

Presentation of the funded projects in 2008 for the Bioenergy Programme

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Titre du projet

AGRI-ELEC – Knowledge-based design of microbial fuel cells to produce electricity from agricultural and forest industry residues

Résumé

Microbial fuel cells (MFCs) convert directly to electrical energy the energy produced by the oxidation of different costless organic compounds contained in sediments, soils, domestic or industrial wastewaters. The catalysis of the oxidation process is achieved by electro-active microorganisms that develop on the anode surface. The Agri-Elec project gathers the complementary skills of seven partners in order to develop MFCs able to use residues from the agricultural and forest industry as fuels. It is aimed first at progressing in the fundamental understanding of microbial-electro catalysis, in particular by coupling the electrochemical analytical techniques with the tools of molecular biology with the view to optimise the electrochemical properties of microbial biofilms. The final goal consists in using the created basic knowledge to design a MFC able to use wastes for paper industry and different fractions of agricultural residues.

Partenaires

LGC, CNRS-Université de Toulouse
LEMIRE, CEA/IBEN-CNRS-Univ. Aix-Marseille II, Cadarache
CEA-Saclay
ECOFOG, Université des Antilles et de la Guyane, Cayenne
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Aide de l'ANR

1 167 610 euros

Début et durée

December 2008- 48 months

Référence

ANR-08-BIOE-001

Titre du projet **ALGOMICS**– Omics of energy conversion and storage by microalgae

Résumé

Photosynthetic micro-organisms hold a huge potential for biofuel production (such as biohydrogen or biodiesel). Microalgae show a high surface biomass productivity and some species accumulate high amounts of reserve compounds (polysaccharides and lipids), lipid accumulation reaching up to 70% of the biomass content in some species. The productivity of high energy compounds is however impaired by the existence of biological limitations. A major ambition of the ALGOMICS project is to develop, *via* a system biology-base approach, a thorough understanding of processes of energy conversion and storage, aiming at developing innovative concepts for an advanced domestication of photosynthetic solar energy conversion. The project involves a strongly integrated network of field-leading laboratories in genomics, proteomics, metabolomics, fluxomics, genetics, physiology and process engineering. A model of metabolic interactions involved in energy conversion and storage will be constructed, analyzed and further validated, using the unicellular green alga *Chlamydomonas reinhardtii* as a model organism. The unravelling of key regulatory components (metabolites, proteins, genes...) controlling energy conversion and storage will be used to propose innovative strategies towards improving microalgal biofuel production.

Partenaires

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CEA Grenoble
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Aide de l'ANR

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Début et durée

December 2008- 48 months

Référence

ANR-08-BIOE-002

Titre du projet**AMAZON– Adequacy of multi-resources biomass to Gasification****Résumé**

The processes of production by liquid fuel gasification of second generation biofuel (sector BtL - Biomass to Liquid) and of biogas (sector Synthetic Natural Gas) are currently in a phase of development preliminary to their industrial deployment. Although these processes offer important perspectives for the French lignocellulosic both forest and agricultural resources, it is necessary to avoid the competition with the agricultural production for food purposes, but also the destabilization of the current agro-forest markets. The objective of the project AMAZON is to optimize the use of lignocellulosic biomasses (France - Brazil) in the processes of transformation by thermochemical pathway, in particular the gasification for the BtL and SNG applications. Our goal is to confront the "theoretical" potential approached by the physico-chemical characterization of the biomass with the real process behaviour using both analytical devices and laboratory pilots in order to obtain crucial information for a future implementation of larger scale pilots (demonstration or semi-industrial). Moreover, the project is devoted to French resources (existing and those currently developed for bioenergy applications) and imported biomasses (Brazil) which will be pre-treated in laboratory and semi-industrial pilot plants in Brazil, then gasified in France.

Partenaires

France : FCBA, CEA, CIRAD, ENSTIMAC/RAPSODEE, GDF Suez, GIE Arvalis-Onidol, RAGT.
Brazil : LPF-SFB, UFPA, EMBRAPA Agroenergia, Arcelor-Mittal, Biaware

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Aide de l'ANR

1 000 101 euros

Début et durée

December 2008- 48 months

Référence

ANR-08-BIOE-010

Titre du projet	Anabio-H2 – Valorisation of agro-industrial by-products through hydrogen production with anaerobic, mesophilic microbial strains
Résumé	The AnaBio-H2 project aims at establishing a tool at the laboratory scale enabling to quantify and optimize production capacity of hydrogen by a microbial biomass. The proposed work includes the isolation and characterization of anaerobic mesophilic microorganisms organized in consortia, able to degrade and ferment of agro-industrial lignocellulosics by-products associated to by-products of the meat industry. These microorganisms will be implemented in a submerged membrane bioreactor and volatile fatty acids recovered will be valorised through the production of microbial lipids for use in the biodiesel industry.
Partenaires	LGCB – Université Blaise Pascal – Clermont Ferrand II LMGE - Université Blaise Pascal – Clermont Ferrand II Biobasic Environnement ADIV
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Aide de l'ANR	695 527 euros
Début et durée	December 2008- 36 months
Référence	ANR-08-BIOE-013

Titre du projet**ANAMIX – Assessment of rheological behavior and mass transfer properties for the improvement of dry digestion processes****Résumé**

Methane fermentation is a biological process converting organic matter into a methane-rich gas (biogas). It is mostly used for municipal and agricultural organic wastes, which constitute a valuable resource: the European production of biogas was equivalent to 5 million tons of oil in 2006. Most systems used for municipal wastes today are called dry digestion processes: they are more efficient and less water-consuming than classical systems, but the mechanical structure of the digestion medium is still ill-defined and difficult to control at the industrial scale. The essence of the ANAMIX project is to answer to specific questions associated to dry digestion, using new techniques and new approaches for the description of dense and pasty media. It combines Process Engineering (rheology, mass transfer, mixing) and Life Science (microbial kinetics and ecosystem ecology) together to study the complex interactions occurring in dry digestion, and to propose a model enabling the simulation of the mechanisms. Our project is guided by a double expectation: first, to improve our knowledge of basic mechanisms that take place in dry digestion systems; Second, to provide the tools for making the future industrial systems easier to design and to operate.

Partenaires

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Aide de l'ANR

528 841 euros

Début et durée

December 2008- 36 months

Référence

ANR-08-BIOE-009

Titre du projet**BioButaFuel**– Bioconversion of lignocellulose hydrolysates to Butanol, an advanced bioFuel at high titer and yield**Résumé**

The butanol is an alcohol with properties that make it a high performance fuel produced from agricultural feedstocks rather than petroleum. The properties of butanol as a biofuel have been known for nearly 100 years but it has not been widely adopted because it is costly to produce. Considering the previously published results, the aim of the present proposal is to develop a novel biological way to convert at high yield cellulose derived sugars (hexose) and hemicellulose (pentose) into butanol (without any other product) by an improved engineered strain of E. coli. The final objective of this project is to develop a new biotechnological process for the production of butanol, known as an efficient advanced biofuel, from a renewable resource that would be an economical alternative to the production of butanol from petrochemical resources

Partenaires

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METabolic Explorer

Coordinateur

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Aide de l'ANR

263 745 euros

Début et durée

December 2008- 36 months

Référence

ANR-08-BIOE-012

Titre du projet	EMERGE – Compatible volume/biomass and nutrient contents equations for fuel wood and forest resource : tools for sustainable and clear management
<p data-bbox="427 450 564 483">Résumé</p> 	<p data-bbox="603 443 1442 689">EMERGE (Elaboration of Models for a Robust and Generic Estimation of the wood Energy) aims at producing reliable estimation of volume, biomass, nutrient content and heat value of wood whatever the origin of the stands, their structure, their fertility, their size, whatever the top diameters (commercial, industrial and fuel wood harvesting).</p> <p data-bbox="603 689 1442 869">This objective will be achieved by an original consortium of forest managers, forest modellers and statisticians which will share all experimental and technical data available in France, will share methods and needs to obtain shared and robust tools.</p> <p data-bbox="603 869 1442 1010">This project will contribute to more robust and clear estimating of bio-energy and fuel wood resource studies, compatible with commercial resource and carbon stocks.</p>
Partenaires	<p data-bbox="603 1048 868 1330">ONF LERFoB-INRA BEF-INRA Cemagref Nogent IFN FCBA CNPPF-SUF IDF CIRAD-AMAP</p>
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Aide de l'ANR	<p data-bbox="603 1469 823 1503">715 293 euros</p>
Début et durée	<p data-bbox="603 1541 1023 1574">December 2008- 48 months</p>
Référence	<p data-bbox="603 1612 879 1646">ANR-08-BIOE-003</p>

Titre du projet

Hémili – Investigation and reduction of hemicellulases-lignin interactions for improved enzymatic pretreatment and fractionation processes of lignocellulose

Résumé

The goal of the project is to focalize our researches on the impact of lignin during fractionation of lignocelluloses with xylanases, biocatalyseurs that would offer numerous advantages to cellulases-based technology for the production of ethanol (less drastic physico-chemical pretreatments of lignocellulose, valorization of pentoses). These studies will allow to understand the molecular mechanisms responsible for the non productive interactions between xylanases and lignin. The strategy of the project will be based on evaluation of interactions between various xylanases and a large panel of lignins presenting increased complexities via methodologies like SPR and ellipsometry. One aspect of the project will concern the reduction of interactions by designing reaction media with additives. Finally, impact of selected scenarii (xylanases, lignocelluloses with ideal content and quality of lignin, additives) generating reduced or inexistent interactions between xylanases and lignin part of lignocelluloses will be evaluated in terms of yields of hydrolysis of cellulose and xylans by enzymatic cocktails.

Partenaires

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UMR 792 INSA-INRA, Toulouse
UMR 5546 CNRS-UPS, Castanet Tolosan
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Aide de l'ANR

373 161 euros

Début et durée

December 2008- 36 months

Référence

ANR-08-BIOE-004

Titre du projet**InGEcoH– Ecological engineering of microbial ecosystems producing biohydrogen by dark fermentation****Résumé**

Numerous microorganisms can produce hydrogen by "dark fermentation". Even though biohydrogen productivities and conversion yields can be interesting for industrial purposes, several scientific and technical constraints remain to be addressed. In particular, the presence of alternative metabolic pathways for hydrogen consumption generally results in chronic instability of the biological processes in mixed cultures. To increase the stability and the efficiency of dark fermentative processes, it is now necessary to get a better understanding of the metabolic interaction networks between producing and consuming microorganisms. The present InGEcoH project plans to develop an innovative and multidisciplinary approach to ecological engineering, which consists in the design, building and study of synthetic microbial consortia to establish the metabolic networks existing between microorganisms for further optimization of biohydrogen production. More specifically, this implies (i) selection and characterization of bacteria with a high potential for biohydrogen production, (ii) building of a "synthetic" microbial consortium to develop mechanistic models of metabolic interaction networks, and (iii) study and optimization of selected consortia for producing biohydrogen efficiently under real conditions and with high stability.

Partenaires

Laboratoire de Biotechnologie l'Environnement (INRA - UR050)
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Aide de l'ANR

706 380 euros

Début et durée

December 2008- 36 months

Référence

ANR-08-BIOE-005

Titre du projet**SLUGAS– Impact of inorganics in the gasification of sludges****Résumé**

This project concerns the development of gasification technologies for sludge with the objective to produce syngas for fuel synthesis. The project will mainly analyse technical difficulties that are linked to the presence of a significant amount of inorganics.

There is a great interest for the valorisation of waste, including sludge. Therefore the gasification technologies, which will be chosen for biomass gasification, should be robust. Sludges are a potentially interesting resource (with negative costs) but represent also an important challenge for the gasification technology. The sludges may contain up to 50 w% inorganics (on a dry material basis). If it is possible to find a reactor technology that can account for the problems related to such a huge amount of inorganics, this technology would then be compatible with practically all organic resource. It would also contribute to solve the problem of waste management.

In the present project not all the problems will be solved. Priority will be given to the problem that affects the reactor. Detailed analysis will be made for the entrained flow reactor which seems to be the more promising technology. In particular, operation temperatures will be determined and interaction between slags and ceramics will be analysed. Specific attention will be brought to the problem of aerosol formation. Experiments in a small scale entrained flow reactor will be conducted. The technical analysis will be completed by an economical evaluation in order to compare with other processes (incineration,...).

Partenaires

4 partners : CEA ; CNRS-CEMHTI ; Suez Environnement ; a Danish SME, TKE

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Aide de l’ANR

897 621 euros

Début et durée

December 2008- 36 months

Référence

ANR-08-BIOE-008

Titre du projet**SYLVABIOM– New concepts of sustainable energy crops with woody species****Résumé**

The goal of the present project is to re-define the concept of energetic crop of perennial forest species in the context of the "plant x environment x crop-system" relationships. Two production methods will be evaluated: short rotation coppice and short rotation plantation. These two systems are justified by the reproduction biology of the two groups of fast growing species tested. The project is centered on a short rotation plantation network that will be planted in contrasted environments, where local pedo-climatic and silvicultural parameters will be monitored. In the specific case of short rotation coppices (SRC) and for three species (poplar, willow and black locust), the project will also improve our knowledge of water and nutriment use efficiency, two key factors of the sustainability of this type of culture. Adequation between vegetal material and environment will be thoroughly looked at, with a goal of fertilization and irrigation minimization depending on site characteristics. Several contrasted pedo-climatic and silvicultural conditions will be tested.

Partenaires

UR Amélioration, Génétique et Physiologie Forestières – INRA
Centre d'Orléans
UMR Ecologie et Ecophysiologie Forestières – INRA Centre de Nancy
Institut Technique Forêt Cellulose Bois Ameublement
Laboratoire de Biologie des Ligneux et des Grandes Cultures
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Aide de l'ANR

814 449 euros

Début et durée

December 2008- 48 months

Référence

ANR-08-BIOE-006

Titre du projet**SYMBIOSE – Study and Optimization of coupling anaerobic bacteria-Microalgae to produce energy by biological way from primary biomass and organic waste****Résumé**

The ambition of Symbiose project is to develop an integrated system designed to produce methane using a source of industrial CO₂, a source of organic waste, and solar energy. This technology will reduce the costs associated with the recovery of the energy issued from microalgae. The project is aiming at combining microalgae cultivation capturing CO₂ from industrial process and anaerobic digestion for recycling nutrient in the culturing units and produce methane. Symbiose relies on recent advances in both control of microalgae cultivation and anaerobic digestion processes. It integrates ecology of pond ecosystems and ecodesign. Therefore new field of researches will be investigated: research of ecosystems involving algae / bacteria with high tolerance to extremes growth conditions, use of two step anaerobic digestion, codigestion of an organic substrate with algal biomass and recycling mineral nutrients into the microalgal growth unit. The project is targeting the exploitation of mechanisms that take naturally place within aquatic environments, but by placing them in optimal conditions. Expected results will be of key interest for most of the projects dealing with mass cultivation of microalgae.

Partenaires

- Naskeo Environnement (Narbonne)
- INRA-LBE (Narbonne)
- INRIA –COMORE (Sophia Antipolis)
- IFREMER (Nantes)
- CNRS-ECOLAG (Sète)

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Aide de l'ANR

1 028 568 euros

Début et durée

December 2008-36 months

Référence

ANR-08-BIOE-011

Titre du projet	VeGaz – Green natural gas production from syngas through biomass gasification
Résumé	<p>Biomass gasification is a promising way to make renewable energy. It produces syngas which can be turned into different kinds of energy: CHP (Combined Heat Power), bio-fuel or combined SNG (Substitute natural gas) and heat. Combined SNG/heat is environment-friendly (high energetic and chemical yields, local heat valorisation, reasonable biomass supply and valorisation) and are complementary to the other renewable energies.</p> <p>VeGaz will study the combined SNG/heat process, in the case of gasified biomass. It is part of an industrial project made of a demonstration operation and an R&D platform on biomass gasification and its different valorisation.</p> <p>An usual process to make SNG and heat from biomass is made of 4 blocks: gasification, syngas conditioning, methanation, SNG conditioning for natural gas grid injection or for NGV. Gasification is not specifically studied in this project.</p> <p>Vegaz is going to</p> <ul style="list-style-type: none"> - estimate the place of combined SNG/heat position technically, economically, environmentally in comparison with the other uses of gasified biomass (BtL) - identify and characterize the R&D needs and the roadmap toward industrialization. <p>In order to fulfil these goals, Vegaz is working on the syngas conditioning, the methanation, the SNG conditioning, to get the missing scientific and technical ground data. These data will be the keys to simulate combined heat/SNG processes and then get energetic, economic, environmental balances. With these results, Vegaz will be able to evaluate the combined heat/SNG path.</p>
Partenaires	<ul style="list-style-type: none"> - GDF SUEZ / DRI - CRIGEN - Ecole Centrale de Lille for the Catalyst and Solid Chemistry Division - Process, Environment and Food industry Laboratory – EMNantes School of Engineering - Claude Bernard Lyon 1 University – Analytical Science Laboratory UMR 5180 - French Atomic Energy Commission/DEN/DTN/SE2T/LPTM
Coordinateur	Olivier Guerrini – GDF SUEZ / DRI - CRIGEN
Aide de l'ANR	796 228 euros
Début et durée	December 2008- 24 months
Référence	ANR-08-BIOE-007