

Bayer Group offers combined expertise for biofuel production

Biofuel on the fast track to success



The oldest biotechnology procedure known to man was discovered by the Sumerians. Six thousand years ago, they used yeast to produce a type of beer. The technique they invented could help solve modern energy problems. According to European Union plans, 5.75 percent of all fuel sold by 2010 is to be made of bioethanol, biodiesel and similar products. Bayer is supporting this development every step of the way: The Bayer subgroups and service companies are working on innovative solutions in everything from crop protection to plant engineering.



Energy plants: Dr. Manfred Kern (above right) and his colleagues at Bayer CropScience are developing new crop protection concepts for field crops such as corn which are becoming increasingly significant as the basis for biofuels (left).

The fields around the town of Monheim on the Lower Rhine are a brilliant yellow. It is May, and the rapeseed is in full bloom. More than 1.3 million hectares of farmland in Germany are swathed in a sea of yellow each spring. And this trend is set to grow. The area under cultivation with rapeseed has doubled in the past fifteen years, spurred on by the immense demand for biofuel made of rapeseed oil. According to Dr. Manfred Kern, this a positive development for agriculture: "The boom in biofuels is strengthening the agricultural industry," says the expert from Bayer CropScience in Monheim.

Yet rapeseed is only the forerunner of a development that could revolutionize agriculture. Experts estimate that 20 to 30 percent of land used for agriculture will be cultivated with energy-producing plants by the year 2025. High gasoline prices aren't the only reason for this, legislation is playing a role as well: In the EU, 5.75 percent of all fuel sold must be produced with renewable resources by 2010, and a goal of no less than 20 percent is envisaged for 2020. In addition to biodiesel, the end products in consumers' gas tanks could include the synthetic designer fuel "SunDiesel" and biogas (methane).

The main candidates for energy-producing crops in Europe are rapeseed, wheat, sugar beets and corn. Sugarcane, soy and switchgrass represent other options in the rest of the world. Experts at Bayer CropScience have identified a total of 40 potential fuel-supplying plants. In order to

ensure that both the production of foodstuffs and animal feed as well as the cultivation of energy-producing plants function as smoothly as possible, they are preparing for the upcoming changes in a timely manner. In cooperation with research institutes and universities, Bayer CropScience is already working on developing the right crop protection strategies. "Very little rapeseed is planted in Spain any more, for example," reports Kern, "so here we have to develop new spraying methods to combat weeds that flourish in the warm Mediterranean climate."

Developing new concepts for agriculture

To ensure that the cultivation of energy-producing plants is just as sustainable as that of foodstuff or animal feed crops, Bayer CropScience is offering training seminars and courses in which farmers can earn certificates. "We won't budge an inch on our environmental standards," says Manfred Kern, allaying environmentalists' fears that more fertilizers and crop protection agents could be used in the cultivation of energy-producing plants than in the production of foodstuffs.

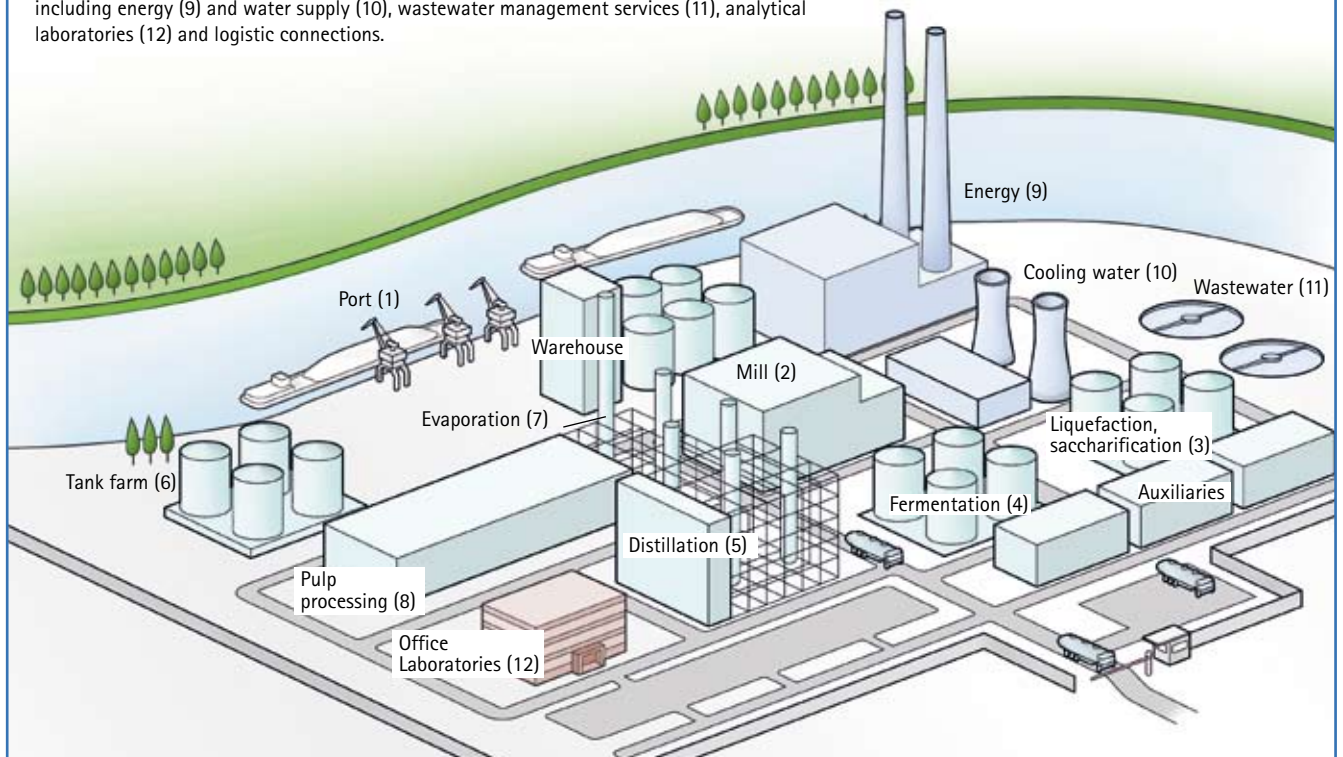
Up to now, the main part of energy-producing plant crops has been further processed in small and mid-sized facilities. However, the capacities of these facilities will not be sufficient to produce the 5.75 percent of all fuel demanded with statutory requirements. Additional large industrial facilities are therefore now in the planning, for



Concentrated expertise: Andreas Nickel (center) from Bayer Technology Services plans biofuel production facilities, Dr. Michael Weber (left) from Bayer Industry Services is responsible for locating biofuel facilities in the Chemical Park, and the specialists of tomorrow like Peter Hadamik are trained at the biodiesel facility in the Dormagen Chemical Park (right).

Manufacture of bioethanol

In the bioethanol unit in the graphic, wheat delivered for example by ship (1) is first ground (2) and then liquefied (3). Biotechnological processes split the starch in the wheat into sugar (3) and then ferment this into alcohol (ethanol) (4). Distillation (5) turns the ethanol into a high-grade biofuel (6). The remaining constituent of the wheat, the pulp, is evaporated (7) and dried (8) and can then be processed further into animal feed or methane. Many Bayer sites offer an excellent infrastructure including energy (9) and water supply (10), wastewater management services (11), analytical laboratories (12) and logistic connections.





Biodiesel, bioethanol & co.

Biotechnology and purely chemical-based procedures help to convert the energy from the sun stored in plants into liquid fuel. The following biofuels are currently in development or already available on the market:

Plants containing sugar and starch such as grains and sugar beets are fermented into bioethanol by yeast cultures in an oxygen-free environment. Following distillation, this mixture is known as schnapps. Distilled, dehydrated bioethanol can be burned in normal gasoline engines. No conversion work is required for fuels with up to five percent bioethanol. "Flexible fuel vehicles" able to run on either super-grade gasoline or a mixture of gasoline and ethanol (with a maximum of 85 percent ethanol) are already being mass produced and marketed by several automobile makers, especially in South America.

The methane gas derived from bioproduction can be used in block-type thermal power stations as well as for fuel. It is created when microbes convert animal or vegetable waste – or even energy-producing plants – into the hydrocarbon methane without the presence of oxygen. Cars powered by natural gas can run on methane with no technical conversion.

Biodiesel is created by the transesterification of rapeseed or other plant oils. The final product is a vegetable oil methyl ester with properties similar to the diesel fuel made from fossil raw materials.

SunDiesel, or BtL (Biomass to Liquid), is another type of biofuel. This clean designer fuel is derived from biomass such as wood chips or straw in a highly complex procedure.

example in Leverkusen. "The BioSpirit company is preparing to build a facility in the Chemical Park that will begin operating in 2008 and produce 300,000 tons of biodiesel per year," explains Dr. Michael Weber of Bayer Industry Services. Choren, the maker of SunDiesel is also planning to build a facility with a capacity of 200,000 tons a year in Dormagen. Construction is scheduled to start in 2008.

An expertise network for biofuel facilities

The Bayer sites are the optimum environment for biofuel investors. "We offer a first-class network perfectly suited for biofuel facilities," underscores Weber. Since all Bayer plants are located on large rivers or on the coast, ships can be used to deliver the raw materials and carry away the products. The infrastructure for energy supply and wastewater disposal is already present. Required chemicals such as potash lye, methanol and sulfuric acid are produced by Bayer MaterialScience, while the antioxidant Baynox®, which makes biodiesel more stable, is made in

the Chemical Park by Lanxess, a company with close links to Bayer. In addition, powerful analysis laboratories are present on location to provide quality assurance services such as examining incoming substances, monitoring processes and certifying finished products. Professional approval management at Bayer Industry Services is helping to rapidly satisfy the requirements for operation of the plant.

Last but not least, Bayer Technology Services (BTS) is available as a technology and engineering service provider which can offer competent project support, from planning of facilities all the way to commissioning. "Our strength lies in constructing facilities perfectly tailored to our customers' needs and adapted to the location," says Andreas Nickel, product manager for biomass conversion at BTS. The biofuel and bioethanol facilities built for customers can be designed to accommodate the various energy-producing plants and their byproducts.

The experts from BTS are also examining different concepts for energy creation. "Wood-fueled biomass power plants are ideal for the CO₂ balance in

bioethanol production," says Nickel. But prices have skyrocketed because the demand for this fuel has risen sharply over the past several years. "As a result, one of our projects is examining the possibility of procuring steam and electricity from a waste incineration plant." Another idea is to convert the remaining residue – the pulp now usually sold as animal feed – into methane and use it to operate a power plant. Nickel believes this is the solution best suited for small and mid-sized facilities: "There will soon be so much pulp that the large volume of animal feed created with it will lead to a noticeable drop in prices."



www.aboutbioenergy.info/

An educational website on biofuels from the International Energy Agency of the Organisation for Economic Co-operation and Development (OECD)