

## Pure biogas in three steps: University of Hohenheim develops new type of biogas plant

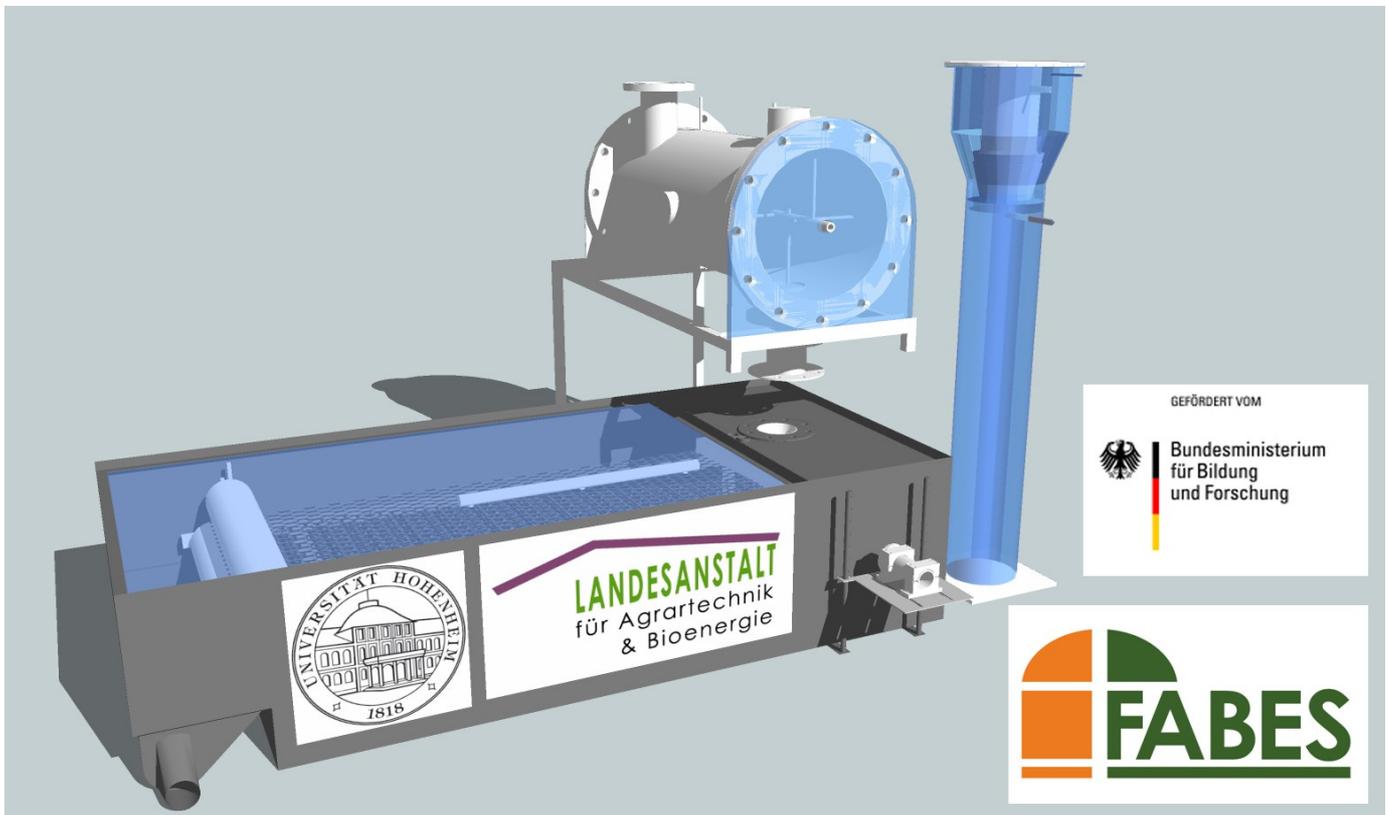
**Higher methane level, shorter process times, more flexible products: researchers from the University of Hohenheim are planning to establish a three-tier pilot plant over the next three years that is able to produce all this. In the long term, this will contribute to a reduction in the energy required to produce biogas relative to the energy currently required to produce natural gas and it will also enable biogas to be supplied via existing gas networks. This means that biogas will no longer have to be produced at the site where it is used. The researchers also envisage that the new plant will be more flexible than existing biogas plants in terms of substrates used and usable products. The cooperative project involves eight partners and is financed by the BMBF (Project Management Organisation Jülich) as part of the "Bioenergy 2021" programme, which is providing a total of 1.96 million euros. 275,500 euros are allocated to Hohenheim, making the project one of the major research activities at the University of Hohenheim.**

The new miniature biogas plant will be erected on the university campus close to the Institute of Agricultural Technology. The plant will be equipped with four 100-l fermenters that are able to ferment 1 kg dry mass of a model substrate consisting of grass and corn or straw and hay. 410 l biogas with a methane proportion of up to 85 per cent will be produced in a separate methane reactor with a volume of 50 l. Although the quantity of methane is too low for direct use, the Hohenheim agricultural scientists nevertheless have big ideas for the small pilot plants.

The goal of the cooperative project is to develop a new type of biogas plant, which will combine several advantages: first, it will be able to use a broad range of substrates; second, it will lead to higher methane levels in the final product and third, the entire process will be sped up.

### 2 + 1 = completely new type of biogas plant

Up until now, biogas was produced in Hohenheim using biogas plants consisting of one tank where acid is formed and degraded to methane. The use of only one tank provides the microorganisms with suboptimal environmental and growth conditions. Initial experiments focusing on two-tier fermentation processes have shown that the separation of the actual fermentation process from the generation of methane speeds up the process considerably. However, a two-tier biogas plant has considerable disadvantages in terms of control.



Model of the planned biogas pilot plant  
 © Lemmer/Landesanstalt für Agrartechnik, Hohenheim

The new biogas plant will consist of three tanks instead of only one or two. This will enable the researchers to separate the processes of fermentation and methanogenesis. "Hydrolysis will take place in the first fermentation tank. Hydrolysis is a process during which enzymes degrade the substrate into monomers and acids, leaving behind structural substances, i.e. insoluble residues, in the case of lignified substrates. The substances that can be easily degraded are turned into 100% soluble substances," explains Dr. Andreas Lemmer from the State Institute of Agricultural Engineering and Bioenergy.

A process known as biological leaching (bioleaching) takes place in the second tank. During this process, soluble substances, i.e. acids and soluble sugars, are leached from the non-degradable structural substances. Subsequently, these soluble intermediary products are transferred to a third tank which resembles a filter in which the organic acids are converted into methane. It is expected that the methane content of the biogas produced with the new type of plant will be up to 40 per cent higher than is currently possible using one-stage biogas plants.

## More flexible, purer, quicker

The separation of fermentation and methanogenesis makes the biogas plant more flexible. "The obvious goal is to increase the range of substrates and increase the quantity of methane produced in Germany without needing to use land that can be used for other purposes," said Andreas Lemmer. In addition, the biogas plant can be used for the production of fuel from structural substances. Another potential goal is the production of organic acids. Lemmer concludes that the new type of biogas plant will become a module that is both flexible in terms of substrates used and final products.

Another advantage of the new biogas plant is the shorter processing time. For example, the

degradation of grass in one-stage fermenters takes between 70 and 100 days. In future, this will only take 18 to 25 days. Andreas Lemmer explains that the more rapid degradation becomes possible by adapting the pH values to the conditions in any of the three tanks. "Fermentation works best at a pH of 5.5; the formation of methane works best at a pH of 7 to 8. We are also able to adapt the temperature to the individual requirements of the groups of microorganisms used." The third tank (biological leaching) is used to strictly separate the other two biological processes in order to produce methane that is as pure as possible in the methane reactor.

## Background: Research heavyweights

Researchers at the University of Hohenheim acquired around 26 million euros in third-party funds in 2009, which is around 20 per cent more than in the previous year. The "Research heavyweights" series will provide outstanding research projects with a third-party funding volume of at least 250,000 euros (125,000 euros in the economic and social sciences).

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### Press release

25-Mar-2010

Source: Universität Hohenheim (16.03.10)