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FiB
Bioenergy research



Fighting over biomasses

The fight over available biomasses has increased significantly in recent years; however, the possibilities of increasing the bioenergy production and obtaining better environmental circumstances are still good.

A growing demand for biomasses for energy production purposes is far from unproblematic. Along with various environment protection organisations, the UN has repeatedly issued warnings stating that we are approaching the limit as to how much land we can reserve for energy production. Cutting of trees in the rain forest is becoming an increasing problem and in the long run, dramatic price increases within the markets of corn and maize, amongst other things, might lead to food shortages and poverty in large parts of the world.

Hence, biomasses constitute a limited resource that must be used carefully. On the following pages, a number of researchers present their suggestions on how we might increase the amount of biomass available for energy production whilst maintaining a sustainable agricultural industry.

The good news is that this is easily done. If done sensibly, we can increase the production of renewable energy significantly and improve the environment at the same time.

Today, livestock manure makes up a substantial resource. By focusing on perennial crops, the agricultural industry could increase its contribution to energy supplies fivefold without jeopardising the main role of the Danish agricultural industry as a producer of forage and foodstuff. This is the main conclusion presented in a report written by a group of researchers for the Danish Ministry of Food, Agriculture and Fisheries. The report is discussed in detail on page 3.

Renewable grass from meadows is just one example of a currently unexploited resource. By harvesting the grass and using it in biogas plants, we are able to more than double the Danish production of biogas, at the same time removing nutrients from environmentally sensitive areas. Henrik Bjarne Møller and Lisbeth Nielsen discuss this issue further on page 6.

Finally, we look at the question of utilising algae such as sea lettuce in the production of biogas and ethanol. The potential is enormous but it will probably be several years until we are able to turn this particular theory into practice. Read more about this on page 7. *TS*

Agriculture has the ability to increase bioenergy production fivefold

Recent research shows that our farmers would be able to increase their bioenergy production fivefold; however, this must be done carefully. Perennial crops for power planted heat production constitute the way forward if we want to protect the environment and maintain sensible energy utilisation procedures.

By Torben Skøtt

A large part of the raw materials needed for future energy supplies are to be found in the countryside – they are produced by farmers and forest owners, who already cover almost 12% of our current energy consumption. This is almost five times as much as what we obtain from wind power. Bioenergy constitutes the largest source of renewable energy by far, making up 15% of our total energy supply.

But are we able to keep using the resources of the Earth for energy production purposes if we also need to reserve sufficient acreage areas for food, forage, forests and nature? Nowadays, many people doubt that using agriculture produce in the production of biofuels, as an example, is still justifiable; however, according to a recent report from the Danish Ministry of Food, Agriculture and Fisheries, we would in fact be able to increase the agricultural energy production fivefold without jeopardising the main role of the Danish agricultural industry as a producer of forage and foodstuff.

Bioenergy benefits the environment

– We have identified two large areas of potential; firstly encouraging the utilisation of livestock manure in the biogas production and secondly making the farmers go for perennial crops such as willow and elephant grass instead of corn, says senior researcher Uffe Jørgensen from the Faculty of Agricultural Science at the University of Aarhus. He is one of several experts behind the recent report from the Danish Ministry of Food, Agriculture and Fisheries, and he believes that using biomasses for energy purposes carries a range of positive side effects.

– This is a unique possibility of increasing the production of renewable energy, at the same time improving the environment by selecting the right kind of crops, explains Uffe Jørgensen. He recons that agriculture would be able to reduce nitrate emissions by around 18,000 tons per year by increasing the production of biogas and dedicate 15% of their corn areas to perennial energy crops. In this way, we would be close to reaching the goal of reducing nitrate emission levels by 21,000 tones per year as defined within the Danish Action Plan on the Aquatic Environment III.

Answering the question of whether an increased bioenergy production might lead to environmental problems, Uffe Jørgensen says:

– In the long run, and if we remove large amounts of biomasses, we might face the challenge of having to re-establish a sensible carbon content in the soil. Whereas planting substitution crops and using perennial crops will increase the carbon content, one-year crops have the opposite effect. This is why we mainly have to focus on selecting the right kind of crops and using sensible cultivation methods that require a minimum amount of soil movement.

According to Uffe Jørgensen, the carbon content is not reduced overnight; however, the results of current cultivation methods will show in 50 to 100 years.

photo: torben skøtt/biopress

If we want to protect the environment and increase agricultural bioenergy production, biogas and energy willow must be part of the main solution.

Generally, soil in Jutland has a very high carbon content, whereas several areas in eastern Denmark are approaching the limit as to what is deemed justifiable. This variation is explained by the fact that Zealand has a limited number of livestocks and pastures but a significant production of corn and straw.

Select biogas and power planted heat

The report from the Danish Ministry of Food, Agriculture and Fisheries once again points out that we obtain the largest amount of energy and the biggest environmental advantages by producing biogas and power planted heat. Biogas production leads to an unusually high level of greenhouse gas displacement, facilitating the collection of methane produced within the manure tanks. Furthermore, thermal gasification of biomasses has a great potential.

On the contrary, researchers are not impressed by the large amounts of corn and maize based biofuels produced by the EU, and to an even greater extent by the USA. Such energy production measures are completely unsustainable and in no way a feasible competitor to the South American ethanol production based on sugar cane, the report says. Brazil is still the only country in the world producing bioethanol that is able to compete with fossil fuels, and it displaces almost three times as much CO_2 as corn-based ethanol from the USA and the EU.

Finally, biofuel production based on residual products and waste is currently the subject of intensive research efforts. Such production measures would probably also lead to an energy balance and certain environmental effects similar to those fostered by ethanol production based on sugar cane; however, the economics behind advanced second-generation plants are still to be fully explored.

Become a vegetarian

In coming years, researchers are expecting a globally increasing demand for forage and foodstuff based on population growth and increasing prosperity. The latter is mainly expected to happen in a number of densely populated and currently economically developing countries within the third world, e.g. China, India and Brazil. This increase in prosperity is expected to lead to a growing consumption of animal foodstuff such as meat and milk.

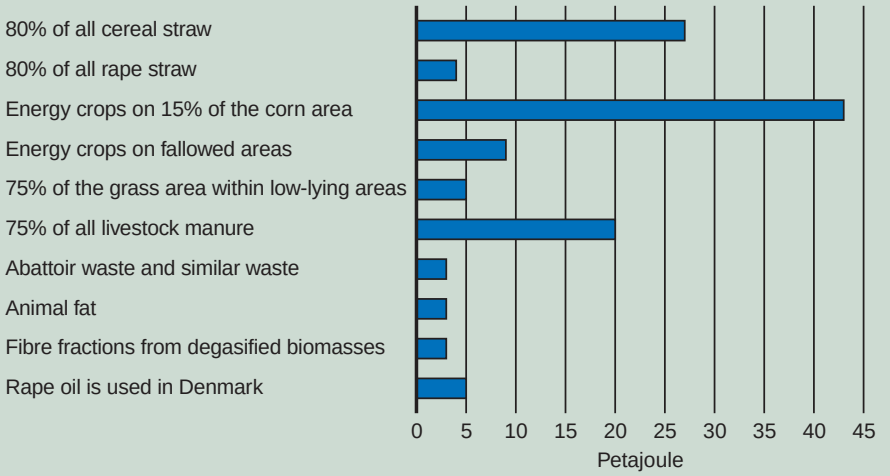


Figure 1.How to get more energy from agriculture. Researchers recon that within the next few years, the agricultural industry will be able to produce 122 PJ of bioenergy. Today, the production amounts to around 27 PJ, of which 19 PJ are based on straw, 4 PJ stem from biogas, and the rest from all other areas.

As meat belongs to the heavy end of the CO_2-production scale, such developments might foster a significant increase in greenhouse gas emission levels. Several research reports highlight that whereas one kilo of meat leads to an average emission of more than three kilos of CO_2, a kilo of vegetables is linked to just 0.1 kilo of CO_2. The main sinner is beef - up to 27 kilos of CO_2 from one kilo of beef – whereas chicken meat places much less strain on the environment.

Calculations show that if all Danish families introduced one meatless day a week, we would save 240 tons of CO_2 per year. This is the amount of CO_2 emitted by 24,000 Danes each year.

The blue biomass

Neither does the report from the Danish Ministry of Food, Agriculture and Fisheries deal with forestry biomasses, nor with the so-called blue biomass from the sea. The latter is practically not being utilised for energy production although several researchers point out that biomasses from the world seas contain substantial resources that would contribute significantly to energy supplies in the long run. Whereas a close connection often exists between agricultural and forestry biomass productions, blue biomass has its own cycle. Thus, it makes little sense to increase the production of agriculturally-based energy production if this happens at the expense of forest areas - something often witnessed in the third world.

According to FAO, the western world planted 8.8 million hectares of forest from 1990 to 1995, but during that same period, the forest areas in the third world were reduced by around 65 million hectares. This scenario usually occurs because individual countries want to increase their production of agricultural crops. Look at Brazil as an example. In Brazil, the agricultural areas have been tripled over the last 30 years, mainly in an effort to cope with a growing demand for bioethanol.

– Cutting of trees in the third world is a big problem but the western world must be careful not to act too self-righteously, says Uffe Jørgensen. He completely understands that the third world has to be included in the plans on limiting greenhouse gasses, but he also points out that unrealistic demands lead to nowhere. ■

Facts on perennial crops

Opting for perennial crops carries several advantages. Compared to one-year crops such as corn and rape, perennial crops lead to:

- 70% less nitrate emission
- 60% less consumption of pesticides
- 60% larger reduction of greenhouse gasses

Grass is true green energy

– and it doubles the biogas production

photo: det jordbrugsvidenskabelige fakultet, århus universitet

Grass stemming from meadow areas has the ability to more than double biogas production and the resulting energy balance is significantly better than when using traditional agriculture crops such as maize and corn. At the same time, nutrients are removed from sensitive areas, which would otherwise probably just end up being turned into forest.

By Henrik Bjarne Møller and Lisbeth Nielsen

Senior researcher Henrik B. Møller next to one of the plots used in the testing of meadow crop utilisation, carried out by the University of Aarhus.

We are witnessing a growing interest in the utilisation of energy crops in biogas plants for the purpose of increasing the content of solid matters and speeding up the gas production. Additionally, an increasing number of areas featuring renewable grass are becoming available: these areas are no longer pastured but need to be taken care of in order to avoid them being turned into forest.

If the grass is regularly harvested, significant amounts of nutrients can be removed from environmentally sensitive areas. This means that considering nature conservancy and energy production as being two parts of the same issue will be most advantageous. We are still, however, faced with a range of unanswered questions on economy, output and feasible operating strategies, which is why a project within the University of Aarhus, featuring the National Environmental Research Institute, Denmark (DMU), DTU-Risø, Brandstrup Consult and the company Natlan, has been initiated.

Amongst other things, the project has seen a number of practical tests within the meadows on Fussingø in 2006 and 2007, analysing the following operating strategies:

A. Early harvest on June 10th followed by pasture.
B. Late harvest on July 15th followed by pasture.
C. Early harvest on June 10th followed by another harvest on August 25th.
D. Late harvest on July 15th followed by another harvest on September 15th.
E. Early harvest and addition of potassium vinasse, a by-product from the production of alcohol and yeast that has been approved by the Danish Plant Directorate for utilisation in organic farming. Around 115 kilos of potassium and around 3 kilos of nitrogen were added per hectare.

These operating strategies were compared to plots without grass harvesting and pastured plots.

Biogas output

The harvesting strategies were analysed using small plots of 140 – 365 m^2. Plot sizes depended on whether or not the plot was to be used just for harvesting or pasture or a combination of both. For those strategies involving pasture or harvesting, the plots would constitute a part of a larger pasture area.

The grass on each individual plot was harvested, weighed and removed. Afterwards, tests were carried out in order to determine biogas output and the chemical composition.

Figure 1 depicts how much (as a percentage) of the theoretically possible biogas output that can be reached through 90 days of digestion in an experimental reactor involving biomass degasification in portions. The figure shows that almost all strategies led to an output of more than 50 percent. Generally, 2007 saw a slightly lower biomass decomposition and by delaying the first harvest from June to July, the decomposition output was reduced by more than 20 percent.

Amongst other issues, these results must be seen in the light of maize ensilage, which when harvested under optimal conditions provides an output of 85 – 90 percent of the theoretically possible gas output in practice. Although the output level is much lower than that of maize, most biogas plants managers are still expected to be interested in purchasing the grass as long as its price reflects the lower output level.

A feasible energy balance

Looking at the total energy output is a vital part of evaluating the feasibility of grass utilisation in biogas plants, and a comparison of individual strategies (see figure 2) points to some rather large differences. Potassium fertilisation through vinasse seems to have a very positive effect on the energy potential, more or less doubling output in comparison to areas that have not been treated with potassium. The output difference between the two localities using strategy D is down to different nutrient contents within the soil.

Those plots fertilised with potassium present a biogas output similar to that of intensively cultivated maize fields. Another interesting fact is that such plots have a far more feasible energy balance. Thus, cultivating grass that has been treated with potassium results in an energy balance twice as good as that of maize cultivation, the reason being that much less field work and artificial manure is required for grass as for maize. Furthermore, energy production based on grass areas does not get in the way of foodstuff production as a large part of the areas in questions are currently not being used anyway.

photo: det jordbrugsvidenskabelige fakultet, århus universitet

The grass from each individual plot was weighed and subsequently, samples were collected with a view to define biogas output and chemical structure.

Environmental feasibility

Apart from analysing energy-relevant aspects, the project also evaluated the possibility of removing nutrients from the areas in question. Some areas contain a high level of nitrogen and phosphor, in parts stemming from cultivated farmland. By harvesting biomasses, such nutrients are removed so that they can no longer harm the local aquatic environment.

The tests carried out at Fussingø show that significant amounts of nitrogen can be removed through biomasses (see figure 3). Whereas the addition of potassium vinasse makes it possible to remove close to 200 kilos of nitrogen per hectare per year, only 150 kilos of nitrogen is removed per hectare per year without the use of potassium.

By harvesting the grass twice, some 10 – 20 kilos of phosphor is removed per hectare per year, whereby those areas fertilised with potassium show the biggest reduction. As a comparison, pasture without the addition of potassium leads to around 8 kilos of nitrogen and 2 kilos of phosphor per hectare being removed per year. Harvesting the grass, rather than pasturing it, thus leads to a much more efficient nutrient removal process.

Twice as much biogas

In Denmark, 102,000 hectares of meadow have been designated as “fresh meadows” in accordance with § 3 of the Danish Nature Conservancy Act. These areas are to be kept natural. Additionally, quite a few ▶

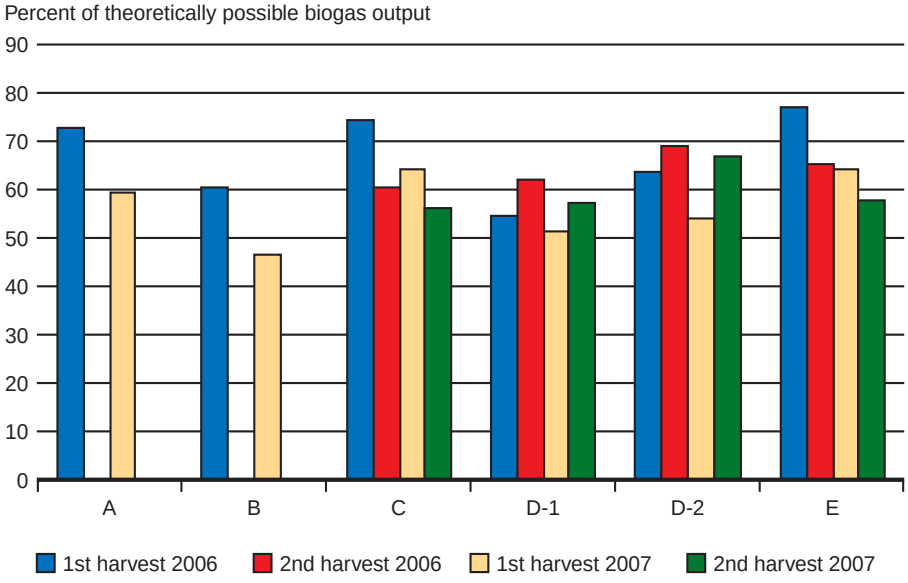


Figure 1. Biogas output for grass after 90 days of mesophilic digestion in an experimental reactor involving biogas degasification in portions. Output is defined as a percentage of the theoretically possible biogas output from 430 litres of methane gas per kilo of organic solid matters. For strategy D, the output has been registered for two different localities.

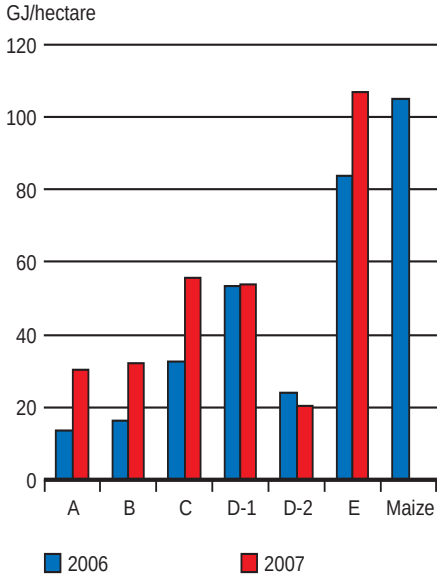


Figure 2. Biogas energy production based on grass and maize respectively. The energy consumption for fertilisation and field work has been deducted.

photo: det jordbrugsvidenskabelige fakultet, århus universitet

Harvesting and collecting grass from the meadow areas by Fussingø.

currently fallowed stream areas could most probably be harvested in order to obtain grass for biogas production and finally, a number of areas close to salt meadows, as an example, also contain biomasses suitable for energy production purposes.

Defining exactly how many hectares of land would be suitable for biomass harvesting is very difficult; however, around 100,000 hectares is deemed a realistic guess. Assuming that harvesting twice a year would result in a total energy output of 50 GJ/hectare, those areas would support the production of 5 PJ biogas per year. This is more than the current biogas production stemming from agriculture, treatment plants and waste dumps, which account for a total of around 4 PJ per year.

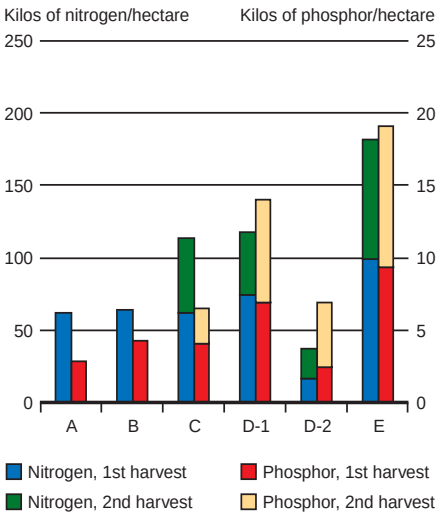


Figure 3. Removal of nitrogen and phosphor from renewable grass on meadow areas when using various operating strategies.

Biomasses derived from such meadow areas would be an efficient means of reducing CO_2 emission without getting in the way of food production. Additionally, large amounts of nutrients would be removed from environmentally sensitive areas, and such nutrients would in turn substitute artificial manure or facilitate organic crop production in a way that would make it independent of the currently used conventional livestock manure.

It only makes sense, however, to apply potassium vinasse to meadows featuring relatively high levels of nitrogen and phosphor within the soil and furthermore, no manure is to be applied to areas of a botanically high nature quality.

We are left with a range of unanswered questions on how to make meadow biomasses available to biogas plants in practice, including harvesting, storage and transport planning issues, as well as biomass billing details. Several of those questions make up the focus of the last phase of the project.

Henrik Bjarne Møller is a senior researcher at the Faculty of Agricultural Science at the University of Aarhus and Lisbeth Nielsen is a consultant at Natlan in the Agro Business Park. *The project relies on support from an innovation project as well as an organic project (BioConcens), granted by the Danish Ministry of Food, Agriculture and Fisheries.*

USA wants grass-powered cars

According to a new American large-scale research project, grass has the potential of improving environmental accounts significantly.

It has been mentioned on several occasions but now it is certain: switch grass – used for ethanol production – renders five times as much energy as it takes to cultivate it. As a comparison, maize, for example, supplies just around 25 percent more energy than what is required for its production. This is the result of an American large-scale research project based on actual numbers from ten farmers, who have harvested switch grass on their marginal land. Previous projects pointed in the same direction; however, never before have the results been based on practical tests carried out during a period of five years in cooperation with a group of farmers.

In this way, grass lends bioethanol a better image, and given the increasing prices of corn and maize, it might even turn out to be a good deal – especially if the different varieties are processed to obtain higher output levels. In comparison to the work on corn and maize, having resulted in significant output increases throughout the past 40 – 50 years, very little effort has been put into the processing of grass.

Nowadays, grass renders a much lower output than maize; however, as establishing, fertilising and harvesting grass requires only a minimal level of energy consumption, it turns out to be both economically and environmentally very feasible.

American life cycle evaluations show that if grass is utilised for ethanol production, CO_2 emission levels can be reduced by as much as 94 percent compared to the use of fossil fuels.

Switch grass does not thrive in Denmark, and the American research project also shows that output is highly dependent on where the grass is harvested.

Source: The magazine "Proceedings of the National Academy of Sciences".

A research project headed by the Danish Technological Institute sets out to find out whether or not it is practically and economically possible to exploit the enormous biomass potential contained in sea lettuce. Ideally, we would produce biomasses, receive CO2 from the power plants and buy manure from the agricultural industry all at once.

photo: michael bo rasmussen, dmu

Algae soup might be the fuel of the future

By Torben Skøtt

When considering the size of the biomass resources available for energy production, we are faced with a new concept: blue biomass, also called marine biomass. This notion basically includes everything living from within the sea as long as it contains organically attached carbon. Whereas researchers outside Denmark tend to focus on micro algae, the Danish researchers are more interested in macro algae such as sea lettuce.

Blue biomass is extremely interesting for a number of reasons: first of all, it carries an enormous potential; secondly, there are no food and energy production conflicts involved and thirdly, it features the possibility of utilising excess nutrients from agriculture and CO_2 from power plant waste gasses.

Obviously, it is not as simple as that. The practical issues might turn out to be complicated to solve and at this stage, there is no way of knowing just when the first plants will be ready to be taken into operation.

Almost a year ago, Michael Bo Rasmussen from the National Environmental Research Institute, Denmark, presented the idea of utilising sea lettuce for energy production purposes and recently, Energinet.dk granted DKK 8.5 million to a consortium charged with the task of exploring this idea further.

– We need to define each individual process in order to obtain a constantly substantial growth, says biologist Peter Daugbjerg from the Danish Technological Institute. He has been chosen as project leader and, cooperating closely with researchers from the National Environmental Research Institute, Denmark; Risø as well as Dong Energy, he will be spending the next few years trying to find out whether or not it is practically and economically feasible to exploit this alternative biomass potential.

Use CO_2 and manure

Sea lettuce doubles its growth within 2-3 days. Whereas application of nutrients and CO_2 speeds up this growth, cold and lack of light slow it down. At the National Environmental Research Institute, Denmark, a range of laboratory-based tests will now be carried out in order to find out how to optimise the process and put the results to use on a larger scale. Ideally, we would produce vast amounts of biomass, receive CO_2 from the power plants and assist the agricultural industry in getting rid of excess manure all at once.

All in all, it seems feasible to produce algae in connection with power plants as they will be able to deliver excess heat and CO_2 and perhaps even utilise some of the biomasses as fuel instead of coal.

Alternative experiences

Outside of Denmark, a range of research projects on utilising algae for energy production purposes are being carried out; however, these projects tend to focus on micro algae used for biodiesel production. Shell is currently building a pilot plant on Hawaii and on www.greenfuelonline.com, you can witness a range of interesting tests on utilising CO_2 from power plants to increase micro algae growth.

In Denmark, Højbogaard Biogas carried out tests on utilising sea lettuce from the Inlet of Odense back in 1983 and a few years ago, Thorsø Biogas tried utilising grass weed from the stream Nørreåen for a while. They quickly gave up on that idea, however, because of quite a few practical problems, including various foreign objects in the biomass and a content of solid matters way too low to create any type of significant contribution.

In 1998, PlanEnergi carried out a literature search on algae as ordered by the Danish Energy Authority. That study contains interesting information on the use of algae as it has emerged through history, as well as a range of practical tests harvesting algae in the Inlet of Odense. ■

EnergiForsk2008

June 12th 2008 at 9.30am
"Ingeniørhuset" Copenhagen

On June 12th 2008 at 9.30am, the energy research programs will be presenting their results at a conference taking place in "Ingeniørhuset" in Copenhagen. This year's themes are:

- Transport and energy
- Management, adjustment, and Intelligent Electricity Consumption
- Energy materials
- Comfort of homes and buildings

The conference is held by the Danish Energy Authority, the Danish Council for Strategic Research, Dansk Energi and Energinet.dk.

You may register for the conference at www.danskenergi.dk

The company Gosmer Biogas has always had a mind of its own and is known for its simple and reliable plans based on gasification of livestock manure. Now, biogas production procedures are to be integrated into natural manure separation and degasification of fibre fractions. The picture shows one of the company's biogas plants located at Korinth Agricultural School on Funen.

photo: torben skøtt/biopress

Farm biogasses featuring new manure separation technique

Not only will future farm biogas plants produce gas, they will also have the ability to separate manure and convert the solid fraction for energy production purposes. This is the idea behind a new concept for farm biogas plants, which the company Gosmer Biogas will fully develop based on a grant.

photo: torben skøtt/biopress

Master smith Jens Pedersen (left) and the chairman of Gosmer Biogas, the farmer Svend Åge Pedersen.

By Torben Skøtt

The Danish Ministry of Food, Agriculture and Fisheries, along with the EU, would like to have more farm biogas plants in rural areas and for this reason, they have recently granted DKK 550,000 to the village Gosmer in eastern Jutland, where an exciting development project has been initiated. This is the most recent development project to be selected by the Danish Ministry of Food, Agriculture and Fisheries, the reason being that it contains sufficient novelty value to obtain a grant from the Rural Areas Program.

The project is headed by the company Gosmer Biogas Aps, created in 1992 by a group of pig breeders, a fitting contractor and the creative master smith, Jens Pedersen, who had been working on the development of simple and stable farm biogas plants for several years. Throughout the years, the company has presented numerous inventions focusing on technology simplification and the creation of stable and reliable plants.

As opposed to other suppliers, Gosmer Biogas has never attempted to optimise the gas production by applying external waste; on the contrary, the company has always considered the biogas plants as being purely environment-based plants, providing the farm with sufficient energy by means of livestock manure possibly supplemented by limited amounts of energy crops.

The first plant was established along with a power plant; however, Jens Pedersen quickly realised that the income from electricity sales would far from cover the substantial operational costs of keeping the gas engines running. Therefore, all subsequently established plants are only equipped with a gas furnace, and the number of pumps, valves and rotors has been reduced to the bare minimum.

Natural separation

The new plant, to be developed by Gosmer Biogas, will not only produce gas; it must also have the ability to separate degasified manure. In this way, the farmer will apply only the thin slurry to his fields, thereby reducing the requirements as to how much acreage is needed per property, and allowing an extended livestock production. Additionally, the solid fibre fraction can be utilised for energy production purposes by burning it in a stoker furnace or by using the fibres in a thermal gasification plant.

– Everything will become slightly more complicated but we need to accept the fact that farmers prioritise manure separation, not biogas production, says Jens Pedersen. He is, however, deter-

mined to select the simplest solutions possible, which is why manure will be separated by means of natural separation – a completely new concept.

– There will be no need for chemicals, centrifuges or other types of expensive hardware. Our plant is constructed in a way that allows separation to take place in a natural way by means of sedimentation, explains Jens Pedersen.

In the next few months, the system will be tested at the company test plant in Gosmer and if everything goes well, it will then be integrated into a new plant under construction by Gosmer Biogas in Malling south of Aarhus.

Burning or gasification

The next development phase will be concerned with the utilisation of the solid fraction for energy production purposes. Initially, the fibres will be burned in a stoker furnace; however, in the long run, the people in Gosmer are looking to put the fibres to use in a thermal gasification plant.

– Technically seen, this is easily done and considering the fact that gas is worth more than heat in several respects, it would be the right long-term solution, explains Jens Pedersen.

In the light of the additional gas production, utilising the gas for power planted heat becomes increasingly interesting and considering the latest electricity price increase of DKK 0.15/kWh, Jens Pedersen is now more and more determined to create electricity-producing plants.

– This is no money spinner but it is reasonably feasible, and the resulting electricity would contribute to making agriculture a truly green industry, says Jens Pedersen. He is expecting the fibre burning plant to be ready for testing next summer. Only then will focus be shifted to fibre fraction gasification.

Apart from works on the Malling plant, Gosmer Biogas is also trying to sell a plant to a farmer in Sorø; however, according to Jens Pedersen, establishing biogas plants in Denmark is very difficult because the municipalities are extremely uncertain when it comes to dealing with such projects.

Gosmer Biogas has already delivered biogas plants to Poland and negotiations on a plant for a large pig breeding farm in Vietnam, involving more than 14,000 sows with piglets, are currently going on. ■

DKK 50 million for biofuels

photo: torben skøtt/biopress

By establishing a demonstration plant in Kalundborg, the IBUS project developments, headed by DONG Energy, are now entering the next phase.

Recently, the Danish Energy Authority awarded DKK 50 million to two projects with a view to facilitating ethanol production based on waste and residual products from agriculture. The funds were taken from the Globalisation Fund, through which DKK 200 million have been earmarked for demonstration of second-generation biofuels.

The BioGasol project located on the island of Bornholm and DONG Energy's project located close to Kalundborg will be sharing the initial DKK 50 million coming out of the total Globalisation Fund money pool of DKK 200 million, which is to be distributed amongst biofuel projects over the next four years. BioGasol has been awarded DKK 27.5 million and DONG Energy has received the remaining DKK 22.5 million.

The BioGasol project, known as Born-Biofuel, is expected to be ready by the end of this year and be fully developed at the time of the climate summit in 2009. It will be a flexible plant processing residual products from agriculture, garden waste, straw and grass for bioethanol, biogas and biopellets production purposes. Self-sufficient in terms of energy, the plant will also feature a closed system that will be able to re-use the process water.

– BioGasol has developed world-leading technologies in the area of second-generation bioethanol, and these developments are now entering the next phase, says Professor Birgitte K. Ahring, managing director at BioGasol. She appreciates the money; however, an even larger sum would have facilitated even further developments. At a price of around DKK 275 million, BioGasol will still have to find additional funding to cover the costs of establishing the Bornholm plant.

The plant Asnæsværket

The other project, headed by DONG Energy, involves a demonstration plant in the town of Kalundborg for production of second-generation bioethanol, also expected to be ready for the climate summit in 2009.

The plant, established in co-operation with Statoil, Danisco and AgBioEnergy, will be placed adjacent to the plant Asnæsværket. Here, a yearly production of 17,600 m^3 bioethanol, 24,000 tonnes of animal forage and 10,500 tonnes of solid biofuels will take place, using raw materials consisting of 30,000 tonnes of straw and 30,000 tonnes of feed wheat.

Danisco Genencor will be supplying the enzymes, and DONG Energy is expecting to be able to sell the ethanol to the Statoil refinery in Kalundborg where it will be used in the production of Bio95, which consists of 95 percent fuel and 5 percent ethanol. The solid biofraction resulting from the production process will be used by DONG within the plant Asnæsværket for the production of electricity and heat that will be used in the bioethanol plant at a later stage. In this way, the ethanol process becomes self-sufficient in terms of energy. *TS*

DONG: We need biorefineries

Even recent years' extremely hard criticism of biofuels has not made DONG Energy tremble; they are convinced that we are going to need modern biorefineries that utilise biomasses for a variety of purposes.

photo: torben skøtt/biopress

The managing director of Inicon presents the IBUS plant in Skærbæk to the Federation of Energy and Environment Jounalists. The new plant will be located in Kalundborg.

By Torben Skøtt

– Biomass accumulation by means of photosynthesis is a unique process allowing nature to create a range of complex substances. In many ways, it is a real shame to ruin all that just by striking a match, and such actions do not lead to optimal resource utilisation. Those were the words of Niels Henriksen from DONG Energy at a seminar for energy journalists held in February. Niels Henriksen is a business developer at DONG as well as recently appointed managing director of the subsidiary Inbicon, a company focusing on advancement and commercialisation of the IBUS technology.

IBUS stands for Integrated Biomass Utilisation System, which is also the core of the project. This is not just a bioethanol production plant; it is a concept allowing all parts of the biomass to be put to efficient use for a variety of purposes.

– Our area of core expertise is biomass processing. Initially, we will be focusing on straw; however, we are planning to advance into all types of biomass and waste, said Niels Henriksen.

Three fractions

The first processing phase involves boiling the material at high pressure. Afterwards, enzymes are added, basically doing the job of small "nano-scissers" that separate the material into three fractions: cellulose, hemicellulose and lignin.

The cellulose fraction is the easiest fraction to convert into ethanol by simply applying enzymes and yeast. If the right enzymes and microorganisms are used, hemicellulose can also be converted into ethanol; however, this is a slightly more complicated process and not one that the people at Inbicon will be focusing on. Instead, they are going to invite those research institutions possessing sufficient experience in that area to test their organisms at the Kalundborg plant.

Finally, using lignin as fuel involves the challenge of creating a clean fraction without alkalisalts in order to be able to use the fuel on a larger scale within existing power plants. Currently, only up to ten percent of the coal can be substituted by straw; however, by utilising "cleaner" biofuel, the amount of straw used in power plants would increase significantly, facilitating the use of the resulting fuel within the new highly efficient plants.

Strong partners

– We are currently focusing more on bioethanol but basically, it all boils down to coming up with a more sensitive way of using our resources by means of advanced technology. Once we can handle processing, we can start adding on various "building blocks" onto the system. Bioethanol is just one of many possibilities such as fuel, forage, manure and, in the long run, plastic bags, clothing and many other products.

– It is going to take some strong partners to make all the pieces fall into place but fortunately, Denmark has a large pool of companies and research institutions interested in taking on this task, says Niels Henriksen.

He also points out that the larger perspectives are to be found outside of Denmark, where power plants often feature a total efficiency level of around 35 percent because they do not utilise the waste heat. By combining electricity production with fuel and forage production, that level of efficiency may increase to just above 70 percent, more or less equalling that of a CHP plant.

– The perspectives entailed in the IBUS concept are far more extensive than those of power planted heat because being able to produce fuel is worth more than the ability to produce hot water. As we become better at isolating our homes and identifying alternative means of heating, the advantage of power planted heat decreases and the overall interest in our IBUS project increases, Niels Henriksen points out. ■

	Input	Output
Straw	57,6 GJ	
Ethanol		16,0 GJ
Feed		15,0 GJ
Fuel		10,1 GJ

The energy balance of the demonstration plant in Kalundborg that will be able to treat 4 tonnes of straw per hour, equal to 57.6 GJ. The total output will be 41.1 GJ per hour, amounting to an energy efficiency level of just over 71 percent.

DONG: Taxes make up the biggest barrier

When it comes to developing second-generation biofuels, energy taxes make up an enormous barrier: the ethanol tax relief turns out to be marginal compared to that of hot water production.

By Torben Skøtt

– It simply makes no sense. On one hand, DKK 200 million is earmarked for the development of second-generation bioethanol but at the same time, the tax system clearly favours hot water production as opposed to the production of bio fuels, said Knud Pedersen, vice president of DONG Energy and former CEO at the Danish Energy Authority. During a seminar for energy journalists, held in February, he made no secret of the fact that the current tax system in Denmark constitutes a true hurdle when it comes to putting Danish biofuels research results to use.

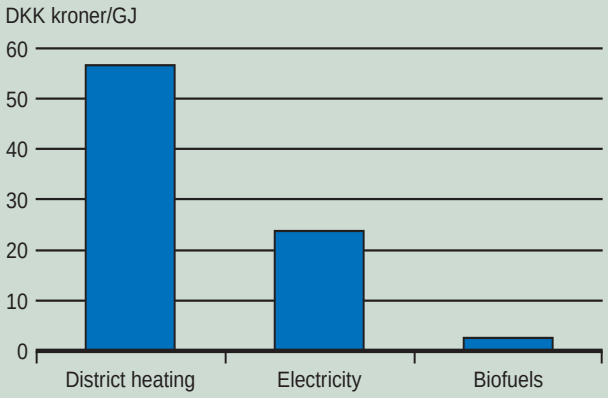
– Making people understand this problem is extremely important. If our politicians believe that energy research results are to be used in this country, they need to create the incentives needed to make companies invest in the technology, said Knud Pedersen.

He also has misgivings about the politicians beginning to "turn the technology into political issues", as he named it, pointing to the fact that grants are now earmarked for certain technologies.

– Our politicians ought to define the overall goals and then create the framework required to reach those goals. The rest should be left to researchers and industry to deal with, said Knud Pedersen.

According to calculations carried out by DONG, the tax relief on biomass-based district heating equals an indirect subvention of around DKK 56/GJ. Electricity production is subsidies by around DKK 24/GJ, whereas biofuel production is supported by just DKK 2.50/GJ.

The difference is due to different rules applying to the kind of production in question. Biomass-based district heating carries no taxes whatsoever; on the contrary, a direct subvention per kWh can be deducted and an indirect exemption subvention by means of buying CO_2 quota is also available. Bioethanol is exempt from the CO_2-tax of DKK 0.22/litre but carries energy taxes of no less than DKK 3.85/litre ■



Direct and indirect subvention of district heating, electricity and transport fuel production based on biomasses. Source: DONG Energy

USA wants to implement Danish technology

A consortium consisting of the Danish company BioGasol and the American ethanol production company Pacific Ethanol has been granted US$ 24.3 million by the American energy agency.

BioGasol's technology will now be demonstrated in connection with an already existing ethanol factory owned and run by the company Pacific Ethanol in the town of Boardman, Oregon, on the American west coast. This factory will be the first ethanol factory in north-western USA to produce ethanol based on cellulosic biomasses. The demonstration plant will be producing 10 million litres of ethanol as well as 10,000 tonnes of fuel pellets per year and also, the plant will see a production of biogas that in turn will be used to run the entire plant.

Managing director at BioGasol, Professor Birgitte Ahring, named the DOE grant a tremendous and international recognition of BioGasol technology.

– This project constitutes a vital step in our efforts to commercialise our technology on the vast American market for second-generation bioethanol. We are expecting our ethanol to be sold at around one dollar per gallon, equal to DKK 1.37 per litre. Once the technology has been fully developed, our ethanol will be perfectly able to compete with oil-based transport fuels and other new liquid biofuels, says the managing director.

The largest ethanol producer on the American west coast, Pacific Ethanol currently has two ethanol factories in California and Oregon, and two new factories are being constructed. *TS*

Ethanol without enzymes

The American company Coskata has invented a new method of producing ethanol based on waste. Neither does this method require the use of enzymes, nor must the biomass be processed: it just has to go through a three-step process involving micro-organisms, amongst other things.

According to a company press release, a gallon of bioethanol is produced at the price of just one dollar, equal to DKK 1.28 per litre. This producer price is much lower than that of fuel, which is currently at DKK 3.20 per litre.

Coskata claims that their technology returns almost eight times the amount of energy required for its production. Furthermore, greenhouse gas emission will be reduced by 84 percent compared to normal fuel.

Source: www.coskata.com.

Wood chip felling in the plantation of Klosterhede between the towns of Lemvig and Struer. As is the case in western Jutland, particularly light sandy soil suffers when nutrients are removed along with forest floor wood chips. A new PSO project has now been initiated with a view to identify ways of maintaining a sustainable forestry industry whilst utilising large amounts of wood chips for energy production purposes.

photo: torben skøtt/biopress

Wood chip felling must not ruin the forest

Utilising CO_2-neutral fuel such as wood chips for energy production purposes is not sufficient. In terms of truly renewable energy, nutrient recirculation is required in order to avoid forest eco-system overload.

By Torben Skøtt

In recent years, the amount of wood chips utilised for energy production purposes has been on a steady increase, and the recently agreed energy settlement contains no signs of wanting to bring this development to a halt.

In many ways a positive thing for the environment, the forest eco-system reacts differently. When removing wood chips from the forests, a variety of nutrients are removed at the same time, thus creating a significant risk of impoverishing the soil and making it difficult for future generations to maintain a healthy and fertile forest.

– Worst case scenario is that at some point, we will have less forest because we overexploit forest resources in our eagerness to use CO2-neutral fuel, says senior researcher Morten Ingerslev from the institution Forest & Landscape. He is currently researching ways of maintaining a sustainable forestry industry whilst utilising large amounts of wood chips for energy production purposes.

Returning ashes to the forest

One possible solution is to return ashes from wood chip-firing plants to the forest. Currently, most ashes are deposited; however, the forest management agency of Thy has been distributing ashes throughout the forest as a test for years, and they have recorded such positive results that their system is now to be applied in other parts of Denmark.

– As a matter of fact, legislation is the largest hurdle to overcome, explains Morten Ingerslev. Ash distribution is to be carried out in accordance with the so-called "bioashes regulation" that outlines strict rules on the amount of ashes tolerated in any given area. The problem is that such ashes contain cadmium, a poisonous and in terms of nature very problematic heavy metal

– Wood chips always contain large or small amounts of cadmium so if ashes were returned to the forest, it would simply be like setting fire to the tree inside the forest. Ashes are not "polluted" at the plants but according to Danish law, returning residual products is only then allowed if they have been purified beforehand, explains Morten Ingerslev.

Whereas removing cadmium from the ashes is a technically possible, yet relatively expensive process, only returning the bottom ashes from wood chip-firing boilers would be another solution. Most of the cadmium is located in those ashes stemming from the smoke cleaning plant, i.e. by mainly distributing bottom ashes in the forest, adhering to the rules listed in the "bioashes regulation" would actually be possible.

A new executive order

Notwithstanding the cadmium problem, returning ashes to the forest floor is mainly advantageous. The ashes contain substantial amounts of nutrients needed by the forest, allowing a sustainable balance between removed and added nutrients to be obtained.

For years, the forestry industry has been dissatisfied with existing rules within this area and currently, the Danish Environmental Protection Agency is compiling a new executive order that will make it easier to recirculate wood chip ashes. This executive order will be very similar to the rules applied in Sweden, where wood chip ashes are much more widely used as a means of manure than in Denmark.

Morten Ingerslev is carrying out his research project supported by PSO funding, administered by Energinet.dk, and the results are due in 2010. ■

Seminar on business plans

March 27th 2008 from 9am to 5pm "Søhuset", Hørsholm

The new EUDP program entry requirements include an overview of both technical as well as business-related developments foreseen within the projects. If no business plan is submitted, the project will not qualify for a grant.

Having developed the commercial requirements on behalf of the EUDP secretariat, the company 1st Mile now offers a seminar on business plan writing for EUDP program applicants. The seminar has been put together in co-operation with the EUDP secretariat in order to fulfil their wish for high-quality applications.

The seminar starting point is the applicants own applications, due to arrive at the EUDP secretariat no later than April 11th 2008. One of the seminar goals is to provide the participants with an outline of the commercial part of their individual EUDP application, based on the knowledge gained.

Not only will this seminar raise the application quality by means of better competences and a better understanding, it will also save the participants a lot of time with regards to the wording of their applications, and increase the chances of obtaining a positive answer.

Program:

8.30am - 9am	Registration and morning coffee.
9am - 9.30am	Presentation of participants, seminar goals and the commercial criteria defined by EUDP.
9.30am - 11am	Group task: What if...? An exercise introducing the participants to a commercial way of thinking.
11am - 12.15pm	Case study: Identify the product and its value proposal. Following a short introduction, the participants will identify the commercial core of a case study.
12.15pm - 1pm	Lunch
1pm - 2pm	Commercial criteria defined by EUDP: presentation of the new EUDP requirements and their background.
2pm - 2.30pm	Walk-and-talk - and afternoon coffee
2.30pm - 4pm	Participant applications: Value proposal and business plan.
4pm - 4.45pm	Review of general experiences.
4.45pm - 5pm	Evaluation and round-off.

Practical information:

Price:	DKK 6,900 excl. VAT. Company group discount available.
Time:	March 27th 2008 from 9am to 5pm
Place:	"Søhuset", Hørsholm, Denmark
Registration:	www.1stmile.dk

1st Mile | Diplomvej 381 | DK-2800 Lyngby
www.1stmile.dk | ✆ +45 4044 6714

Fuel cells for gasification gas

Title:	33030-0036 – Integration of a SOFC fuel cell and the two-step process
Project manager:	COWI A/S, Jens Dall Bentzen, ✆ +45 4597 2211
Grant:	EFP – DKK 120,000

Part of a larger EU project task, this project involves tests on a SOFC fuel cell running on gas from five different gasification plants across Europe. Click on www.biocellus.de for a more detailed project description.

The Danish part of the project involved testing the fuel cell function when using gas from the so-called wiking-gasifier at the Danish University of Technology. The test was carried out in spring 2006 and the fuel cell was up and running for 168 hours at maximum output without any problems. The test was only terminated because the external partners responsible for the fuel cell had to leave the plant.

In comparison, none of the other four European gasification plants managed to surpass 48 hours of operating time. The reasons for the good results at the Danish University of Technology were most probably that the wiking-gasifier features an extremely stable operation and that it produces high-quality gas that contains neither chlorine, nor sulphur compounds.

photo: henrik flyver christiansen

The wiking-gasifier at the Danish University of Technology.

IEA biogas co-operation

Title:	33032-0004 – IEA Renewable energy technologies, bioenergy agreement: Task 37 – Energy from biogas and landfill gas
Project manager:	The bioenergy task group within the University of Southern Denmark in the town of Esbjerg, Jens Bo Holm-Nielsen, ✆ +45 6550 4166
Grant:	EFP – DKK 220,000

This project involves Danish participation in the International Energy Agency co-operation project on biogas and landfill gas throughout the years of 2006 and 2007.

Since 1997, the bioenergy task group at the University of Southern Denmark has been participating in the technical co-operation of IEA Task 37. The main goal of this co-operation is exchanging and imparting knowledge and experiences within the area of biogas production and utilisation, as well as co-operating with all other international organisations within the biogas industry.

Click on www.novaenergie.ch/iea-bioenergy-task37/index.htm. for more detailed information about the work of IEA Task 37. Furthermore, the bioenergy task group has ensured that any relevant information is made available to the Danish biogas industry through the website www.sdu.dk/bio.

Corrosion study at the plant Avedøreværket

Title:	6511 – High-temperature corrosion study of an AVV2 bioboiler
Project manager:	Dong Energy A/S, Peter Simonsen, ✆ +45 9955 1111
Grant:	PSO – DKK 6,800,000

The project was initiated based on the wish to increase the steam temperature to 580°C at the biomass-based part of the plant Avedøreværket. Existing results from corrosion studies at the plant Masnedø led to the assumption, however, that the risk of starting out at such high temperature would be too high.

The project involved monitoring corrosion developments in a variety of test superheaters, installed in the bioboiler, in order to identify the maximum superheater temperature. Furthermore, boiler corrosion developments throughout the initial years of operation were monitored, in turn making it possible to select the optimal steam temperature that would lead to the highest possible level of efficiency and the lowest possible level of maintenance costs.

photo: torben skott/biopress

Avedøreværket close to Copenhagen features an extremely high level of efficiency, not least because of the high steam temperature within the boiler.

IEA co-operation on biomass combustion

Title:	33032-0027 – IEA bioenergy agreement: Task 32 – Biomass combustion and co-firing.
Project manager:	FORCE Technology, Anders Evald, ✆ +45 7215 7700
Grant:	EFP - DKK 299,000

This project involves Danish participation in the International Energy Agency co-operation project on biomass combustion throughout the years of 2006 and 2007.

In practice, the IEA group co-operation consists of work meetings held every six months. Such meetings see the exchange of experiences, discussions of new developments as well as updates on and evaluations of ongoing research projects. Between meetings, lively exchanges of experiences take place by means of e-mail and telephone, the group website www.ieabcc.nl making up a central focus point.

Danish participants exchange their experiences through a network established for this particular purpose, through which the participants receive relevant material and post problematic issues that can be analysed through the IEA co-operation.

Optimisation of staged gasification plants

Title:	6530 – Optimisation and automation of a staged gasification plant
Project manager:	TK Energi A/S, Thomas Koch, ✆ +45 4618 9000
Grant:	PSO – DKK 2,267,895

Originally, the purpose of this project was to carry out long-term testing on a pilot plant for biomass gasification with a view to become experienced in long-term operation as well as component and operating system troubleshooting. The project was supposed to assist in developing the TK Energi staged gasification concept and support the establishment of a full-scale plant in the village of Gjøl in northern Jutland.

However, as the full-scale plant in Gjøl was in fact fully established before the pilot plant, the latter was never actually completed. For that reason, the project would no longer be a source of new knowledge with regards to the Gjøl project. TK Energi decided to terminate the project on the grounds of budget overrun and a lacking Danish market for that kind of technology. Neither long-term operation, nor component and operating system troubleshooting was carried out. No final report has been compiled; however, the last intermediate report is available from Energinet.dk.

Biomass and working environment

Title:	4774 – Biomass technology efficiency improvements and a good working environment
Project manager:	National Research Centre for the Working Environment, Anne Mette Madsen, ✆ +45 3916 5200
Grant:	PSO – DKK 1,800,000

The purpose of the project was to evaluate the working environment within biomass-based plants, including identification of those work processes featuring an unacceptably high level of endotoxin and microorganism exposure, and definition of suitable means of reducing such exposure.

Investigating working environments at no less than 25 biomass-based plants, the results showed the following:

- Staff members are subject to high levels of endotoxin and microorganism exposure.
- In some cases, the level of endotoxin and microorganism exposure is so high that symptoms of respiratory tract diseases are to be expected at some point in time.
- In general, no serious health issues were identified at straw-based CHP plants.
- Fungal allergies do not seem to be a big problem.
- The studies do indicate, however, that high levels of microorganisms in the air lead to more people developing symptoms of respiratory tract diseases. Therefore, lowering the exposure level would still be advantageous in health-related terms.
- Areas reserved for straw scarifiers and straw reception have been identified as high exposure areas.
- When bales of straw are uncovered, straw is being unloaded, straw is swept around using a broom, or when straw is being relocated, dust exposure levels increase markedly.
- Dust and microorganism exposure levels may be reduced by means of utilising a central vacuum system instead of a broom or by shielding off the straw scarifier.

Anne Mette Madsen is still available for presentations on project results.

New concept for district heating production

photo: torben skøtt/biopress

Title:	33032-0070 – Improved heat production method by means of waste gas cooling, wetting and condensation
Project manager:	COWI A/S, Jens Dall Bentzen, ✆ +45 4597 2211
Grant:	EFP – DKK 323,000

By applying a well-known industry technique, COWI has developed a completely new concept for waste gas cooling at district heating plants. This concept is expected to feature a variety of advantages compared to traditional plants, the most important ones being:

– No deposits in the waste gas cooler

– No corrosion in the waste gas cooler

– Higher level of efficiency (10 - 15 percent)

– NO_x reduction

– Low price

– Low maintenance costs

Within this concept, waste gasses from the boiler room are cooled down by means of injecting atomised water into them. Because of the high level of latent heat of evaporation within the water, the waste gasses are quickly cooled down whilst the water evaporates. Amongst other places, this technique is applied in the production of cement and glass in which waste gasses must be cooled down to 200°C in order for it to be purified before escaping into the environment.

By utilising the industry cooling technique within this new type of district heating plants, the vaporised water will turn into water again, at the same time giving off heat to the district heating water. In this simple way, the injected water has been used to relocate energy from the extremely hot waste gasses to the district heating water.

Traditional district heating plants let the waste gasses be cooled down in a heat exchanger that will only cool the waste gasses down to around 130°C because of corrosion issues. The new concept allows waste gasses to be cooled down to 30 – 40°C, whereby the energy potential contained in the fuel is exploited at a level some 10 – 25 percent higher than in traditional plants, depending on the moisture ratio of the fuel in question.

COWI has compiled technical documentation on this new concept, which is being tested at the district heating plant in the town of Hundested in 2008.

MaxiFuels pilot plant

Title:	33031-0066 – MaxiFuels – Pilot-scale testing and further development of a fermentation platform for maximum bioenergy production (ethanol, hydrogen and methane) using biomass residual products such as straw
Project manager:	BioCentrum/Danish University of Technology, Birgitte K. Ahring, ✆ +45 4525 2600
Grant:	EFP – DKK 10,779,000

The purpose of the project was to establish and test a pilot plant based on the so-called MaxiFuels concept, which converts agricultural waste and residual products into bioethanol. The MaxiFuels concept is a patented technology with a proven ability - at laboratory level - to produce bioethanol at very low costs based on the integration of several processing procedures; hydrolysis through addition of enzymes; fermentation as well as conversion of residual products into biogas.

Inaugurated in September 2006, the following months were spent performing equipment testing and adjustments of the MaxiFuels plant in order to increase the efficiency of each individual process.

Overall, the pilot plant is now up and running and the test schedule has been adhered to in accordance with the original application. Operational data has been utilised to establish an economic model of the entire concept, showing how the efficiency of each individual sub-process influence the final production of ethanol. Based on this model, a full-scale plant has been designed and a business plan has been drawn up. The model, the full-scale design and the business plan were prepared by the company BioGasol in co-operation with BioCentrum/Danish University of Technology.

Furthermore, a confidential report on pilot plant operation results has been drawn up and given to the consultancy firm Black&Veatch with a view to obtaining an objective evaluation of the MaxiFuels concept. A scientific paper on operation results of the biogas process is being published and more are underway.

The MaxiFuels concept is continuously developed: currently BioGasol is establishing a demonstration plant on the island of Bornholm in co-operation with Siemens, Alfa Laval, Agrotech and Grundfos. Ethanol production will be initiated by the end of the year and the plant is expected to be fully developed by 2009.

photo: bo jarmer, danmarks tekniske universitet

A photo taken at the inauguration of the MaxiFuels plant at the Danish University of Technology in September 2006.

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The Danish version of the newsletter is also available in a printed version. Further copies of the Danish version can be ordered from BioPress, via the following e-mail address: biopress@ biopress.dk, or telephone nr +45 8617 8507.

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Photo on the front page:
Aarhus University, Torben Skøtt and Michael Bo Rasmussen

Next issue:
– to be published in the middle of June 2008. The deadline for articles is 15 May 2008.

Funding for new energy technology

photo: chec-gruppen, danmarks tekniske universitet

The new EUDP program makes it possible to apply for grants for energy research projects several times a year. Whereas Wednesday, March 5th, was the deadline for second-generation bioethanol technologies, the deadlines for all other technologies will be April 11th and September 19th 2008.

EUDP are now accepting applications for funding 2008. A total of DKK 190 million are available for projects on development and demonstration of new energy technology.

Second-generation bioethanol makes up a main area of action: the Danish politicians have decided to earmark DKK 50 million per year for a period of four years for technology demonstration purposes. In December 2007, the Danish Energy Authority awarded the first DKK 50 million to two projects, and Wednesday, March 5th, saw the application deadline for further funding.

– In Denmark, many qualified and goal-oriented efforts are being made within the area of energy technology and we know that many people are waiting impatiently to apply for funding through our institution. Therefore, our administrative board has arranged the call for tenders as fast as practically possible, says Torkil Bentzen, chairman of the EUDP program. He would like to offer the possibility of applying for funding several times a year in order to avoid people being left with good ideas on their hands. The next application deadlines are April 11th 2008 and September 19th 2008.

The law on the EUDP program did not become effective until January 2008 and the program is expected to receive funds through the next national budget. This program replaces the energy research program EFP, which has been distributing funds for research and development in the area of energy technology for the past 30 years. At the last distribution in December 2007, around DKK 111 million were awarded to 43 different projects within the areas of research, development and demonstration of new energy technology. Whereas almost half of the funding was allocated to projects on bioenergy, wind energy was awarded 16 percent, hydrogen and fuel cells were given 14 percent, and rest was distributed among all other areas.

Further information on the EUDP program and application materials is available at the Danish Energy Authority website www.ens.dk. *TS*