

1. cover page

GREEN HEATING ZONE POLDERWIJK
in the
climate neutral municipality Zeewolde



- 1.1 **Green district heating in Polderwijk, Zeewolde, The Netherlands**
- 1.2 **Owner of district heating grid & heat distributor:
Essent Local Energy Solutions, The Netherlands**
**Owner of CHP and biogas transport system:
dairy farm Van Beek of Zeewolde**
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2. Motivational letter

2.1 A small-community system for the Polderwijk in Zeewolde

The municipality of Zeewolde exists for only 26 years. Formerly here was the Suydersea which became Lake IJssel after building a barrier dam. In the seventies part of the lake became polder and in the eighties the first houses and farm came to the area which was named Zeewolde later on.

In 2005 the municipality started developing an urban area called Polderwijk. The municipality consisted in 2007 of app. 7.500 households. The Polderwijk is meant for 3.000 new houses thereby increasing the number of households by 50% in 2020.

2.2 new district energy schema

The realisation of the district heating grid in the Polderwijk started in 2007 and in that year the first houses and a church were connected. Now more than 1,000 are connected to the heating grid. The generation of renewable energy started at the beginning of 2009.

2.3 Why, how and what has been achieved?

The municipality of Zeewolde produced in 2007 already more renewable energy than all households and companies in Zeewolde consumed. That is even better than climate neutral. The growth of the energy consumption caused by building 3.000 houses in the Polderwijk should not have a negative influence on the climate neutral position of Zeewolde. The municipality decided to tender the energy distribution and supply for the Polderwijk on the base of CO₂ reduction and cost effectiveness.

Essent Local energy Solutions won the tender with a district heating scheme and combined generation of heat and power on biogas produced by a dairy cattle farm.

The distance between this farm and the Polderwijk is 5 km. In 2008 a pipeline of 5.5 km was realised from farm to Polderwijk for transport of raw biogas to the CHP at the energy station of the Polderwijk. The CHP was commissioned at 28th of December 2008.

In 2009 and 2010 the production of renewable electricity and the utilisation of heat from the biogas CHP was almost equal to the energy consumption of households, church and schools in the Polderwijk

The cooperation of a dairy farm and a large utility is an outstanding feature and has already proved to be successful.



Zeewolde

3. Summary

The municipality of Zeewolde in the Dutch polder Flevoland is better than climate neutral. Farmers in the municipality operate 256 wind turbines and generate electricity with biogas plants in this young and rural municipality. The dairy farm of Gert Jan van Beek produces renewable electricity out of wind and biogas but also sells renewable heat for the Polderwijk, a new residential area in Zeewolde with nowadays some 1,000 houses and in 2020 some 3,000 houses.

In a tender procedure the municipality gave in 2006 a concession for 30 years to the company who offered a climate neutral district energy concept at reasonable price.

Essent Local Energy Solutions won the tender. The offer of Essent was based on coöperation with the dairy farm Van Beek in Zeewolde. Essent invests in a district heating grid and an energy station for the Polderwijk. Van Beek installed a 1.1 MW cogeneration unit at the energy station of the Polderwijk. Raw biogas is transported from the dairy farm to the Polderwijk over a distance of 5.5 kilometres. Essent buys the renewable heat from the farmer. The cooperation between Essent and farmer is unique. The electricity is fed into the local grid of Zeewolde.

The distribution of renewable heat started at January 7th 2009. The biogas CHP produced in 2009 and 2010 much more renewable energy than the households in the Polderwijk consumed. However in future the production of renewable heat will be enlarged, as the Polderwijk will extend to 3,000 houses.

4. Written description district energy Polderwijk

4.1 System history, configuration, etc.

The plans for building 3,000 houses in a new urban area to be called Polderwijk in Zeewolde date from first years of this millennium. The municipality decided then that the energy system should have a low carbon footprint. In 2006 the municipality asked utilities to offer an energy programme for the Polderwijk in a tender procedure. Main issue in the tender was a 30 years lasting guarantee for a reduction of CO₂ emission of at least 50% for electricity and heat consumption of the 3,000 houses compared to conventional supply with electricity from the grid and heating with individual condensing boilers on natural gas. Quite unusual for The Netherlands the municipality gave no concession for a natural gas infrastructure in the Polderwijk.

The district heating business unit of the Dutch utility Essent won the tender by cooperating with a local farmer. Gert Jan van Beek, owner of a dairy farm with some 140 cows planned to build a manure co digester for the generation of biogas. Essent and Van Beek decided that transporting the biogas to an energy station for the Polderwijk would be the ideal solution as the heat of the biogas engine could then be utilised.

In 2007 farmer Van Beek and Essent Local Energy Solutions signed a contract for a district energy system in the Polderwijk based on a biogas CHP for renewable electricity and heat.



- Zeewolde in 2007 appr. 7.500 existing dwellings
- Polderwijk 3.000 new houses
- municipality Zeewolde demands high sustainability for new Polderwijk
- tender concession for energy on base of price and CO₂ reduction

Essent Local Energy Solutions started with the realisation of the heating grid in 2006. The first customer to be connected was in fact a new church for Zeewolde. Ultimo 2006 7 houses were connected and in 2010 the number had grown to 970.

In the end some 3,000 houses will be connected to the district energy system of Polderwijk. Due to the financial crisis the Polderwijk is growing slower than planned. In 2007 some 350 new houses were built and in the following years some 150 per year.

There was some delay for the realisation of the biogas project. This had to do with a change of horizontal digester to vertical tanks requiring new permits. But just before the summer of

2008 the first concrete was poured for the digesters at the farm site of Van Beek. In the autumn the digesters and a small CHP of 250 kW electric power could already be started up. In the autumn of 2008 the biogas CHP of 1.1 MWe was installed and a pipeline for raw biogas from the farm to the energy station was realised. The commissioning of the biogas CHP was just after Christmas 2008.

January 7th of 2008 the municipality of Zeewolde declared the Polderwijk to a green heat zone. The inhabitants got a post card telling that they got heat fresh from the cow and they were invited to the official ceremony for the start of distribution of green heat and a visit to the farm.

The energy station and heating grid of the Polderwijk

Up till now Essent realised a provisional energy station with two gas fired peak boilers, pumps, water treatment and controls in a Romney hall. The CHP unit of the farmer Van Beek is housed in a container and there is a transformer for feeding electricity into the 10 kV grid. In the next years a new housing for the equipment will be built. Warehouses and stores will then surround the energy station.

The CHP has an electrical output of 1.064 kW and a thermal output of 1,270 kW at 90 °C.

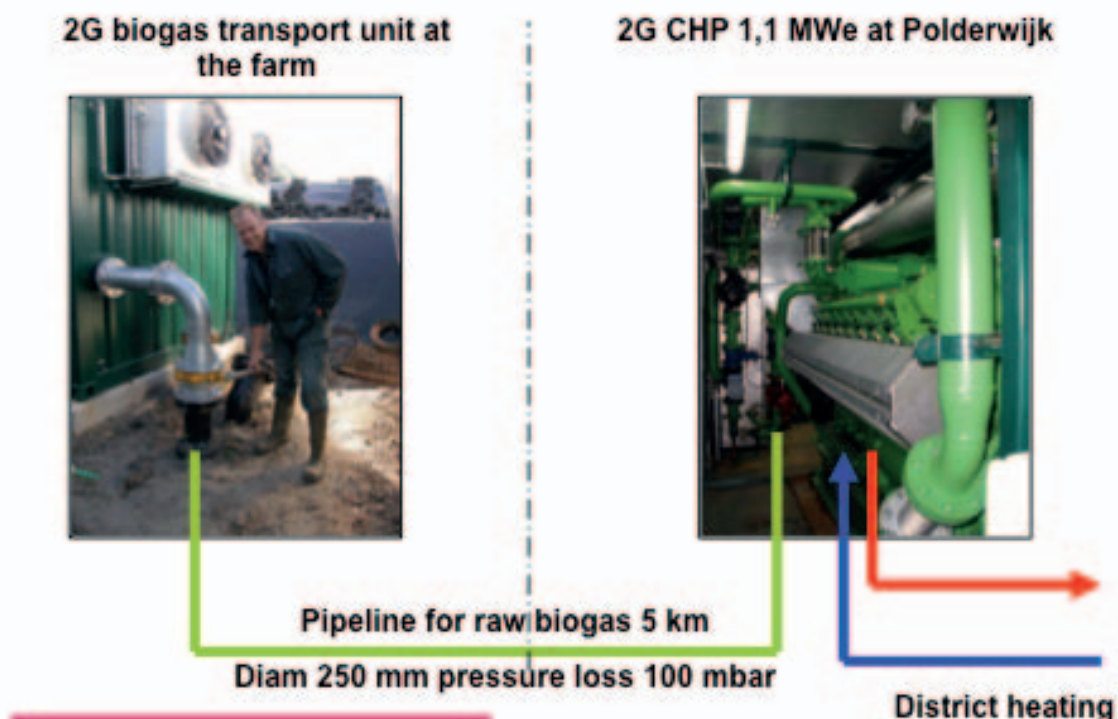
The total efficiency of the CHP is 90% and the electric efficiency 41%.

The heat of the CHP is directly transferred to the district heating grid. The grid is operated at a supply temperature of 75 °C and a return of 45 to 55 °C depending on weather conditions.

The pumps of the heating grid are equipped with frequency control in order to minimise power consumption.

The energy station is unmanned. Essent has remote control for the whole system and the farmer has remote control for his biogas CHP.

For the district heating grid insulated steel pipes are being used with flexible connections to each house. In each house a heat supply unit is installed with an electronic heat meter, controls, valves and a heat exchanger for hot water for bath and shower.



4.2 Data and efficiency

Polderwijk	2009	2010
Average number of households	710	870
est. electricity consumption households	2,485,000	3,050,000 kWh
Heat consumption households	7,930,000	9,350,000 kWh
Electricity generated on biogas	6,700,000	7,500,000 kWh
Utilisation of heat from biogas CHP	5,900,000	7,100,000 kWh
Natural gas peak boilers	3,610,000	4,735,000 kWh
Share of renewable in total consumption	86%	80%
CO ₂ reduction	4,500	5,100 ton

Remarks:

- 1. The electricity generated by the CHP at the farm is not included in the table. When we include the 1,500,000 kWh per year of this unit then the district energy of Polderwijk is 100% renewable*
- 2. the energy consumption of the households had to be estimated as electricity consumption of individual households is not available and the registration of the heat meters does not match the calendar year. For electricity an average of 3,500 kWh per year is calculated*
- 3. electricity from the power stations in The Netherlands has an average emission of 0.54 kilograms of CO₂ per kWh.*

The manure digesters at the farm of Van Beek treat on yearly base some 30.000 tons of material of which at least 50% manure from the cows of Van Beek and from neighbouring farms. As co products Van Beek feeds maize, grass from woods, over date food of supermarkets and glycerine. The composition varies with the prices and availability of the products.



4.3 Reduction of greenhouse gases and environmental benefits

Regarding to greenhouse gases there are several issues in the district energy programme of the Polderwijk in Zeewolde. First of all there is the reduction of CO₂ emission by the local generation of renewable electricity and heat. For 2010 this resulted in a reduction of more than 5,000 tons of CO₂ compared to the normal system in the Netherlands with condensing boilers on natural gas and electricity from power stations.

But probably as important is the reduction of methane gas at the dairy farm. The normal situation is to fertilise the land of the farmer with untreated manure. Then a lot of methane goes into the atmosphere. After treating in a digester however this spontaneous methane emission is practically eliminated. Furthermore the digested manure has more effect thereby reducing the demand of artificial fertilisers. These important effects were investigated in the European project North Sea Bio Energy (www.northseabioenergy.org). by Nij Bosma Zathe, the dairy centre of the university of Wageningen

4.4 Outstanding and innovative

The district energy programme of the Polderwijk is as far as known the first to connect renewable energy from a dairy farm to a new housing area. This connection was made possible from economical and technical point of view by the idea to transport raw biogas by pipeline.

But the role of the municipality and the cooperation between in character and size totally different partners as a farmer and a large energy company make this project outstanding as well.

For the households in the Polderwijk it is a nice idea to know that their energy is fresh from the cow. District heating is rather unusual in The Netherlands and the heat consumers in the Polderwijk like the fact that cows produce energy for them.

Transporting raw biogas

The main invention of the Polderwijk district energy project is the transport of raw biogas over a distance of 5 kilometres. Transport of heat from the farm over this distance would not be feasible. The idea to transport raw biogas by pipe and locate the CHP not at the farm but at the Polderwijk was the key to success.

Transporting of raw biogas appears to be rather easy and can be done with a minimum of energy loss. The pressure loss in the pipe is over 5.5 kilometres only 100 millibar due to using a pipe with a relatively large diameter of 250 mm. A simple maintenance free blower with a very small electric motor can do the job.

However the biogas coming out of the digester is very humid and needs to be dried. The biogas is therefore dehumidified to a dew point of 4 °C by scrubbing with chilled water.

Bacteria at the roof of the digesters transform the H₂S in the biogas to pure sulphur. This desulfurization fulfils the requirements of the manufacturer of the gas engine in the CHP.



Farmer selling heat to district heating company

The contract between farmer Van Beek and Essent Local Energy Systems as operator of the grid is somewhat peculiar. The farmer is not only producing biogas but also owner and operator of the CHP unit at the energy station of the Polderwijk. He sells the heat to Essent at a price related to the price of natural gas. Essent operates the peak boilers and supplies itself the natural gas for these boilers.

This split in heat production was not by coincidence. It proved in practice to deliver the best results. Biogas production from manure is not really a thing for an energy company but it is for a farmer. Feeding the co digester is just like feeding cows: not too much, not too little and no abrupt changes in diet. If the farmer is responsible for biogas production he should be responsible for the results of the biogas CHP as well. Over the past years farmer Van Beek did his job excellent resulting in a very high number of operating hours of the CHP.



farmer Van Beek operates CHP and biogas transport

4.5 Quality of life

District heating is comfortable as there is no boiler in the house needing maintenance and no chimney on the roof and no space consuming hot water storage vessel. As the supply water of the district heating is at a safe temperature all the time there is no risk for legionella in shower water.

The energy consumed by the households is to a high extent renewable. Inhabitants even can visit the dairy farm and the manure digesters to see how their energy is generated within their own community.

There is some extra employment within the municipality because of operating the biogas plant.

The municipality of Zeewolde remains a climate neutral community despite a strong growth in the number of households due to the development of the Polderwijk.



inauguration of the green heat zone with kids of the school in the Polderwijk

4.6 Challenges

Essent found several local farmers with plans for manure digesters. But it was not so easy to contract a fit partner for the idea of biogas supply to a new housing area. After serious negotiations with a farmer nearby the Polderwijk Essent had to start searching again as permits for building manure digester at that farm would not be possible. Other farms also had problems with permits and did not get governmental support for generation of renewable energy. For Van Beek it took a lot of effort to get permits and financial support. The negotiations with Essent took less time and Van Beek managed to regain lost time by building digesters, biogas system and CHP within half a year.

A second challenge is the financial crisis, which slowed down the development of the Polderwijk. In 2009 and 2010 less than expected houses were built.

4.7 Financing

The investments in digester, biogas pipeline, CHP were for farmer Van Beek whereas Essent invested in district heating grid, connections to the houses, meters, peak boilers, controls and monitoring. The Dutch ministry of economic affairs subsidised a part of the investments in the heating grid and the biogas transport system in an innovation programme for renewable energy called UKR.

Essent financed its part within its normal programmes. The farmer got a so-called green finance contract for his investments. The green finance results in a somewhat lower interest rate than a standard finance contract.