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Germany

Bio-Fuels

Bioenergy Village - a Concept for Energy Self-Sufficiency in Rural Areas

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Report Highlights:

Juehnde, a 750 inhabitants village in Lower-Saxony, took advantage of public funding for research projects relating to bioenergy and invested into a biorefinery (fermentation plant) for methane, a power station to convert the methane into electricity, and a central heating plant that runs on wood chips. As a result, Juehnde produces more than double its annual electricity consumption and all of its heat consumption from renewable resources. Hence, it calls itself "bioenergy village" and energy self-sufficient. Juehnde is interested to share its experience and exchange information with interested parties. In 2006, the project attracted approximately 7500 visitors from all over Germany, Scandinavian Countries, China, and Japan.

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Summary

Juehnde is the first bioenergy village in Germany, meaning that it produces all of its electricity and energy for heating and cooling locally from renewable resources. While the project was started in 2000, it reached the self sufficiency level for energy in June 2006. In 2007, Juehnde is expected to produce 5 million kWh electricity, while the village's consumption will amount to 2 million kWh. The excess is sold to energy providers. The major feedstocks for electricity generation are methane (biogas) produced from fermented liquid manure and locally grown energy crops. Heat is produced as by-product from electricity generation and in Winter from burning woodchips. Transport fuels are currently not part of the concept. Major motivation behind the use of biomass is climate and resource protection.

Local agriculture is the backbone for operating the project, as 25 percent of the farmland and 10 percent of the annual forest wood growth is contracted for bioenergy production.

The project received 3 million Euro in financial support from Federal, regional, and local government agencies. It proved so successful, that a number of other bioenergy villages are being developed, even without the same government support.

Concept Details

Since August 2006, Juehnde produces all of its heat and electricity supply from bioenergy. Biogas¹ (methane) from liquid manure and locally grown energy plants is used to generate electricity and heat. The waste heat from electricity production is used to heat water to 176 degrees Fahrenheit (80 degrees Celsius). The hot water is then piped to the participating households for warm water supply and central heating². In Summer, when demand for heat is below average, the excess heat is used to dry wood chips. In the Winter, when the heat from electricity generation is not sufficient to meet demand, additional heat is produced from burning those wood chips in a block heating and generating plant.

The project was started in 2000 by the University of Goettingen's *Interdisciplinary Centre of Sustainable Development* (IZNE). In 2001, Juehnde was selected as the model village among 17 candidate villages. Electricity generation started in 2005, and on June 16, 2006, Juehnde inaugurated the wood chip heating plant and eventually became energy self sufficient.

The nine local farmers play an important role for this project as they supply the feedstocks for the biorefinery (fermentation plant) and the block heating and generating plant. They sign annual contracts to produce biomass for the project on their farmland/ in their forests. Currently 25 percent (330 ha = 815 acres) of the farmland and 10 percent (300 MT) of the annual wood growth is contracted for bioenergy production. In addition, farmers annually supply 9000 cubic meters (2.4 million gallons) of liquid hog and cattle manure for the fermentation plant.

¹ Biogas (methane) is produced by fermentation (anaerobic digestion) from liquid manure and whole plant silage of annual energy plants such as wheat, rye, triticale, corn, and sunflower.

² In Germany, central heating of houses is based on hot water that circulates through pipes and radiators. The system of heating by hot air that is used in the U.S. is virtually non-existing in Germany.

Because of the annual nature of the biomass contracts with the farmers, the facility must pay the farmers prices that are competitive with commodity market prices.

Funding/financial support

- Set up costs

The project was financially supported by the Federal German Agency for Renewable Resources (*Fachagentur Nachwachsende Rohstoffe, FNR*) and the Federal German Ministry of Food, Agriculture, and Consumer Protection (*BMELV*). Additional smaller amounts were contributed by the State of Lower Saxony and the county. Total funding amounted to 3 million Euro (US\$ 4.1 million³), of which 50 percent were used for project development and evaluation and the remaining 50 percent financed part of the technical investments.

Total investment costs for Juehnde amounted to 5.4 million Euro (US\$ 7.3 million). Of these 3.4 million Euro were financed through bank credits, 1.5 million Euro through grants (see above), and 500,000 Euro through shares in managing cooperative.

- Operating costs

Generating electricity from biomass, in general, benefits from the German Renewable Energy Law (*Erneuerbare Energien Gesetz, EEG⁴*). This law requires power companies to buy biomass-based electricity from the producers at a fixed price for twenty years, to compensate for the higher production costs. The power companies pass this higher purchase price on to the consumers in Germany. This translates into additional annual electricity costs of about 20 Euro per person.

Key facts about Juehnde

750 inhabitants

200 households, of which 141 participate in the project (70 percent of all households)

9 farmers

1300 hectares (3211 acres) farmland, 25 percent is used to grow wheat, rye, triticale, corn, and sunflower for biomass/energy production

800 hectares (1976 acres) forests, 10 percent of annual growth is used for heat production

Technical data for the project

3000 cubic meters fermenter (anaerobic digestion plant)

700 kW_{el} block heating and generating plant/combined heat and power station (CHP) based on biomass (annual production: approximately 5 million kWh)

550 kW central heating plant based on wood chips (operating only in winter)

5.5 km (3.4 miles) hot water pipeline system

Current annual energy consumption:

2 million kWh electricity

4.5 million kWh heat energy

Annual biomass consumption:

- o 9000 cubic meters of liquid manure

³ Conversion rate: 1 US\$ = 0.7358 Euro, 1 Euro = US\$ 1.3591, as of May 15, 2007.

⁴ For detailed information on the EEG please refer to:

http://www.bmu.de/english/renewable_energy/doc/6465.php

- o 330 ha (25% of total farmland) annual energy crops: wheat, rye, triticale, corn, sunflowers
- o 300 MT wood chips from local forest (10 % of annual growth)

Annual CO₂ reduction:

3,300 MT

= 60% CO₂ reduction per person per year

For more information please visit:

http://www.bioenergiesdorf.info/pdfs/05-07-04_FaBI_Philosophy%20and%20Objectives.pdf

http://www.bioenergiesdorf.info/pdfs/05-07-04_FaBI_Thesis%20and%20Opportunities.pdf

Other bioenergy village projects

While Juehnde was the first energy self sufficient village in Germany, a number of other projects exist, some of which are listed below.

The Juehnde project proved to be so successful, that the idea has found a number of followers in the region. Eleven additional bioenergy villages using the Juehnde concept are planned in the **Goettingen region**. They are expected to be operational by 2009. However, Juehnde is the only project that received direct financial support from BMELV/FNR.

A separate project is the **Mauenheim** village in Baden-Wuerttemberg (Lake Constance area, Southern Germany). It follows a similar model as Juehnde but also includes solar energy in the energy mix. This project was developed by the commercial company *Solarplex* and supported by the NGO German Environment Aid (*Deutsche Umwelthilfe*). It has been operational since November 2006, and serves 60 households. The company plans to develop one additional village per year.

<http://www.bioenergiesdorf-mauenheim.de/> (German language only)

www.solarplex.de/projekte/holzenergie/bioenergiesdorf.php (German language only)

Rai-Breitenbach in Hesse (central Germany) will have its ground breaking ceremony on June 1st, 2007, and is scheduled to become operational in 2008. Currently, 155 households have signed up with the operating cooperative. The majority of the heat generation will be based on wood chips. The use of the perennial *miscanthus giganteus* grass is currently investigated. In times of peak demand, additional heat will be generated from locally produced rapeseed oil.

<http://www.bioenergiesdorf-odenwald.de/english/news/>