

SIXTH FRAMEWORK PROGRAMME



GREENERGY

**Energy Optimisation in European
Greenhouses**

Contract number: COLL-CT-2005-012566

**WP 1: Information, compilation and proposed technical
improvement measures**

**Task 2: State of the technology in the sector
and energy critical factors**

► Contact with related European research projects

1. Identification of related projects.

The present document aims to provide a brief description of how actions were carried out by the partner BIOAZUL in order to:

- identify projects related to the GREENERGY objectives
- contact the coordinators to promote the exchange of knowledge or even clustering projects in the same field

Contacting the coordinators and establishing an active and extensive exchange of knowledge will lead on a more effective way to obtain really innovative advances in greenhouse horticulture, and will contribute to decrease the doubling of the work of different research groups due to the lack of communication. It also will facilitate the dissemination of the project's results when not protected with property rights.

These actions are included in WP1 and linked to Task 2: State of the technology in the sector and energy critical factors.

Since GREENERGY is basically focussed at European scale, the starting point was a search in Cordis database (<http://www.cordis.lu/en/home.html>). Complementary information concerning updated contact details and actual relevance of each of the projects was obtained from different on-line sources. At the same time, the partners of GREENERGY have been asked about related projects in which they have also participated.

Despite of the broad spectrum of R&D projects dealing with horticulture, high intensity crops or energy efficiency in the agriculture sector, very few share the main goals of GREENERGY. Furthermore, most of the projects concerning energy optimisation techniques, alternative energy sources, management procedures or auditing tools for protected agriculture are obsolete or entail high investment measures. It means that successful achievement of the already mentioned GREENERGY objectives would produce a major technical renewal in the sector, and would also allow many farmers to introduce energy efficiency improvements at a low or medium cost.

28 projects, which could be of interest for the successful realisation of the aims of the GREENERGY project, have been identified in the Cordis database. The selection criteria of the identified projects were relevance and newness of them. The only on-going one (CEAF) was selected together with those that were completed in the last five years. So all the projects identified in Cordis that were previous to 2001 were discarded with only two exceptions (see Table 1): LEC Greenhouse (1997/98) and MACQU (1994/97). These two projects were chosen because they settled the basis for newer projects LEC Greenhouse (1998/01) and MACQUD (1998/01).

From the search among GREENERGY partners, two sent us information about related projects and some others said that they do not have any previous participation in relevant projects. A selection of the projects in which the partners were involved is showed in Table 2, including completed and running projects.

The most relevant data of the identified projects have been included in the following tables, including project title, a summary, start date, duration, coordinator details, web-sites or other interesting facts.

Project	Start date /duration	Contact details	Summary
Stimulating participation of Central Europe in the Agri-Food Sector in FP6 (CEAF) www.kpk.gov.pl/ceaf/index.html	2004-11-28 (ongoing)	NATIONAL CONTACT POINT FOR RESEARCH PROGRAMMES OF THE EU Bożena PODLASKA (Ms) Tel: +48-228-262502 Fax: +48-228-285370 E-mail: bozena.podlaska@kpk.gov.pl Świętokrzyska 21 00-049 Warsaw, POLAND	It aims to mobilise help from existing Member States through a Specific Support Action, stimulating participation of New Member States in Central Europe in European research community programmes concerning Food Quality and Safety. It involves experts from the European Commission and the Netherlands, and research institutes and SMEs in the flower and fruit sector from Poland, Slovakia, Latvia, Hungary and Estonia. The latter, will get assistance in how to identify available support and how to submit project proposals. Other goals would be to ensure transference of best practices, knowledge and experience by experts and co-ordination from Member States, and the preparation for establishing Networks of Excellence in Food Quality and Safety. Therefore, it offers the possibility to introduce and to disseminate the GREENERGY results also via this pathway.
PROMotion and dissemination policy on local NATUral REsource use for Agricultural applications in rural areas of CEC and EU (PRONATURE)	2001-03-29 (18 months)	NATIONAL AGENCY FOR NEW TECHNOLOGIES, ENERGY AND ENVIRONMENT Carlo A. CAMPIOTTI (Dr) Tel: +39-0630-486539 Fax: +39-0630-486514 E-mail: campiotti@casaccia.enea.it Biotechnologies and Agriculture Via Anguillarese, 301 - Santa Maria di Galeria 00060 Rome, ITALY	Firstly, the project's partnership developed courses and an overview of the renewable energy policy in the agricultural and rural areas of southern Mediterranean countries. Then, they organized technical meetings in Italy, Spain, France, Romania and Macedonia focused on the issue which refers to the uses of geothermal energy and the solar thermal heating as local heat resources for plant crop processes (e.g. greenhouse heating). Finally, a CD-ROM for managing natural energies for agricultural applications was produced.
Low energy consumption LEC-greenhouse	1998-12-01 (29 months)	GARTNERIET PKM APS Kristian MADSEN (Mr) Tel: +45-66-189074 Fax: +45-66-187954 E-mail: pkm@pkm.dk Slettensvej 207-215 5270 Odense N., DENMARK	The main goal of this project is to develop the LEC (Low Energy Consumption) concept for improving glass greenhouse energy savings. This included designing of a shed roof construction, which uses mobile foil planes in a special double layer screen working as a heat trap as well as a cover. Furthermore an integrated solar heating system consisting of PEL tubes used both to collect and distribute heat energy has been developed and tested within the project. Finally, climate regulation software has been developed with the purpose of controlling and regulating the entire system once completed.

<p>MACQUD: Management and control for quality demonstration</p>	<p>1999-01-04 (24 months)</p>	<p>AGRICULTURAL UNIVERSITY OF ATHENS Nick SIGRIMIS (Dr.) Tel: +30-210-5294038 Fax: +30-210-5294039 E-mail: nns@auadec.aua.gr Laboratory Of Automation And Mechanics Iera Odos 75 118 55 Athens, GREECE</p>	<p>An earlier EU project (MACQU) has developed an advanced complete system (software and hardware) which allows the in-field implementation of intelligent management for greenhouses effectively and at low cost. An objective of this proposal is to prove, under commercial conditions, the advantages of the achieved results, such as the reduced heating caused by the management of energy inputs according to plant heat demand.</p>
<p>Low Energy Consumption - LEC Greenhouse</p>	<p>1997-11-15 (5 months)</p>	<p>ROSAGER & LARSEN RADG. ING. APS. Thomas LARSEN Tel: +45-66180066 Fax: +45-66180324 Email: larssen@post.2.tele.dk 85 Stenlosevej 34 3660 Stenlose, DENMARK</p>	<p>The scientific and technical objectives of this research proposal concern developing a new type of greenhouse with a heat consumption of only 30% of normal consumption in traditional uninsulated greenhouses. This aim shall be reached through high insulating mobile screens combined with solar energy stored in rainwater reservoirs. This research aimed to optimize the Low Energy Consumption LEC greenhouse and to investigate the possibilities of storing solar energy.</p>
<p>MACQU: Management and control for quality of greenhouses</p>	<p>1994-01-01 (36 months)</p>	<p>AGRICULTURAL UNIVERSITY OF ATHENS Nick SIGRIMIS (Dr.) Tel: +30-210-5294038 Fax: +30-210-5294039 E-mail: nns@auadec.aua.gr Laboratory of Automation and Mechanics Iera Odos 75 118 55 Athens, GREECE</p>	<p>The project aimed to reduce inputs, improve the product quality and conserve the environment in greenhouse production systems through the advancement of our knowledge on plants' bioresponses and modern management techniques. It was specifically applied in: optimisation of energy consumption and energy resource utilisation with grower attractive methods in the context of maintaining best grade products; development of hardware and software system to integrate the gained knowledge into the management and control of crop production.</p>

Table 1. Selection of projects from the Cordis database.

Project	Start date /duration	Contact details	Summary
The Danish Greenhouse Sectors Energy Consumption	2006-01-01 (12 months)	DEG GREENTEAM Torben LIPPERT (Mr.) Tel: +45 8740 6623 E-mail: tbl@landscentret.dk Højbakkegård Allé 21 2630 Tåstrup, DENMARK	Today's energy consumption in the Danish greenhouse sector is being surveyed, so a comparison of the effect of future energy policies and effort can be made. Barriers and the means to break down these barriers are being identified for continued energy savings. It is the goal to uncover a range of energy conditions and give an explanation on the distribution and development of energy consumption in the Danish greenhouse sector.
Detection of the Utilization Rate of Artificial Lighting in Greenhouses	2004-01-01 (48 months)	FORSKNINGSCENTER ÅRSLEV Niels Erik ANDERSSON (Mr.) Tel: +45 8999 3362 E-mail: Niels.Andersson@agrsci.dk Kirstinebjergvej 10, Postboks 102 5792 Årslev, DENMARK	The aim of the project is to reduce the period in which artificial lighting is used in plant production in greenhouses. Artificial lighting is limited to be used only when the light compensation point is lower than the irradiance from the lighting system. The change in light compensation point occurs during autumn and spring and the utilization of artificial light by the plant can be determined by using the greenhouse as a cuvette. Owing to variation in natural light condition between years, the acclimatisation will differ from year to year. The knowledge and ability to estimate the degree of adoption limits the seasonal period in which artificial lighting is used. The situation today is that artificial lighting is used without this knowledge and is based on feelings and experience.
Cool plants	2006-01-01 (9 months)	DANISH INSTITUTE OF AGRICULTURE SCIENCE Eva Rosenkvist E-mail: ero@agrsci.dk	In this project a method is tested to predict a plants specie or variety's capability to growth at low temperatures.
Plants produced by optimized production systems and minimized use of resources in greenhouses	From 2003 to the end of 2006	DANISH INSTITUTE OF AGRICULTURE SCIENCE Carl Otto Ottosen E-mail: coo@agrsci.dk	In this project the idea is to produce plants in the autumn with little energy consumption, save the plants during the winter in cool storage, in the fields or in cold greenhouses and then later finish the plants in the late winter or early spring. Several plant species and production systems are tested.

<p>The Demand Side as Reserve Power in the Greenhouse Sector</p>	<p>19-01-2006 (12 months)</p>	<p>DEG GREENTEAM Ole SKOV (Mr.) Tel: +45 8740 6626 E-mail: oes@landscentret.dk Højbakkegård Allé 21 2630 Tåstrup, DENMARK</p>	<p>The greenhouse sector is believed to have a large potential for participating in a better adjustment of electricity consumption and production. Furthermore, via flexible electricity consumption the greenhouse sector could supply regulatory contribution to the electricity network. The aim of the project is to map the potential of price-elastic electricity consumption within the greenhouse sector. The demand for light in different seasons and plant cultures will be taken into consideration. The project will demonstrate the technical opportunities and the economic incentive for a single grower to be a part of the market of fluctuating and reserve power via price-elastic electricity consumption.</p>
<p>The Closed Greenhouse – A Demonstration Project in New Heating and Cooling Systems</p>	<p>2006-01-01 (12 months)</p>	<p>DEG GREENTEAM Torben LIPPERT (Mr.) Tel: +45 8740 6623 E-mail: tbl@landscentret.dk Højbakkegård Allé 21 2630 Tåstrup, DENMARK</p>	<p>The concept 'The Closed Greenhouse' has been researched in some European countries, mainly Holland. In the closed greenhouse, hot air is not ventilated away by opening windows. Instead, access heat is stored and reused. When windows are not opened, a high concentration of CO2 can be maintained, which will increase productivity. If a greenhouse was closed the majority of the day, especially in spring and autumn, a savings of up to 30 % in energy could be obtained. Information from previous European research on the closed greenhouse is being collected, analyzed and implemented under Danish conditions. A demonstration greenhouse is setup with plants to research the effect of keeping the windows closed and the effect of a new climate control. The closed greenhouse influence on plants and the energy consumption savings are being calculated.</p>
<p>Developing a Method for Improving Productivity through an Improved Photosynthetic Effect</p>	<p>2006-01-01 (12 months)</p>	<p>DEG GREENTEAM Torben LIPPERT (Mr.) Tel: +45 8740 6623 E-mail: tbl@landscentret.dk Højbakkegård Allé 21 2630 Tåstrup, DENMARK</p>	<p>Extended research at KVL has shown that photosynthesis models can be used to optimize greenhouse plant production. Optimizing temperature and CO2 concentration to the light can save energy without negatively influencing plant growth. Data (climate and control parameters) from 2-3 growers is being collected. The data is entered into the KVL photosynthesis model to demonstrate the effect of the growers' chosen production strategy. An energy model is added so that the energy consumption in the greenhouse facility can continuously be compared to the actual climate and photosynthesis. Using the two models, the effect of the production strategy is estimated and climatic situations that have a negative effect on the production are recognized. Parallel to the analytical work, greenhouses are set up to demonstrate some of the problematic growing situations, following the recommended growing strategies from the photosynthesis and the energy model.</p>

Electricity savings in greenhouses with LED grow light systems	2006-01-01 (24 months)	THE ROYAL VETERINARY AND AGRICULTURAL UNIVERSITY Jesper M. AASLYNG (Mr.) Tel: +45 3528 2318 E-mail: jmaa@kvl.dk Department of Agricultural Sciences, Horticulture Højbakkegård Alle 21 DK-2630 Tåstrup, DENMARK	The goal of the project is to develop and test prototypes of LED growth light systems for plant production and document the energy saving potential and effect of LED lights on plant growth. Growth light systems are a combination of LED light and electronic management, that makes it possible to adjust the spectral distribution and strength after plants specific needs concerning spectral distribution, light intensity, time etc.
Energy management system for nurseries	The project started in 2000 and is still running in nurseries	DANISH AGRICULTURAL ADVISORY SERVICE/ DEG GREENTEAM Torben Lippert E-mail: tbl@landscentret.dk	In the project a handbook for energy management in nurseries was developed. The system is an official standard (DS 2403). 180 nurseries, 3.5 mio m2 or 70 % of the Danish area with greenhouses use the energy management system. The system is audited yearly in each nursery. The handbook is for sale. The text is in Danish.
Energy calculation on climate set points	Finished	DANISH AGRICULTURAL ADVISORY SERVICE/ DEG GREENTEAM Jens Rystedt E-mail: jor@landscentret.dk	A calculation system was made to calculate the energy consumptions and climate changes on basis of different climate set points on the climate computer. The system calculates on temperature, light (shading screens and artificial light), humidity and CO2. The system is also able to calculate the photosynthesis on basis of the climate in a greenhouse. The calculation system is now used as a tool in DEG GreenTeam's advice jobs in energy savings and climate control.
Energy savings on www.deg-greenteam.dk	The project started in and the website is still updated	DANISH AGRICULTURAL ADVISORY SERVICE/ DEG GREENTEAM Torben Lippert E-mail: tbl@landscentret.dk	An energy saving catalogue is placed on DEG GreenTeam's website (in Danish). On the website the growers can read about technical issues, climate control, energy prices and so on.

Table 2. Projects in which members of GREENERGY consortium have been involved.

2. Contacts.

The coordinators of the projects in Table 1 have been contacted during the first days of 2006 asking for further information on the project and project results and to check the possibilities of the exchange of knowledge.

A summary of GREENERGY has been sent to them with information about aims and objectives of the projects and the partners involved (see Annex 1).

When contacting, we have realised that some of the e-mail addresses are not working any more, so we tried to find alternative email addresses from outside the Cordis web site. This procedure made possible the contact with the coordinator for MACQUD and MACQU projects, but it did not work when trying to contact with the company Rosanger & Larssen Radg. Ing. Aps.

In the sort term, some materials will be sent from PRONATURE, MACQUD and MACQU coordinators:

- Dr Campiotti is going to send some very relevant materials in English: CD-ROM for managing natural energies for agricultural applications and proceedings of PRONATURE.
- Dr Sigrimis suggested that he have lots of materials to send. Both the similarities between MACQUD-MACQU to GREENERGY, as well as the success of those projects make this contact especially meaningful.

A continuous updating and follow-up will be performed in order to increase the possibilities of knowledge interchange and clustering. It also will contribute to the dissemination of the project to the scientific community, connecting to the Work Package 5 Dissemination and Exploitation.

All coordinators will be also informed as soon as the web-site of the project is running.

Annex 1. GREENERGY abstract received by the coordinators.**GREENERGY**

Unlike field agriculture, which bases production costs on hectares, greenhouse costs are calculated on a per square meter of growing area or on a per plant basis. The production costs represent around 78% of the total chain costs in greenhouses, being energy consumption the main factor affecting those expenses.

It is estimated that greenhouses cover an area of about 41000 ha in the European Union, setting Europe as the biggest supplier of greenhouse products in the world. At the same time, as Eastern European markets open up, the EU is also becoming the biggest consumer of greenhouse products in the world. However good the situation may seem the competitiveness of European growers is threatened by the increasingly higher costs of fuel and the competition of external growers producing at low costs. A reduction in the production costs of commodities will help the European greenhouse producers to retain their position in the European market where internal transportation costs are significantly lower than those of external competitors.

GREENERGY is a European Collective Research project with duration of 3 years and funded by the European Commission, which aims to investigate the greenhouse energy requirements for different climatic areas across Europe. A tool for auditing energy efficiency in greenhouses, a set of technical improvement measures and a guideline for the optimisation of energy consumption in European greenhouses will be developed and tested in several case studies taking into account current and upcoming European environmental legislation. The main beneficiaries will be greenhouse farmers' associations and their associates from different European countries.

Duration: 36 months (1st Sept. 2005- 31st Agust. 2008)

Budget: 2.437.914 €

Partners:

- Panhellenic Confederation of Unions of Agricultural Co-operatives (Greece) - Coordinator
- Danish Association of Horticulture Producer (Denmark)
- Horticulture Development Council (United Kingdom)
- Finish Glasshouse Grower Association (Finland)
- Hungarian Fruit and Vegetable Interprofessional Organization (Hungary)
- Estonian Horticulture Association (Estonia)
- General Confederation of Italian Agriculture (Italy)
- Association of Producers and Exporters of Horticultural Products of Almería (Spain)
- Tomato Grower Association (United Kingdom)
- Honkasen Puutarhe Oy (Finland)
- Gärtnerei Hans Paetz (Germany)
- Agrocomponentes (Spain)
- Farm Energy Centre (United Kingdom)
- Gärtnerei Hans -Jürgen Sadowski (Germany)
- Varpio Puutarha Oy (Finland)
- Bioazul SL (Spain)
- A. Pearson & Sons Ltd (United Kingdom)
- Agronin (Romania)
- Hevi-Kolmio Oy (Finland)
- Technologie Transfer Zentrum Bremerhaven (Germany)
- The Royal Veterinary and Agricultural University (Denmark)
- Valtion Teknillinen Tutkimuskeskus (Finland)
- Wageningen University (Netherlands)

- Technical Uni. Timisoara (Romania)
- Estonian Agriculture University (Estonia)
- University of Almería (Spain)
- Hertfordshire University (United Kingdom)

Main Objectives:

- To reduce the energy consumption in existing greenhouse with small changes in configuration and operating procedures by 20 - 40 %.
- To improve the competitiveness of European farmers enabling them to cope with the growing fuel prices and external competition (reduction of production costs of by 20–30 %).
- To decrease the emissions of greenhouse effect gases to the environment, and to assist the farmers to comply with current and upcoming environmental regulations.
- To initiate the adoption of modern management strategies such as standardisation and benchmarking in the field of greenhouse agriculture (more efficient production structures leading to additional cost savings of 10 – 20 %).
- To reinforce the public image of those European greenhouse growers who produce by means of energy efficient systems against external competitors