity. The heat from the engine is used to maintain a desirable temperature in the reactor. The heat that is left can be used at the company for other purposes, for example heating in the buildings or drying of the digestate. To make the process more understandable some typical terminology used in anaerobic digestion is explained below.

Reactor temperature :

Micro-organisms have a certain optimum temperature range in which they perform best in terms of biogas production. They can be divided into two groups: in **mesophilic digestion** the micro-organisms have the highest activity at temperatures of about 35 to 37 °C, while in **thermophilic** digestion the highest activity is observed with temperatures ranging from 50 to 65 °C.

The dry matter (DM) content :

With a dry matter content up to 15 % the digestion process is called “**wet digestion**”, with a dry matter content ranging from 20 to 40 % the process is called “**dry digestion**”.

Types of mixing and feeding biomass to the reactor :

Most reactors either work **continuously**, through **plug-flow** or in a **batch system**. Wet digesters mainly use stirred reactors where the biomass is fed and withdrawn in a (semi) continuous manner (CSTR³). A plug-flow set-up often consists of long cylindrical reactors where the biomass input takes place at one end and the digestate comes out at the other end, there is no thorough mixing of the biomass in this type of reactor. In a batch system biomass is digested in one package in a sealed reactor.

¹ Dijkman, J., Falcucci, A. & Tempio, G. 2013. Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome.

² FAO (2006). Livestock's long shadow - environmental issues and options. Rome, Food and Agricultural Organization of the United Nations, 391 p. www.fao.org/docrep/010/a0701e/a0701e00.HTM

³ Continuous stirred-tank reactor

PART 1: CASE STUDIES

MICRO DIGESTER (type: Bioelectric) On dairy farm Dendauw in West-Flanders (Belgium)

Company

MANAGEMENT

Koen Dendauw & Greet Scheirlynck



FARM CHARACTERISTICS

- **Type of company:** Dairy farm with partly own milk processing in farm products which are sold on the farm. The company has 70 productive dairy cows, 50 heifers, about 100 hens.
- **Buildings:** The buildings where the animals are housed consist of one old stable with heifers and one new cowshed for dairy cows. The new stable is equipped with a full floor between the beds and was constructed to optimize integration with the micro digester.
- **Acresage:** 1,5 ha of potatoes which are sold on the farm, also several hectares of grass and corn as feed for the animals and as an outlet for manure from the company.

HISTORY

Koen and Greet took over the family company in 1996. Originally the company was mixed: both pigs and dairy cattle were held. In 2000, they made the switch to a specialized dairy farm. The company now has a farm shop where farm-own dairy products, potatoes and eggs are offered for sale.

Koen and Greet were keeping track of the evo-

lution in pocket digestion for quite some time. It started with an article that appeared in the agricultural press, where they first read about the concept. Later on they went along with many other dairy farmers to visit a company that installed one of the first micro digesters in Flanders. Because at that time micro digesters were only possible for farms with a minimum of 100 animals, they decided that anaerobic digestion was not possible for their business. A while later Bioelectric brought installations to market for smaller companies, the idea came back and it seemed that small-scale anaerobic digestion of proprietary manure was profitable for their farm. Along with the plans for a new stable in 2013, Koen and Greet immediately seized the opportunity to integrate the micro digester in the construction of this new facility. Together with the manufacturer they visited several experts in stables, pumps and drag systems to work out this integration in the best possible way. The installation was built in August 2014.

BIOMASS FOR ANAEROBIC DIGESTION

The digester only takes in cattle slurry. Rinsed water from the milk installation is collected separately and is led away to the old barn.

Even though the cows ran outside for two months from morning to evening, no problems occurred with the manure supply since there was a sufficient manure reserve from the summer before.

ENERGY CONSUMPTION

- **Electricity:** 56 000 kWh of electricity is consumed each year, this number might increase because milking will be done by a robot from now on. This also means that the milk will need to be reheated up to 35 °C to make creaming possible. The company is divided in two parts that consume electricity with separate counters. The house and the old stable form one zone which is also supplied by electricity from solar panels. The new stable and milk processing facility, including refrigerators and freezers form a second zone. This part of the business will use the energy that is produced by the pocket digester.
- **Heat:** The heat consumption of the company is not known. The heat from the digester is used to clean the milk installation



Technique

TECHNICAL DATA

- **Manufacturer:** Bioelectric
- **Installed since:** The digester has been operational since September 2014. The installation was put together very fast. The construction of the installation only took 2 days, while the complete installation was ready for use in 3 weeks. Green energy was being produced only a day after fresh substrate (manure from another digester) was supplied to the reactor.
- **Reactor volume:** 125 m³, height: 2.5 m, diameter: 8 m.
- **Residence time biomass:** 18-25 days
- **Electric power engine:** 9.7 kW electric power, self-consumption of the installation is 0.85 kW.
- **Proposed annual net electricity production:** The proposed annual gross electricity production averages 64 000 kWh (100%). To know what remains as net production for own use, self-consumption of the installation should be subtracted from the gross production. From September till the end of March the installation produced a net average of 4801 kWh per month. Per year this would come down to 57 617 kWh. In the early months of September and October production was slightly lower than the anticipated gross production (respectively 79% and 84% of the anticipated gross production) due to the start-up (approximately 2 weeks). In the first week of October there was also a problem with foam formation. The problem was resolved quite fast, but a reboot was necessary. From November till March the installation produced between 109% and 123% of the anticipated gross production.
- **Heat utilization:** The residual heat from the engine is stored in a hot water buffer tank of 500 liters/day. This heat is used to rinse the milking installation and milk storage tank.
- **Experiences and monitoring work by the operator:** On average Koen spends about 20 minutes per day to maintain the pocket digester. In the morning he visits the cabin with the CHP (combined heat & power unit) to vent the pump at the time the digestate is pumped to the external storage (about 170 m away from the digester). In the course of the day he takes a look on his computer to see how well the installation is performing. Every 400 hours Koen replaces the oil and filter in the engine. Both oil and filters are provided by

the manufacturer. Almost like a cow, a pocket digester behaves like a 'living' system, which requires some monitoring to see if everything is running smoothly. If a problem occurs, e.g. a problem with digestate pumping, Koen will be notified through his mobile phone. Shortly after the start-up of the installation a foaming problem occurred in the reactor. The manufacturer quickly resolved this problem. Because the reactor had to be opened, oxygen came in. This caused the CHP to stop running for a week. Afterwards there were only a few smaller problems. "Once I had a blockage in the digestate pump due to an ear tag that was caught up in the manure", says Koen.

- **Digestate:** The cost for the disposal of digestate remains approximately the same as for manure. During the digestion process, the volume of manure is reduced by about 5%. Like manure, the digestate is collected in an external storage tank. Later, the digestate is used as a fertilizer on agricultural land. Except for carbon, most of the nutrients present in the manure stay in the digestate, but some are transformed to a more active form.

WORKING PRINCIPLE

Every day at seven in the morning, 4 to 5 m³ of digestate (fermented manure) is pumped from the reactor to the external storage. Next, the same amount of manure is pumped from the stable to the digester. Because the stable is provided with a manure slide, manure enters the digester very freshly. Because of this, the biogas potential is higher and less manure is required to produce the same quantity of energy. In the reactor micro-organisms produce the biogas. The biogas is collected underneath the membrane on top of the reactor tank and is then used in the CHP. The biogas is burned in the engine of the CHP. This engine drives a generator that produces electricity. The heat that is released is partly used to maintain the temperature of the reactor, the residual heat is used for the production of warm water by means of a heating buffer tank.

Important!

Use manure that is as fresh as possible. While calculating the profitability also take into account costs for: excavation works, heat valorization and external manure storage.

PROFITABILITY

- **Investment costs**
 - € 95 000, including CHP (turnkey).
 - € 5 000 to € 10 000 cost for adjustments to the infrastructure: heat utilization, civil charges, costs for obtaining a license (€ 1 000 to € 1 600),... This depends largely on the existing synergies at the farm.
 - If the company does not have an external manure storage this might mean a considerable additional investment. This has to be included in the calculation of the profitability. Starting from 2015, the Flemish Climate Fund provides investment support for infrastructure associated to pocket digestion. On the farm of Koen and Greet an external storage was already available.
- **Operating costs**
 - Maintenance contract: € 3 500/year
 - Costs for administrative follow-up: 1 000/year
 - Labor intensity < 0,5 h/day
 - No additional cost for processing of the digestate
- **Revenues**
 - Substitution of electricity: € 7 500-11 000/year (depending on the price paid for electricity). Due to the fact that the power of the engine is below 10 kW, in Flanders a backward spinning electricity counter can be used. This means that the farmer receives the same price for electricity he produces and injects as he pays for on moments he uses more than is produced. This applies for as long as his total production is less than his total consumption.
 - Substitution heat: depending on own heat source (electric, gas or oil) and the heat profile.
 - Green electricity certificates: approximately 67 certificates x € 93 = € 6 231/year
 - Heat certificates: around 160 certificates x € 31 = € 5 000/year
- **Payback time:** 5 to 7 years (*). If no adjustments to infrastructure are required: 5 years (*).

REQUIRED PERMITS AND ASSOCIATED OBLIGATIONS:

Both an environmental and building permit are required. The license for the micro digester was applied for together with the authorization request for the stable.

STRUCTURAL REQUIREMENTS FOR TECHNOLOGY INTEGRATION ON THE FARM

- Excavation for the digestate drain towards the external storage.
- The digestate is best discharged to an external storage.

(*) - The substitution of heat was not taken into account for the calculation of these payback periods. The amount of heat that is not used to maintain a desirable temperature in the digester depends on the outside temperature and will vary during the year. The heat that can be utilized on the farm is therefore an added benefit that has not yet been taken into account. The manufacturer estimates that each year an average of 230 MWh of heat is produced.

- Small plants (< 10 kW in terms of installed capacity) with a backward spinning electricity counter may be charged an annual fee from 1st of July 2015. This rate is on average € 81/kW/year. Due to the increase of the classical electricity distribution rates the advantage of buying less electricity increases. As a result, it can be expected that the influence on the return on investment for installations with a rotating back counter will be rather limited.



POCKET DIGESTER (type: GreenWatt)

Chicory company Joluwa, Nijvel (Waals-Brabant)

Company

MANAGEMENT

Joost De Paepe

FARM CHARACTERISTICS

- **Company type:** chicory farm where annually ca. 120 ha of chicory roots are processed
- **Accommodation:** the company accommodation forms a contiguous whole and comprises the living unit, the personnel unit (sanitary complex, refectory), harvesting chamber (with packaging line), force cells and cooling units.

HISTORY

The chicory company of Joost de Paepe lies north of the municipality of Nijvel in the province of Waals-Brabant. The company operates in its current setting since 1999. Since the start-up, the company chose to invest in a large scale production unit. 120 ha of chicory roots are



processed annually. The in-house chicory production is only part of the total production. The other roots are grown by farmers nearby.

Forcing chicory roots is a continuous process, only interrupted by a few weeks of vacation throughout the year. The company owns four harvest lines. About 25 people work at the company, they manage the different processes of the chicory production: insertion of the roots in breeding tanks, sorting and packaging. Since the start-up of the company, efficient management of water and energy was of particular interest for Joost De Paepe.

Recently the company expanded with the installation of a new unit for biological chicory production.

BIOMASS FOR ANAEROBIC DIGESTION

The chicory company produces 5 days a week and 48 weeks a year. About 14 to 17 tons of chicory are produced per day, resulting in 3 750 tons of chicory per year. An equal amount of waste is produced and fed to the digester. This adds up to 75 tons of forced chicory roots, leaves and fibrous roots per week. Additionally about 10% (440 tons) of silage maize is fed to the digester.

ENERGY USE

Typically, a chicory company consumes about 10 000 kWhel per hectare of forced roots (for harvesting and storage). 50% of the electricity demand goes to the cooling units where the roots are stored (starting in autumn) before they are forced. The forcing unit accounts for 40% of the total electricity demand of the company. Next to the residual heat of the digester, Joluwa also recycles the residual heat of the cooling units (through floor heating).

Technique

TECHNISCHE GEGEVENS

- **Constructor:** GreenWatt
- **Year of installation:** 2010

- Reactor Volume :

- Pre-digestion tank volume: 400 m³
- HYFAD volume (see working principle): 2 x 20 m³
- Post-digestion tank volume: 400 m³

- Biomass retention time:

- Pre-digestion unit: 10 days
- HYFAD unit: 18 hours
- Post-digestion unit: 20 days

- Electrical power engine: about 100 kWel, 150 kWth

- Annual net electricity production:

- The digester produces 500 MWhel/year:
- 145 MWhel (29%) is consumed by the digester
- 355 MWhel (71%) is mainly consumed in the chicory production process. The remaining electricity is injected into the grid.

- Heat consumption:

- The digester produces 760 MWhth/year:
- 205 MWhth (27%) is used to maintain the digester's temperature
- 281 MWhth (37%) is used in the chicory production process
- 82 MWhth (24%) is sold to the nearby printing house (group Rossel). The heat is transported through a heating pipe
- About 84 MWhth (11%) of the heat is not used

- Maintenance:

A few times per day roots are transported to the digester, the technical maintenance is done by the constructor GreenWatt.

- Digestate:

The digestate is separated into a solid fraction and a liquid fraction. The solid fraction is used as a soil improver on the farmer's fields, while the liquid fraction is also spread on the field as a fertilizer.

In the past, the company tried to reuse the nutrient-rich liquid fraction as a fertilizer in the breeding tanks, but the risk for contamination with *Phytophthora* (a genus of plant-damaging water molds) was assumed to be too high.

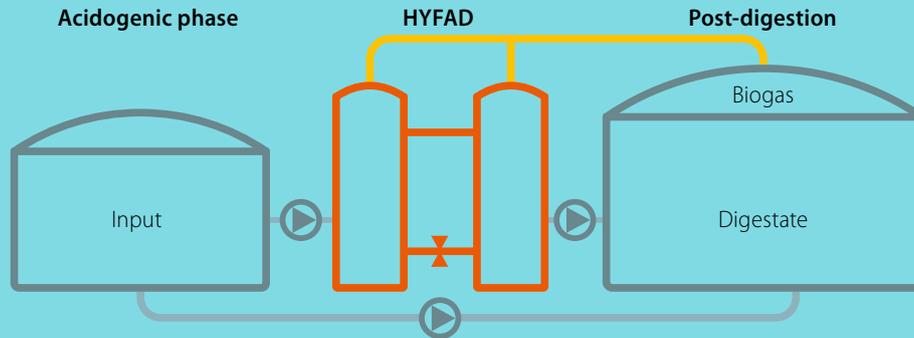
WORKING PRINCIPLE

Every day approximately 10 tons of chicory roots are added to the digester. These roots are cut before putting them in the biphasic digestion process. The two stages of the methanization process take place in two separate reactors. This allows to process pure plant material with a maximum biogas yield.

The first stage, called the acidogenic phase, takes place in a separate tank at a pH of approximately 6, and acid is formed.

The HYFAD® (High Yield Flushing Anaerobic Digester) is a high efficiency pressure vessel for methanization developed by GreenWatt. In this reactor, the temperature is kept constant and the pH is 7. The bacteria convert the fatty acids into biogas. High concentrations of micro-organisms on a solid support material form a biofilm, which allows for the pressure vessel to reach a high methane production efficiency. The unit also includes a device for unclogging and renewal of the biofilm.

In a post-digestion tank, the last part of methane is captured from the digestate.



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Important! In order to avoid blockages and damage to the digester, the chicory roots are washed first. During this event other heavy materials like stones are removed by sedimentation.



PROFITABILITY

- **Investment cost:** €900 000, incl. CHP (turn-key) and:

- An installation for washing the roots before they go into the digester
- A pipe for hot water between the digester and the adjacent printing facility

Attention: the investment cost is highly dependent on the project which is tailored to the client's needs.

- **Operational costs:**

- Service and follow-up by GreenWatt: €30 000 a year
- Labor intensity is less than 1 hour a day, which is mainly feeding the digester a few times a day
- No additional cost for processing the digestate

- **Revenues:**

- Substitution electricity: €45 500/year
- Substitution heat: €20 000/year
- Certificates (GSC and heat): €64 000/year
- Selling heat to the adjacent printing facility: €5 200/year

- **Payback time:** 9 to 10 years, but highly dependent on the project

The completion time for a similar installation is about 9 to 12 months. In this case, an administrative procedure was already completed (study, permits, etc) and is not included in these 9 to 12 months. The time needed for the administrative procedure is strongly dependent on local regulations and can take up to a year.

REQUIRED PERMITS AND RELATED OBLIGATIONS:

Building permit and environmental permit.

STRUCTURAL REQUIREMENTS FOR ON-SITE INTEGRATION OF THE TECHNOLOGY

Since forced chicory roots are available for almost the entire year there are no root production peaks and the company did not have to invest in a larger storage capacity. A favorable heat profile in the surrounding area is needed to achieve optimal use of the heat. To be able to utilize the heat, a hot water pipe has to be installed resulting in an extra investment cost.



POCKET DIGESTER PILOT

On the pig and manure treatment company Ivaco cvba

Company

MANAGEMENT

Carine Tolpe-Decloedt

FARM CHARACTERISTICS

- **Type of company:** The company (located in Gistel) is a combination of a pig farm and a manure treatment installation.
- **Commercial buildings:** The farm has a capacity of 11 000 production pigs. Each year, about 29 000 pigs are fattened. The capacity of the manure treatment installation is about 60 000 tons per year.

In the manure treatment process, the raw manure is separated into a solid fraction and a liquid fraction. The solid fraction is converted into high-quality compost by maturation in the composting plant. The liquid fraction is purified in the biological tank and stored in a buffer basin. The effluent from the biological tank is purified by a system of cascading wetlands (reed beds). Through this process the characteristics of the effluent comply with the standards for discharge into surface water. The incoming manure is completely converted into compost and dischargeable water.

HISTORY

The company was founded in 2000 with the launch of the first manure treatment plant in Eernegem. The processing of raw manure is the company's main activity and is either done with proprietary manure from the private stables (Devano Bvba) or with manure from external pig farmers. The compost is an important (by)product and is sold to the market.

Since the beginning, Ivaco had a clear pioneering role within the sector: in 2006, the first reed bed was installed (site Eernegem) allowing to convert the processed manure into dischargeable water. The same activities (manure treatment and reed bed) were also carried out on the site in Zevekote. A pocket digester was installed in Zevekote in 2013.

In parallel with the construction of a small-scale digester, a major capacity expansion of pig stables was realized on the site of Zevekote. For now, there are no plans for further expansions or adjustments. However, the company continues to fulfil its pioneering role in several innovative projects.

BIOMASS FOR ANAEROBIC DIGESTION

The pocket digester is mainly fed with pig manure. Initially, a license was granted for 5 000 tons of fresh biomass/year, which consisted of a combination of pig manure (raw and solid fraction) and energy corn. To increase the profitability the company applied for a permit to increase the ca-

capacity to 12 500 tons/year. A limited fraction of this 12 500 tons would consist of organic vegetable waste. After this expansion, the installation can no longer be considered a small-scale installation.

ENERGY USE

Before the construction of the digestion installation, most of the electricity on the site of Zevekote was generated by solar panels. The starting point of the pocket digester was not to cover the company's own electricity costs and therefore the installation might not be considered "pocket digestion". For example, all calculation models for this project take into account 100% grid injection (with accompanying lower injection rate) for the produced electricity. In practice, this will not be the case since the CHP also provides power at night when the solar panels do not produce electricity.

As for the heat utilization, there is a clear "win" thanks to the digestion plant. The Zevekote site has several heat demands :

- The piglets stable (equivalent to 20 000 liters of heating oil/year)
- The house
- The composting plant: formerly a CHP on rapeseed oil (125 kW) was used on the Zevekote site to accelerate the drying process in the composting plant. Because of the high cost for oil, the plant was removed. The residual heat from the CHP is a useful energy source for the drying process.

Technique

TECHNICAL DATA

- Constructor:

- Digestion tank: Biodynamics
- CHP: Continental Energy Systems
- Piping, electricity, etc.: smaller subcontractors

- Year of installation:

- Start construction: September 2012
- Digester (CHP engine): May 2013
- Volume of reactor: 1 000 m³

- Biomass retention time:

- Original (5 000 tons/year): 73 days
- After renewal of the environmental permit (12 500 tons/year): min. 30 days

- Electrical power CHP: 190 kW_{el}

- Initial estimated annual net electricity production:

- Initial theoretical: 1 170 000 kWh_{el}/year
- Realized: 774 000 kWh_{el}/year

- Heat Use:

- In the digester, composting hall, living quarters and piglets stall
- No heat measurements (calculated theoretically)
- Initial theoretical: 1 530 000 kWh_{th}/year
- Realized: 1 304 000 kWh_{th}/year

- Experience:

- Intensive follow-up needed, especially at the start of a project
- High quality flows (= high biogas potential) needed in order to be profitable

- Digestate: the digestate is processed in the proprietary manure treatment

Important!

- Need for high quality input streams
- The installation needs the same follow-up and monitoring equipment as a large-scale installation

WORKING PRINCIPLE

Best practice was used at Ivaco to integrate the small-scale digester into the farm. On the supply side, there is a synergy with the existing pig farm, the manure from the piggeries is extracted from the manure pit very freshly and utilized in the digester. The manure either goes directly to the digester, or is separated first into a liquid and solid fraction. Only the solid fraction is used in the digestion plant. In addition, energy crops are supplied (maize or corn cob mix) in order to have an optimal C/N-ratio.

On the output side, there are also synergetic opportunities with the existing agricultural activities. The digestate can be separated and processed in the composting unit (solid fraction) and the biologic plant (liquid fraction). The green power is used on the farm and the residual heat of the CHP plant can be used to heat the piglet house and improve the composting process.

PROFITABILITY

- Investment costs

- € 250 000 digester
- € 200 000 CHP
- € 100 000 other expenses (for study, administration, pretreatment, civil works...)

- Operating costs:

- Engine: € 18 000/year
- Installation: € 10 000/year (estimate)
- Administrative support: € 12 000/year (including manure treatment).
- Labor intensity: 2 hours/day
- No relevant additional costs to process the digestate because of the limited supply of additional nutrients (e.g. energy corn) to the digester
- Injection tariff (medium voltage, Infrac West): approximately € 1.60/MWh_{el} injected and annual fee of € 825 (for both solar panels and pocket digester)

- Revenues:

- All electricity is injected into the grid: currently € 35 600/year (the goal is a theoretically optimum of € 53 820/year)
- Substitution heat: € 26 000/year
- Green power certificates: approximately € 110 000/year
- Green heat certificates: approximately € 50 000/year (decrease after 4 years)
- € 150 000 investment aid (demonstration project VEA)

- Payback time: the demonstration project is only in its early stage, therefore it is not possible to make a statement on the profitability yet.



Realized with the support of the Flemish Government and the Flemish Energy Agency (VEA).
Participating partners: DLV, Ghent University, Innolab and DLV InnoVision.



POCKET DIGESTER

(type: Microferm, HoSt)

on a dairy cattle farm and dairy processing company Den Eelder (Netherlands)

Company



© Den Eelder

MANAGEMENT:

The van der Schans family

FARM CHARACTERISTICS:

- **Type of company:** dairy farm en dairy cows
- **Company buildings:** stable and dairy processing facility
- **Acreage:** 150 ha grassland and 70 ha maize

HISTORY

At the end of 2013/beginning of 2014 the company started running an anaerobic digestion plant for 7 500 m³ of cow slurry. Soon the digestion plant will be scaled up to 15 000 m³ of cow slurry. The manure that is currently not digested is separated and the solid fraction is used as bedding material. After the upscaling of the plant, the aim is to separate all digestate and to pasteurize and export the part of the solid fraction that cannot be used as bedding material.

BIOMASS FOR ANAEROBIC DIGESTION

Currently 7 500 m³ of fresh cow slurry is digested, together with a very small amount of rinsing water from the milking parlor.

ENERGY USE

Den Eelder covers 40-50% of the electricity use with its own energy production. The heat is being used to maintain the reactor temperature.

WORKING PRINCIPLE

The residence time of the slurry in the reactor is 8-12 days. Fresh slurry is being pumped continuously from the stable to the reactor (in total about 20 m³ of slurry each day). The Microferm is a heated, isolated vertical reactor with a 130 m³ capacity and a central agitator. In merely 6 days about 80% of the biogas potential is produced. The digestate flows to a small, unheated post-digestion reactor, where the last part of the biogas potential is being utilized. The biogas is stored underneath a double membrane above the post-digestion reactor after which it is sent to the CHP installation.

Technique

TECHNICAL DATA

- **Manufacturer:** HoSt B.V.
- **Installed:** 2013
- **Reactor volume:** vertical tank of 130 m³
- **Residence time biomass:** 8-12 days
- **Electrical power CHP:** 65 kW, the installation uses part of the thermal energy to heat the reactor (40°C) and also uses up to 2.2 kW of the electrical power. This low energy use for the installation makes it quite unique.
- **Yearly net electricity production:** 480 000 kWh
- **Heat use:** the produced heat is used to heat the slurry in the reactor. After upscaling and installation of a second reactor, it will also be possible to use the heat from the current CHP to heat this second reactor. The biogas produced from this second reactor will probably not be used in a CHP, but in a boiler, to be used in the dairy processing facility.
- **Maintenance:** 30 minutes per day. Maintenance takes very little time. The slurry is automatically pumped to the reactors and the whole system is run by an advanced control system.
- **Digestate:** the digestate is partially spread out on cropland and grassland of the company. Part of it is sent to a composting plant so that it is pasteurized and released for export after pasteurization. Currently the composting process still has to be validated according to the rules set out in the Animal By-products Regulation (EC N° 1069/2009).

Important!

To maximize biogas production, fresh cow slurry is needed.

PROFITABILITY

- **Investment cost:**
 - € 300 000 for the plant (incl. pre- and post-treatment, and storage of digestate)
 - € 150 000 for the CHP
- **Operational costs:**
 - Maintenance CHP and biogas installation: € 15 000 - 20 000/year
 - Work load: less than 0.5 h/day
 - No relevant extra costs to process the digestate
- **Revenues:**
 - Electricity production for proprietary use: € 40 000/year (dependent on the tariff)
 - Heat production for own usage: no revenues as all heat is being used to maintain the reactor temperature
 - SDE + subventions (Dutch system): € 110/MWhel: € 52 800/year
 - Producing green gas would be more profitable
 - CHP certificates: no subventions for heat production for mono-digestion, because all heat is used to maintain reactor temperature
- **Payback time:** 6-8 years



© Den Eelder



DRY TYPE POCKET DIGESTER (type: Eribox, Erigène)

On the horse farm of Thierry de Pas in Bois-Guilbert (France)

Company

MANAGEMENT

Thierry de Pas

FARM CHARACTERISTICS

- **Type of company:** The farm is specialized in breeding Icelandic horses. The farm in Bois-Guilbert holds about 150 adult animals and about 50 foals. Generally the ponies are sold to private owners, where the farm continues to take care of the animals as a service to their client. Next to the farming activities, the company also offers accommodation in different "gîtes" (about 80 beds in total), typical vacation homes for the region.
- **Company buildings:** Main building with stables, multiple guest houses, drying instal-

lation (not linked with the biogas installation but used for "standard" agricultural activities and fodder storage).

- **Acreage:** 128 ha cropland for cultivation of different crops in rotation (wheat, maize, rape-seed, etc.) next to 98 ha grassland.

HISTORY

It was Thierry's father, Louis de Pas, who built up the farm from 1952 onwards on the family domain in Bois-Guilbert. In 1960 the first ponies (Shetlands) came to the farm. Five years later in 1965 the pony club was founded which is now run by Thierry de Pas. In that same period, Louis was also closely involved in the foundation of the French national pony association. Since 2000 Thierry specialized in breeding Icelandic horses, a significant milestone was reached in 2008 when the herd of horses expanded to

more than a 100 horses. In the future the company will keep investing in the expansion of recreational activities on the family domain.

BIOMASS FOR ANAEROBIC DIGESTION

The digester's biomass input on a yearly basis consists of 650 tons of litter and 850 tons of communal bio-organic waste and other biomass.

For the largest part of the year, the ponies are kept inside the stables. In spring, there is a grazing period for the whole herd. Solid manure is available in large quantities from the stables. Thierry started a collaboration with the company Erigène to produce biogas from this solid manure.

Besides manure there is also input of bio-organic waste from roadside management, bio-organic waste from communal kitchens is also added to the digester. The farmer is expanding his input streams and therefore contacted a number of potential partners including the grain processing industry.

Energy use: Heat and electricity are used to the fullest for the farm's own energy demand. With his biogas installation Thierry wants to be largely independent of third party energy sources. The many "gîtes" and the drying installation make sure that the residual heat from the digestion process can be used efficiently. The farm has a small heating network which transports warm water to the different buildings.



WORKING PRINCIPLE

The system is a mesophilic dry digestion and uses multiple modular digestion containers (Eribox). The standard size of these containers is 30m³. The containers are adapted so that they are sealed gas-tight. The necessary gas exhaust, heat exchange and leak water connections are provided.

The percolate (the fluid that comes from the biomass during anaerobic digestion) is recirculated at 250 l/h to maintain a favorable microbial community in each of the containers.

The containers are filled and emptied one after the other using a pre-load system and a transporting system to unload the containers. The process is repeated every 25-30 days for each of the containers. The biogas is captured and stored in a "gas balloon".

Technique

TECHNICAL DATA

- **Manufacturer** : The French company EriGène
- **Installed since** : August 2012. The site is in operation since June 2013, but due to expected start-up problems the installation could only operate at full power in February 2014.
- **Reactor volume** : 30 m³ per box, at the moment the installation consists of 6 containers, end of 2014 12 boxes should be in operation.
- **Residence time biomass** : 25-30 days
- **Electrical power CHP** : 50 kWel
- **Yearly net electricity production** : 253 000 kWel
- **Heat use** : 425 000 kWth (47% for gîtes, 38% dryer, 15% house). The farm owns a drying installation (installed power: 9kW) for hay, wheat and other agricultural products, where the residual heat is partially valorized.
- **Maintenance** : the start-up of the exploitation of this pilot plant was not easy but in the end successful through a process of trial and error. To reach a stable state of the microbial community was especially hard.
- **Digestate** : is spread out on proprietary grass-land and cropland.

Important!

The dry batch system is robust and is able to process a lot of different types of dry biomass. For a good digestion process it is essential that a sufficient amount of percolate can be pumped.

PROFITABILITY

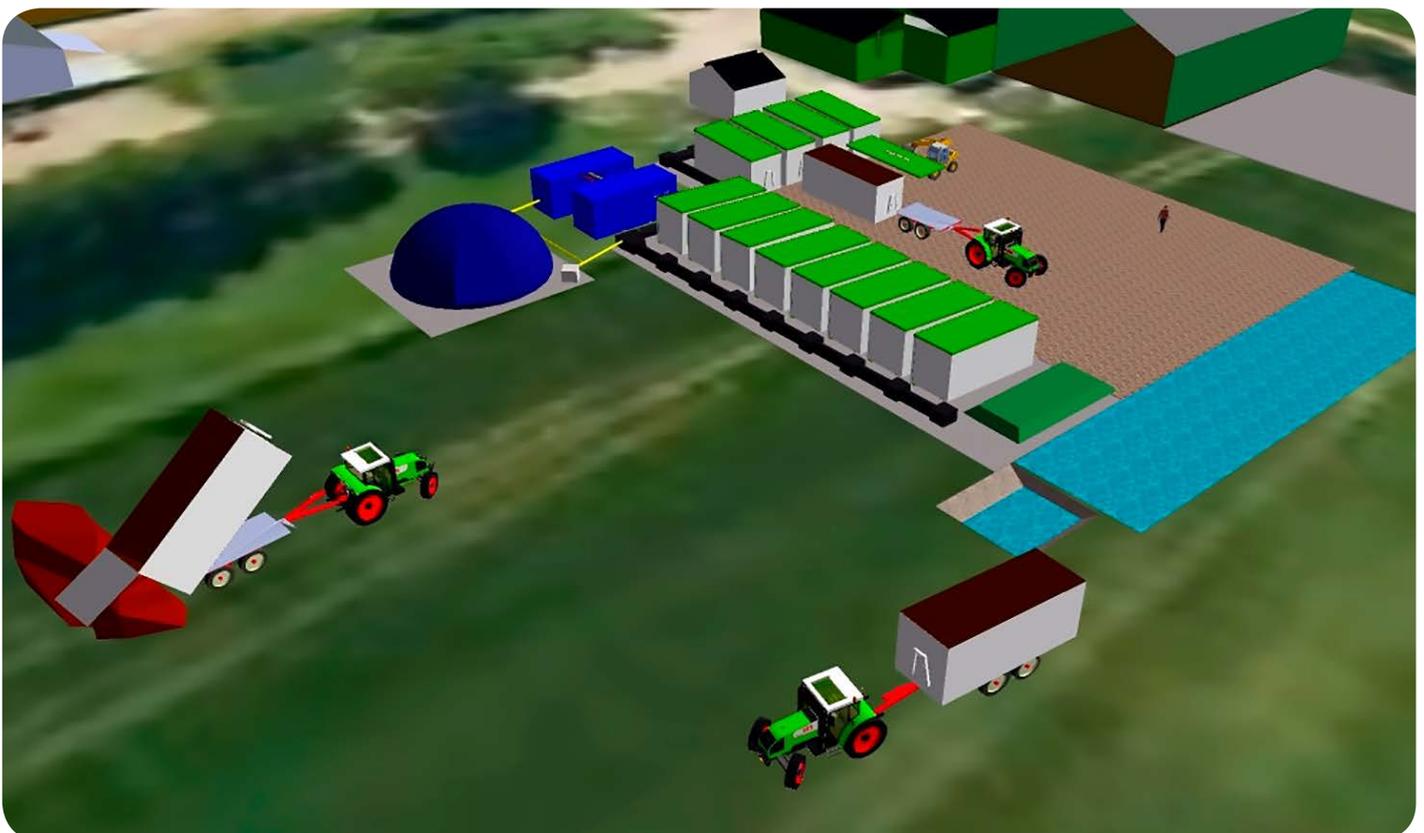
- **Investment cost**
 - € 383 000 for Eribox system (10 containers)
 - € 123 000 for CHP installation (2 x 25 kW) and gas storage
 - € 110 000 for the installation of the heating network
 - € 68 000 additional costs (concrete surface, instrumentation, technical assistance)
- **Operational costs** :
At this stage of the pilot phase, it is unclear what the operational costs will be.
- **Revenues** :
 - Substitution of electricity and subventions for the production of green power: € 45 500/year
 - Substitution of heat: depending on own heating system and heat demand profile
 - Gas: max. about € 19 000/year
 - Heating oil: max. about € 30 000/year
- **Return on investment** : The pilot project is only in an early phase of operation, so it is not possible to estimate the profitability.

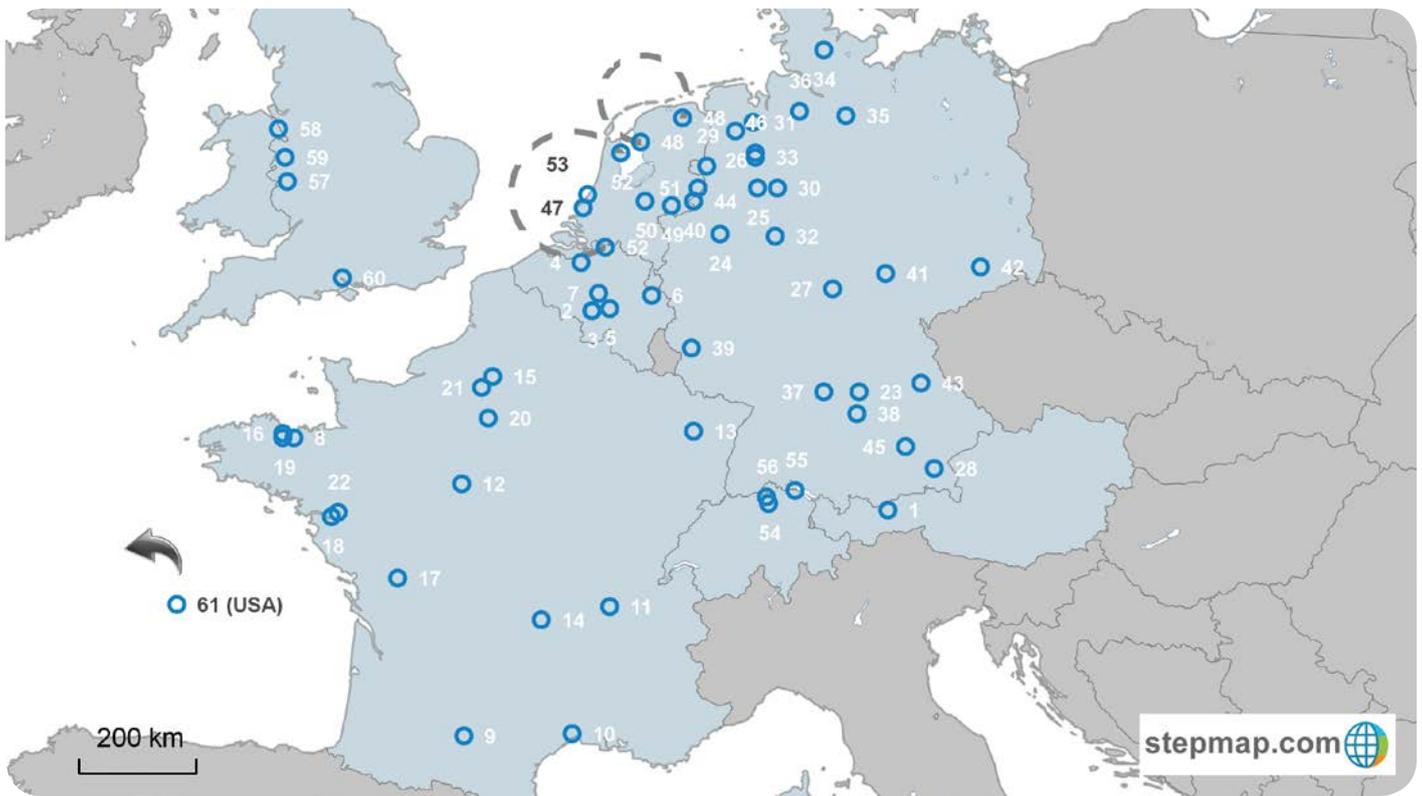
REQUIRED PERMITS AND ASSOCIATED OBLIGATION

To be able to install the system, the farmer had to file a request for a building permit and an environmental permit. There is a strong collaboration with and control by ADEME (Agence de l'environnement et de la maîtrise de l'énergie).

STRUCTURAL REQUIREMENTS

The installation was placed on a large concrete surface.





Manufacturer (+ name of installation if applicable)	Power <50 kWel	Power ≥50 kWel	Manure mono digestion	Biomass	Number of known reference projects
AUSTRIA					
1 Bio4Gas GmbH	x	x	x	Manure	Bert: >10; Bart: >10
BELGIUM					
2 Agrofutur SA	x	x	x	Manure, bio-organic waste, sludges	3
3 Anatis	x	x	x	Cattle slurry, litter	1
4 Bioelectric	x		x	Cattle slurry	about 80
5 EnergX	x			Manure	no small scale references on website
6 Enersolutions					
7 GreenWatt		x		crop residues	6, of which 3 small scale installations
FRANCE					
8 AEB Méthafrance		x		Manure, bio-organic waste, energy crops	12
9 ARIA Energies (silogaz type)	x	x		Manure, bio-organic waste, energy crops; type silogaz: dryer biomass	silogaz: 19
10 Arkolia (Arkobloc)		x		Manure, bio-organic waste, crop residues, a variety of input; 25% DM	
11 Biocité	x		x	litter, green waste	Pilot
12 Bioeco	x		x	Manure, bio-organic waste, green waste	Dozens
13 BIOGAZ Hochreiter	x	x		Manure, bio-organic waste, energy crops	1600
14 Enerjit					no small scale references on website
15 Erigène (Eribox)	x	x		litter, green waste, dryer biomass	Pilot
16 Evalor		x		Manure, bio-organic waste, energy crops	11 in operation and 5 in build-up
17 KUB Process	x	x		15 - 25 % DM	
18 Naskeo Méthajade		x		litter (cattle), poultry manure, intercropping	1 in operation (55 kW); 2 in build-up (160 kW and 170 kW)
19 Odipure (Méthafast)	x	x	x	Cattle manure & pig manure (& silage)	
20 S ² -watt	x	x		Manure, bio-organic waste, dry biomass	2
21 Valogreen (Valokit)		x		liquid manure, solid manure, dry biomass	Pilot
22 Weltec Agripower France	x	x		liquid manure <10% DM, energy crops	>7

PART 2: MARKET STUDY

To inform future investors about what is available on the market of small-scale anaerobic digestion Biogas-E and Inagro focused on collecting information from technology suppliers in Northwestern Europe. They were able to compile a list of 61 companies that are active in the sector of small scale anaerobic digestion. Some of them are testing the installations on a pilot scale, in other cases you have providers that want to fully deploy on the market. The differences between providers are situated in different domains and are mostly determined by a local context: the size of the agricultural company, the availability of input biomass (different types and volumes), the manufacturer's experience with large scale projects and the policy concerning subventions and permits. Although some of the providers try to translate their existing large scale experience with the bigger 'standard' CSTR-reactors to a smaller scale installation, others also add ideas to differentiate their installations and give them their own 'identity'. A minority of the manufacturers also focuses on mono-digestion of manure. Remarkable is the fact that a number of providers in the list offer pocket installations on dryer biomass (for example: litter). The next table provides a simplified overview of all providers as a result of our research, the list is up to date up to 31/12/2014. A list that is regularly updated is available online: <http://www.enerpedia.be/nl/pocketvergisting#t4287>

We gladly provide feedback to your questions, remarks or suggestions. If you are a provider or manufacturer of small-scale installations and wish to be added to the list, please don't hesitate to contact us. Contact information is available at the back of this brochure.

Installation Type	Website
cylinder in cylinder, pressure mixing	www.bio4gas.eu/index.php
Anaerobic filter, short residence time	www.agrofutur.eu/agrofutur_biomethanisation.php
Fixed bed reactor	www.anatis.be
CSTR	www.bioelectric.be
Fixed bed reactor	www.energix.be
Fixed bed with bag-type secondary digester	www.enersolutions.be
Multiple phase, HYFAD (patented technology)	www.greenwatt.be
CSTR + mixer + secondary digester	www.aeb-energie.fr
Bag type, silogaz: plugflow	www.aria-enr.fr
Two-phase container system	www.arkoliaenergies.fr/index.php
Dry digestion silo	No website. More info: http://blog.isara.fr/biocite-cree-une-unite-de-methanisation-cles-en-main or www.youtube.com/watch?v=ynSNibF79Z0
Batch-type dry digester for litter, CSTR-type for wet streams	www.bio-e-co.fr/index.php
CSTR + mixer or paddle + secondary digester	www.biogaz-hochreiter.fr
Fixed bed, bag or container	www.enerjit.fr
Containers, dry batch system, percolation system	http://erigene.com
CSTR	www.evalor.fr/index.php/methanisation
Modular "cube" (galvanized metal)	www.kub-process.fr
Garage type, batch system, percolation system	www.methajade.fr
CSTR	www.odipure.com/solutions-techniques/methanisation/methafast/
Dry digestion	http://s2-watt.com
CSTR (gegalvaniseerd)	www.valogreen.fr
CSTR	www.weltec-agripower.com

Manufacturer (+ name of installation if applicable)	Power <50 kWel	Power ≥50 kWel	Manure mono digestion	Biomass	Number of known reference projects
GERMANY					
23 Agrikomp Gmbh (Güllekompakt - Das Güllewerk - individual concepts on demand)	x	x	x	Güllekompakt: 100% liquid manure; Das Güllewerk: 80% (liquid) manure & 20% bio-organic waste, energy crops; options	Numerous
24 Bebra Biogas		x	x	liquid manure, grass	
25 Bioconstruct (BioCompact)		x		Cattle manure, pig manure, bio-organic waste	8000
26 Biogas Weser EMS		x		Manure, energy crops	360
27 Biogas-Ost (Clever-Ferm-System)	x	x		Manure, bio-organic waste, energy crops, various inputs	Dozens
28 Chiemgauer Biogasanlagen	x	x		80% Manure & 20% grass, various inputs	9
29 Consentis/Conviotec (CON2)		x	x	Cattle slurry, various inputs	24
30 Eggersmann (Smartferm)		x		bio-organic waste (only from vegetable origin), grass	
31 Energieraum (EVA 75)		x			2
32 Enspar	x	x		Manure, bio-organic waste, energy crops	401
33 Envitec Biogas (Envifarm Compact)		x		Manure, bio-organic waste, energy crops	no small scale references on website
34 Farmatic		x		Manure, bio-organic waste, energy crops	Mainly large installations
35 KBGA Gmbh (Enbea Bots)	x	x		various inputs	Pilot
36 MT-Energie		x	x	Manure, bio-organic waste	>600
37 Novatech	x	x	x	Manure, bio-organic waste, energy crops	>250
38 NQ Anlagentechnik	x	x	x	Liquid manure, energy crops	153
39 Ökobit (System Flex of System Korn)		x		Manure, bio-organic waste, energy crops	Mainly large installations
40 PlanET Biogastechnik Gmbh, Biogaz PlanET	x	x		Manure, bio-organic waste, energy crops	>330
41 Portaferm	x		x	liquid manure <10% DM	Pilot
42 Sauter Biogas (SB Mini)		x	x	solid manure, liquid manure, energy crops, various inputs	5
43 Schmack Viessmann (Eucolino)		x		liquid manure, energy crops	1
44 UDR Röring (MonoTube)	x	x		Cattle slurry, energy crops	
45 UTS biogastechnik (Kairos, Helios)		x		liquid manure, energy crops, various inputs	3
46 Weltec biopower		x		Manure, energy crops, various inputs	no small scale references on website
THE NETHERLANDS					
47 Agrimodem		x	x	Cattle manure	Pilot
48 Bioclear bv, Paques bv, Oosterhof-Holman Milieutechniek	x		x	Cattle manure	Pilot
49 Ecbio-organic wasteg - Nijhuis Water Technology		x		Manure, grass	1
50 Fermtechsystems	x		x	Cattle slurry	Pilot
51 HoSt (Microferm)		x	x	liquid manure, various inputs	4
52 Manure Power BV in co-operation with M.I.P. Tanks&Silo's			x		Pilot
53 Serigas		x	x	Manure (experience with garden waste, Water hyacinth)	Pilot
SWITZERLAND					
54 Axpo Kompogas		x		green waste, bio-organic waste	79
55 Renergon		x		bio-organic waste, poultry- or horse manure, bio-organic waste, etc.	
56 Swiss EcoSystems Gmbh (EcoGas)		x		Manure, bio-organic waste	>2
UNITED KINGDOM					
57 Evergreen gas		x		Manure, bio-organic waste, energy crops	2
58 Fre-energy (Fre-Energy digester)		x	x	Manure, bio-organic waste, energy crops	
59 Marches Biogas (CSTR; Agridigestore; "Plug and Play")	x	x	x	CSTR: Manure, bio-organic waste, energy crops; Agridigestore: manure, energy crops; Plug and play: manure	minimum 2 CSTR, 1 Agridigestore and 1 plug flow
60 SEaB Energy (MuckBuster, Flexibuster)	x			Muckbuster: agricultural waste; Flexibuster: bio-organic waste	5
UNITED STATES					
61 Avatar Energy	x	x	x	Cattle slurry, bio-organic waste, energy crops	

Installation Type	Website
Güllecompact: concrete digester; Das Güllewerk: horizontal plug flow (steel) with paddle agitator	www.biogastechnik.de
Vertical plug flow or compact silo digester	www.bebra-biogas.com/en/products/compact-digesters.html
CSTR, mesophilic (thermophilic reactor also possible)	www.bioconstruct.de
CSTR	www.biogas-weser-ems.de
CSTR mixed, multi-stage system	www.biogas-ost.de
Coverable basins, batch system	www.chiemgauer-biogasanlagen.de/startseite
Mono digestion of manure (75 kW), modular multi chamber reactor without mechanical parts, container construction	www.consentis.de
Garage type, batch digester	www.smartfarm.com
CSTR	www.energieraum-e3.de
CSTR + mixer	www.enspar.de www.envitec-biogas.com
CSTR	www.farmatic.com
Two-phase, combined wet and dry system	www.enbea.de ; www.kbga.de
CSTR	www.mt-energie.com/de/produkte/mt-farm.html
CSTR	www.novatechgmbh.com/67.0.html
CSTR	www.nq-anlagentechnik.de
CSTR	www.oekobit-biogas.com
CSTR	http://en.planet-biogas.com/services/new-construction/
Horizontal cylinder, plug flow	www.portaferm-biogas.de
Lagoon system or concrete tanks, long retention time	http://sauter-biogas.de
horizontal plug flow reactor or round tank	www.viessmann.be/nl/industrie_bedrijven_overheid/Producten/Biogasinstallaties/Natte_fermentatie/EUCOLino_compacte_biogasinstallaties.html
UDR=upflow-downflow-reflow. Digestion system with 2 to 3 coated steel tanks. MonoTube has 1 or 2 (> 50 kW). U & D are fixed bed reactors. Thermophilic > 50 °C.	www.udr-systems.com
CSTR (Kairos)+ secondary digester	www.uts-biogas.com
CSTR	www.weltec-biopower.com
Multiple phase	non-commercial
Struvite digestion in tower silos, digestion of the liquid fraction	non-commercial
Manure bag	non-commercial. More info on www.microvergisters.nl
Two-phase	www.fermtechsystems.com/Lopende%20projecten.html
prefabricated tower silo, digestate storage bag or silo	www.host.nl ; www.microferm.nl
Digestion of liquid fraction	www.mip-nv.com
Multiple phase digestion, specific micro-organismsn, multi-stage pre-treatment	www.serigasinternational.com
Continuous dry fermentation, plug flow digestion	www.axpo.com/axpo/kompogas/de/home.html
Dry digestion, modular to 8 containers	www.renergon.ch/ ; www.christiaens.com
CSTR	http://swissecosystems.ch
Mesophilic, frequent mixing	www.evergreengas.co.uk/home
CSTR	www.fre-energy.co.uk
Agridigestore: conversion of digestate storage; Plug and Play: horizontal tank, spray mixing	www.marchesbiogas.com/home
Modular, containers	www.seabenergy.com
Horizontal modular plug flow (fiberglass)	www.AvatarEnergy.com

“

Pocket digestion is a technique to increase self-sufficiency in terms of energy demand.

”



MORE INFO

Projects

There are also other initiatives and efforts concerning small-scale anaerobic digestion small-scale anaerobic digestion on a local and regional scale as well as on an international scale. Listed below, amongst others, are some projects that are being executed (or have been finished) on a European level:

- Biogas³ - www.biogas3.eu
- BioEnergy Farm II - <http://ec.europa.eu/energy/intelligent/projects/en/projects/bioenergy-farm-ii>
- BiogasETC - <http://biogas-etc.eu>
- BiogasXpose - www.biogasxpose.eu
- BIORES - <http://ec.europa.eu/energy/intelligent/projects/en/projects/biores>
- www.microvergisters.nl

CONCLUDING REMARKS

In the years to come it is expected that the market for small-scale installations in the agricultural sector will continue to grow. There are different reasons to support this statement, the most important are: the increasing demand for measures **to reduce the environmental impact (for example greenhouse gas emissions) of residual waste streams** and increasing interest to **invest in renewable energy production**.

Based on the availability of residual waste and the current energy demand many agricultural companies show a certain potential for implementation of small-scale anaerobic digestion. The examples in this brochure show that small-scale anaerobic digestion can be profitable. However, the implementation needs to be company specific and a well-advised preliminary calculation is necessary.

Future investors have a broad range of providers in the whole northwestern region of Europe. Because it is expected that the demand for small-scale installations will increase strongly in the near future, and taken into account that a number of manufacturers are still experimenting in a pilot phase, we also expect that the group of providers will expand accordingly.

It is important that the agricultural companies that are interested in investing in this technology make sure that they are well informed before they start their project. Site visits to existing installations can be very useful. A good follow-up by both manufacturers and owners is of great importance to the success of the implementation of a small-scale anaerobic digester.

The authors of this brochure want to focus on research, advice and communication concerning small-scale anaerobic digestion to inform the sector to a maximum of the opportunities associated to pocket digestion.

This brochure was created under the Interreg IVb project ARBOR. ARBOR's mission is to promote an innovative and sustainable approach to the production of energy from biomass in North West Europe (NWE). The regions in which the ARBOR partners operate are: Flanders, Germany, Luxembourg, the United Kingdom, Ireland and the Netherlands. ARBOR receives support from the European Regional Development Fund through the INTERREG IVb, the Flemish Energy Agency (VEA), the Agency for Entrepreneurship and the provinces of West Flanders, East Flanders and Flemish Brabant. More information on ARBOR is available on the website: www.arbornwe.eu.



met steun van het
Agentschap Ondernemen



This brochure is the result of a collaboration between different organisations :

Inagro vzw is the research and advice center for agriculture and horticulture in West-Flanders. Inagro focuses on a practical approach to the different sub-sectors within agriculture and horticulture. The division Energy, Biomass and Innovation is charged with research, the formulation of advice and communication to the sector concerning energy efficiency and energy production. The division is clearly linked with energy production, including biomass. Special attention is paid to small scale anaerobic digestion as one of the topics that is part of the division's scope. Inagro also has a leading role within the Flemish agricultural energy platform and agricultural energy encyclopedia Enerpedia, where Inagro works closely with other Flemish agricultural practice and knowledge centers.

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Biogas-E vzw is the platform for the implementation of anaerobic digestion in Flanders and acts as information point where anyone can ask for independent information and advice in first line. Biogas E vzw is a non-profit organization and acts as an independent expert institution concerning all aspects of anaerobic digestion (technological, economical, legislative, social, ecological). The association strives for full valorization of the biogas potential in Flanders and aims to objectively support a maximum of initiatives related to anaerobic digestion.

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The Flemish Coordination Centre for Manure Processing (VCM) is an organization that supports the government as well as private companies in realizing sufficient manure processing within the Flemish region. VCM operates as an expert organization and has an advisory role. The agricultural aspect as well as the ecological, spatial, economic, and energetic aspect are important to be able to accomplish sufficiently sustainable solutions for the Flemish manure excess.

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DLV InnoVision supports innovating entrepreneurs in their business development. The support takes variable forms and comprises support when drafting a business plan, maximization of project funding and subventions, or complete project coordination. As an independent consultancy company DLV InnoVision regularly carries out feasibility studies for small-scale anaerobic digestion and digestion of less common biomass streams.

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Ghent University, abbreviated to UGent, is one of the major universities in the Dutch-speaking region of Europe and one of the leading Universities in scientific research worldwide. The Faculty of Bioscience Engineering educates generations of scientists in leading edge research and high impact work with governments and communities, industry and NGOs, to support innovation and sustainability in life sciences while managing and protecting natural and man-made ecosystems.

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