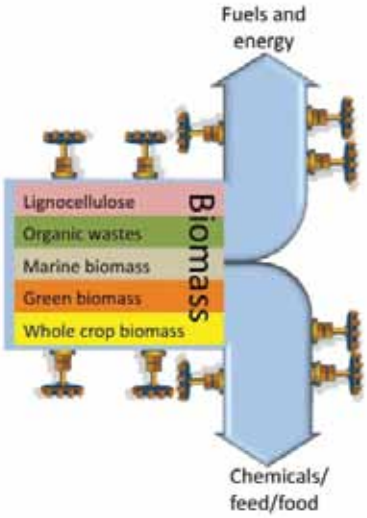
Biotechnology **goes green**

By Chris Tachibana



A new Aalborg University programme trains students in sustainable biotechnology

Medicon Valley is known around the world for its commitment to a greener future. Windmills and bicycles are everywhere, and Copenhagen was host to the 2009 United Nations climate change meeting. Biotechnology is also going green. In summer 2010, Aalborg University started Europe's first two-year graduate degree programme in sustainable biotechnology at its Copenhagen Institute of Technology campus in Ballerup. Sustainable biotechnology means converting renewable biomass into fuel and products for agriculture and industry, instead of relying on fossil-based sources.

- We are running out of oil, and we need something else. We can get electricity from wind and sun, but we use a lot of oil for plastics, textiles, solvents, and paints, and these cannot be replaced by anything that is not biological. Sustainable biotechnology can produce valuable chemical commodities by biological means, says Peter Westermann, an associate professor in the Section of Sustainability Biotechnology.

The starting biomass can be crops like maize grown specifically for this purpose, or waste, like the husks of maize used for feed or food. In highly inhabited areas like Medicon Valley, Westermann says household wastes and garden compost are good biomass sources. Sustainable biotechnology refinement techniques use microbial growth or enzymes from microbes instead of non-biological, chemical conversions that have high energy demands. Sustainable processes use renewable fuels and have a low environmental impact. Other universities offer graduate programmes in sustainable energy or technologies, but of the Aalborg University programme, Peter Westermann says,

- Our programme is very focussed on sustainability and everything is biological. Energy is only a small part of our programme, because in the long run, biomass is too valuable for producing just biofuel. We cannot produce enough biomass to cover the fuel and food needs of expanding populations, so only when you have sucked out all the compounds that can be used for the biosynthesis of valuable commodity chemicals, should biomass be used for bioenergy.

Corporate benefits

Companies benefit from replacing a traditional industrial method that uses fossil fuel-based raw materials with a sustainable biotechnology process. The corporate advantages include industrial methods that do not depend on dwindling petroleum-based resources, and a shift from end-of-process cleanup to procedures that are inherently cleaner. Green technology can also have a positive impact on consumer perception of the company. Local companies interested in sustainable biotechnology include Novozymes, which had representatives on the panel that created the Aalborg University master's degree programme.

- Novozymes is seven kilometres from our campus, and we closely collaborate with them on many projects. Across the street is a small biofuel company, BioGasol, working on second-generation biofuels, especially ethanol. We already have PhD students with them. There's also Chr Hansen in Hørsholm, and Novo Nordisk, because our programme matches their requests for new biotechnology methods, says Peter Westermann,

Changing industrial production strategies can be difficult and costly, though. This is clearly a barrier for companies looking to introduce sustainable biotechnology methods, says the 2001 study "The Application of Biotechnology to Industrial Sustainability" from the Organisation for Economic Co-operation and Development. But costs were ultimately lowered by using sustainable biotechnology to produce everything from pharmaceuticals to food, according to the study. Costs savings came from reduced energy and water use, and decreased production of wastewater and greenhouses gases. Corporate partnering with an academic institution facilitates adoption of sustainable biotechnology, which puts Aalborg University's graduate programme on the cutting edge of implementing industrial sustainability.

The first class of sustainable biotech students

From molecular biology to business plans, students in Aalborg University's sustainable biotechnology programme will learn how biological techniques are applied to create environmentally friendly ways of producing fuel and pharmaceuticals. Students enter with a bachelor's degree in a relevant field. At the end of the programme, they will have a Master of Science in Engineering, having taken courses in standard industrial topics like production of bioactive compounds and materials, and use of anaerobic or fungal microorganisms in biotechnology. They also take classes and do projects in subjects like sustainability and biomass conversion, and will spend their last semester on an individual project, possibly at a company.

The first class in the new master's degree programme has about ten students, who have come from China and all over Europe, says Westermann. Aalborg University has a problem-based teaching philosophy, with half of the education spent working on production- or company-oriented projects in small groups, similar to actual corporate work conditions. Students in the sustainable biotechnology programme also choose one of two paths. Westermann says these are,

- Either process-oriented or more molecularly focussed courses, with genetic and metabolic and enzyme engineering. All the students will be very skilled in modern biotechnology.

Westermann says that career opportunities for the first graduates in 2012 include research companies like Novozymes, Novo Nordisk and Chr Hansen, and companies that produce biogas, and energy companies like Dong and Statoil. Waste handling and waste conversion are other areas looking for people with sustainability training.

- Most companies are concerned about bringing sustainability into their processes, says Westermann. These students will be used to thinking in sustainable ways about all resources and processes, not just those that are dedicated to producing biofuels or biotechnology, he says.
- Next year, the Centre for Sustainable Biotechnology plans to offer a bachelor's degree as well. We're confident that when we get it all up and running, it will be a great programme, ends Peter Westermann.

Resource websites

1. Aalborg University programmes
www.en.aauk.dk/studyprogrammes

2. Summary of "The Application of Biotechnology to Industrial Sustainability" from the Organisation for Economic Co-operation and Development
www.oecd.org/dataoecd/61/13/1947629.pdf