

**BioConcens 2007-2010**

## **Biomass and bioenergy production in organic agriculture**

### **– consequences for soil fertility, environment, spread of animal parasites and socio-economy**

The production of bioenergy from local biological resources and the maintenance of soil fertility seem to have been opposing aims in organic agriculture. It is, however, important to reduce the reliance on fossil fuels and decrease greenhouse gas emissions in organic agriculture, especially in the context of enhanced integrity of organic agriculture.

This interdisciplinary project aims at developing new methods and processes for co-production of bioethanol, biogas and animal feed based on resources from organic agriculture and associated food processing and suggests the outline of a medium-sized plant for co-production of biogas, bioethanol, and animal feed. The project will also design and test a new cropping system for biomass production to be used for bioenergy, while at the same time safeguarding soil quality.

## **Conversion of organic resources to biofuels and power**

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Biogas, bioethanol, wind energy, and biomass for combustion can be produced in organic agriculture and contribute renewable energy for self-sufficiency. Biogas can be produced in on-farm and on co-ordinated medium or large-scale plants from animal manure and energy rich wastes. Grass-clover crops commonly grown in organic agriculture have a great potential as raw material for biogasification. Due to several barriers, biogas is not readily available as a fuel for engines, but can be used to produce electricity and heat. Bioethanol produced from starch can be used as a substitute for diesel with addition of an ignition improver.

The project is organized into five working packages as detailed below:

### **1. Co-production of energy and feed**

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The objectives are:

Conversion of grass-clover, animal manure, energy crops (e.g. maize and rye) and agro-industrial by-products from organic farming to biogas, bioethanol and fodder protein in laboratory and full scale studies

Design of a process for co-production of biogas and bioethanol/protein fodder and evaluation of energy balances

### **2. Strip intercropping system for biomass production**

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The objectives are:

To determine the effect of intercropping a grass-clover based perennial forage crop mixture (soil fertility building crop) and annual biomass crops in strips on the biomass and grain yields compared to sole cropping of the same species

To determine the potential interactions between intercrop border rows and associated mechanisms

### **The overall objectives are:**

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- ▶ To develop new methods and processes for co-production of bioethanol, biogas and animal feed based on resources from organic agriculture and associated food processing and to suggest the outline of a medium-sized plant for co-production of biogas, bioethanol, and animal feed
- ▶ To design and test a new cropping system for biomass production to be used for bioenergy, while at the same time safeguarding soil quality
- ▶ To analyze the effects of remains from bioenergy production on soil fertility, greenhouse gas emissions, survival of parasites and weed seeds in the manure as affected by bioenergy production
- ▶ To carry out corporate and socio-economic analysis of the co-production of biogas and bioethanol at different scales

responsible for a potentially improved resource use (e.g. nutrients, light, water) compared to sole cropping

To determine the effects of green manure from the soil fertility-building strip on the annual biomass crops and the effect on plant growth of nutrients and residues recycled from biogasification

### **3. Soil quality, parasites and weed seeds**

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The objectives are:

To determine soil quality as affected by application of animal manure (non-treated, processed in biogas reactors or aerobically decomposed)

Determine trends in the effects of the manure treatments on the genetic and functional diversity of micro-biota, the soil structure, and the organic matter content and its quality over the entire project period

To measure the capability of biogasification processes in inactivating parasite eggs in the manure (especially *Ascaris suum*, which acts as an indicator organism)

To determine the effect of biogasification on the survival of weed seeds in manure

#### **4. Emissions of greenhouse gases**

The objectives are:

To determine emissions of nitrous oxide (N<sub>2</sub>O) associated with the production of plant biomass in strip-intercropping

To determine emissions of non-CO<sub>2</sub> greenhouse gases (N<sub>2</sub>O and CH<sub>4</sub>) associated with i) the application of bioenergy residues for agronomic purposes, and ii) the storage (pre-treatment) of green/ animal manure for bioenergy utilisation

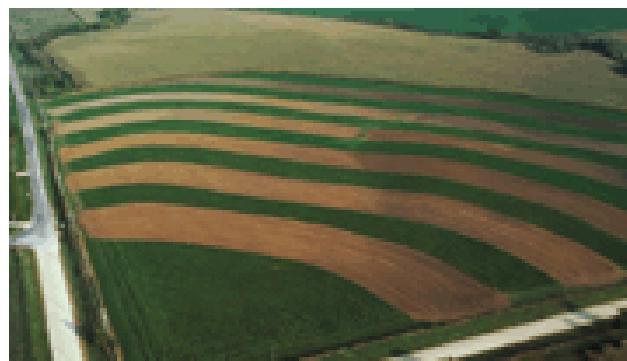
To evaluate quality parameters and C-sequestration potential of bio-energy residues

#### **5. Scenarios for bio-energy production in organic agriculture**

The objectives are:

To carry out detailed partial analyses of socio-economic and corporate-economic, environmental and energy balance effects of investigated alternatives in WP1 to WP4 within organic agriculture.

To model matter flows and greenhouse gas balances for grass clover based crop rotations, and organic biogas energy production systems



To define scenarios and carry out scenario analyses of overall corporate and socio-economic, environmental and energy balance consequences of integrating biogas and bio-ethanol production in organic agriculture.

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### Project leader

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### Links

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Project homepage: [www.bioconcens.elr.dk/uk](http://www.bioconcens.elr.dk/uk)  
[www.icrofs.org](http://www.icrofs.org)

### About ICROFS

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The International Centre for Research in Organic Food Systems (ICROFS) is a "centre without walls" where the research is performed in interdisciplinary collaboration between research groups in different institutions. The centre is an expansion of the former research centre DARCOF, which the Danish Government in 2008 decided to give an international mandate and an international board.

The main purpose of ICROFS is to coordinate and monitor international research in organic food and farming systems in order to achieve optimum benefit from the allocated resources. Further, the aim of ICROFS is to initiate research and create impact of the research results through support and dissemination of high quality research of international standard.

More information at [www.icrofs.org](http://www.icrofs.org)

