IEA Bioenergy Task 37

BIOGAS IN THE SOCIETY
Information from IEA BIOENERGY TASK 37 Energy from biogas and landfill gas

THE FIRST BIOENERGY VILLAGE IN JÜHNDE/GERMANY

ENERGY SELF SUFFICIENCY WITH BIOGAS

SUMMARY

The village of Jühnde is Germany's first bioenergy village. In 2006 they started the project with the goal to substitute all fossil fuels for electricity and heat production with biomass. The village implemented a biogas plant for combined heat and power production from liquid manure and whole plant silage of different crops. To cover the high heat demand during winter months an additional wood chip peak boiler was installed. The heat is distributed via a district heating grid providing 145 houses. The electricity is completely fed into the grid.

FACTS

– Biomass for energy supply of an entire village
– Total heat production 6,500 MWh/year
– Total electricity production 5,000 MWh/year

Figure 1:
The bioenergy plant in the idyllic village Jühnde

BACKGROUND

The goals of the German Federal Government are to increase the renewable electricity production to minimal 30 % by 2020 and the proportion of heat to minimal 14 %. In order to facilitate the development of a sustainable energy supply the Renewable Energy Sources Act (EEG) was introduced in the year 2000 with amendments in 2004 and 2009 that guarantees fixed feed-in tariffs for electricity and a bonus for the heat utilization. In addition specific demonstration projects are supported by the Government in order to achieve a fast replication of innovative energy projects. The bioenergy village Jühnde is such a successful demonstration project which was funded by the German Federal Ministry of Food, Agriculture and Consumer Protection by a grant of 1.3m Euro.

PROJECT

The village Jühnde has 800 inhabitants and is located in the southern part of Lower Saxony. The idea of the Jühnde model is a complete shift from fossil energy sources to renewable biomass from local agriculture and forestry for the entire village. Jühnde was selected in a step-by-step approach on the basis of criteria on economy, infrastructure, nature and society.
For planning the project and to acquire the necessary investment subsidies, the village founded a cooperative. More than 70 % of the inhabitants are members of the cooperative and paid a fee of minimal 1,500 € to get voting rights and they invested money for the connection of their houses to the district heating.
The energy plant is composed of three main elements:
a) A biogas plant for co-fermentation of liquid manure and silage of different energy crops;
b) A boiler fuelled with regional wood chips and
c) A district heating network for 145 houses.

Table 1: Parameters of the bioenergy plant Jühnde

Digester volume	3,000 m³
Storage tank	4,400 m³
CHP	700 kWel, 750 kWth
Liquid manure	9,000 m³/year
Energy crops	15,000 tons/year
Wood chip boiler	550 kWth
Wood chips	350 tons/year
Peak-load oil boiler	1,600 kWth

Biogas is converted into electricity and heat by a CHP plant with 700 kW electrical and 750 kW thermal power. The wood chip boiler with a heating capacity of 550 kW is necessary to cover the high heat demand during winter months. Two hot water storage tanks each of 50 m³ are coupled with the energy plants to ensure that the heat demand of the houses can be fulfilled every time. In addition a conventional oil boiler was installed with a peak load of 1,700 kW which is only necessary as a back-up unit in the case of a break down of the biogas plant or the wood chip boiler.

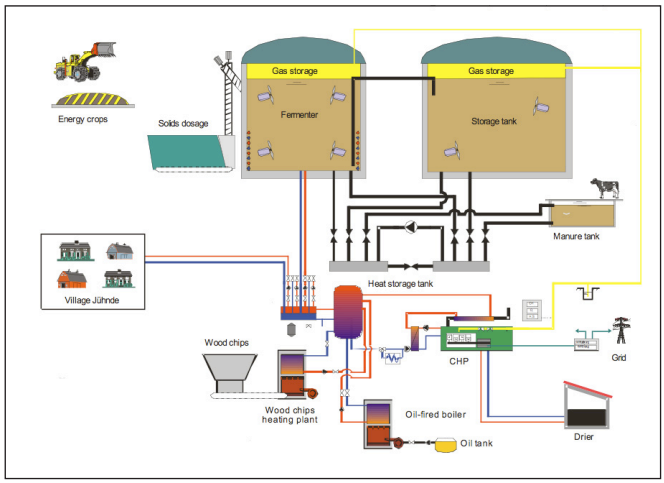

Figure 2:
Schematic draw of the bioenergy plant Jühnde

The district heating grid has a length of 5,500 m which is operated with hot water of 85 °C. The heating grid is directly coupled with the internal heating system of each building and hot water for bath and kitchen is produced via a heat exchanger. The electricity is completely fed into the public grid of the local public utility. The bioenergy plant is located at the edge of the village with short distance to the residential buildings.
For biogas production approx. 15,000 tons whole plant silage and grass are used per year and approx. 9,000 m³ liquid manure from cattle and pigs of six animal farms. A wide diversity of crops and even weeds are used. For biomass production intercropping and double cropping are applied in order to stabilize the agricultural ecosystem. Thanks to the early harvesting time of the crops, the application of pesticides can be kept to a minimum. For the utilization of the surplus heat during the summer months a container drying station was built to increase the calorific value of the fresh wood chips.

RESULTS

The evaluation of the Jühnde project has shown that an active participation of the population of the village and a well functioning social network are necessary in order to achieve a high participation of households linked to the grid. In Jühnde the mayor was an important promoter who motivated the inhabitants to support the idea and to take part in the project.
The energy plant is operated by the local cooperative. Two people are required for the operation of the plants, logistics and administrative work. The biogas plant produces approx. 5,000 MWh electricity per year, which is more than the twofold demand of the village. The amount of heat generated by biogas and wood chips is nearly 6,500 MWhth. The heat amount sold is about 3,200 MWhth covering close to 99 % of the heat demand of the connected houses. Arround 85 % of the heat is produced by combustion of biogas in the CHP-plant and 15 % is produced by wood chips. The heat losses in the hot water grid are approx. 22 % of the input. The process heat demand of the biogas plant is lower than 10 % of the total heat production because the anaerobic degradation of energy crops results in a self-heating effect.
The heat demand of the village strongly varies with the seasons which makes an economic operation of the plant very difficult.

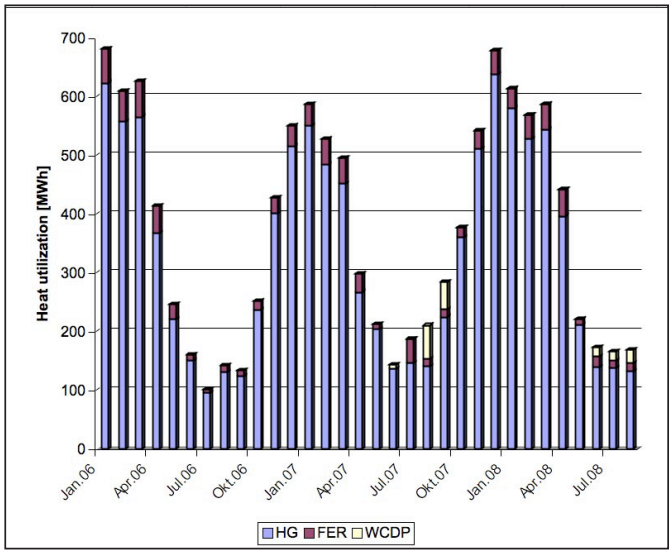

Figure 3: Heat utilization during the year (HG = Heat grid, FER = Fermenter, WCDP = Wood chips drying plant)

The income from electricity production is much higher than from heat. Therefore biogas production cannot be adapted to the heat demand. It is necessary to find an optimum between heat and electricity production which results in a surplus of heat during summer time because only a small part can be used for drying wood chips and hot water production. Therefore, only 70 % of the yearly produced heat can be used.
Thanks to the combined production of electricity and heat 3,300 t of carbon dioxide are avoided and 400,000 l of oil can be substituted per year. Furthermore, the bioenergy plant leads to positive environmental and economical effects and promotes the quality of life in the village:

a) odour emissions from manure storage and field application are reduced,
b) farmer and foresters of the village have a permanent customer for their products and
c) several local service companies, e.g. craftsman, have found a new income.

After the successful implementation and operation of the bioenergy plant the villagers now discuss to use Jühnde for implementing new technologies, e.g. biogas fuel cells, which increase the efficiency of energy generation.

CONCLUSIONS

The bioenergy village shows that the self-support of an entire village by biomass from local agriculture and forestry is a reliable way to become independent from fossil energy imports and from large electricity companies. For a successful and economic stable operation many criteria on infrastructure, biomass production and society aspects of the village must be fulfilled and the decisions must be compatible with the local needs. Therefore a detailed feasibility study and an effective business plan are necessary before such a project can be realized. It is important that the farmer and forester of the village became partner of the bioenergy plant in order to achieve long-term contracts for biomass supply combined with stable biomass prices.
According the positive results of this successful project the Federal Ministry of Food, Agriculture and Consumer Protection has decided to support further demonstration projects with bioenergy in 16 selected regions of Germany.

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