

Products

Technical guide for energy exploitation of plant oils in ECOWAS countries (2011): the objective of this guide is to identify and describe oil-bearing plants of economic and social use at ECOWAS country level and local population level. <http://www.editions-harmattan.fr/>

Data sheets

Four data sheets describing biomass conversion processes are available on request: Gasification of biomass; Rapid pyrolysis of biomass; Heat generation by combustion of biomass; Steam cycle generation of motive force or electricity from biomass.

> Contact: nathalie.iguedlane@cirad.fr

Technical installations accessible to our public and private partners

Staged gasification pilot: this installation, with capacity 20 kg/h (100 kWth), is aimed at producing a clean synthesis gas from biomass.

Fixed-bed coal gasification pilot: the Continuous Fixed-Bed Reactor (CFBR) reproduces the coal gasification zone of the fixed-bed and staged gasification processes. The instrumentation, the key point of this system, enables comprehensive thermal and chemical mapping of the reactive bed.

Rapid pyrolysis pilot: this installation, with a capacity of around 1 kg/h, is aimed at converting biomass to a densified liquid form: bio-oils.

Vibrating bed torrefaction pilot: inside a 3 m electrically heated reactor (walls at 200–300°C) a continuous feed of biomass is broken down into solid residue, condensable and non-condensable gases.

Engine pilots and bench: research into the technological field is based on a set of reactors and pilots ranging from particle scale to semi-industrial scale. So the semi-industrial pilot platform is a key tool, both in terms of research and partnership with the private sector, in a field experiencing an international boom.

Engine test bench: this is a specific room for studying biofuel combustion in engines. This acoustically insulated room has an acquisition centre for measuring the temperatures at different points of the engine, and the exhaust gas composition (via a gas analyser).

> VIP contact: catherine.remondatt@cirad.fr

Training

Cirad is involved in passing on knowledge under partnerships (Albi school of mining, Supagro) and contributes to various Masters courses ("Renewable energy" of the Montpellier Polytechnic Institute and the Paris School of Mining; "Energy" of ZIE).

Training in specific topics can also be organised "on request".

> VIP contact: florence.paulet@cirad.fr

> www.cirad.fr/enseignement-formation/offre-de-formation

December 2011 # 20

VIP

TECHNOLOGY TRANSFER
AND DEVELOPMENT NEWSLETTER

Energy in the South, and thermo-chemical exploitation of biomass

Replacing fossil carbon with "biomass carbon" is a path taken by the Southern countries with increasing frequency. As well as improving the carbon balance, it also enables them to cope with price variations of oil-based fuels and contribute to their energy independence.

An abundant resource in many Southern countries, biomass is a potential energy source for developing economic activities (particularly conservation and food processing activities). The conversion of this biomass into energy must however be optimised by high-efficiency processes, i.e. suited to the available materials, the socio-economic contexts and the local environments.

Cirad has acquired know-how in combustion of agro-fuels in engines, and thermo-chemical conversion of lignocellulosic biomass into energy, via pyrolysis and gasification processes. Our knowledge of these conversion technologies and our experience of cropping systems in tropical zones put us in position as a favoured partner for projects aimed at improving the energy independence of rural populations. Our studies, conducted from the laboratory sample to the industrial pilot stage, are based on multi-discipline approaches required for the adoption of technological innovations and the organisation of the industries for the benefit of populations.

FOCUS

**1/3 of the world's population
does not have access to energy services,
primarily in rural zones of developing
countries.**

VIP
VALORISATION ET INNOVATION
EN PARTENARIAT

Editor: Patrick Caron, Director of Research and Strategy

Coordination: Technology Transfer and Development Office

Editorial Committee: CIRAD network of Technology Transfer and Development Coordinators - vip-cirad@cirad.fr

Avenue Agropolis, TA 181 / 04 - 34398 Montpellier Cedex 5, France
Tél: +33 4 67 61 44 61 - Fax: +33 4 67 61 56 57

www.cirad.fr/en/innovation-expertise/



cirad

LA RECHERCHE AGRONOMIQUE
POUR LE DÉVELOPPEMENT

Expertise, project and partnership

Partnership and capacity building in the South

Cirad and 2IE (the Inter-African Institute for Water, Energy and the Environment) have developed a capacity to meet the requests of West African private companies and government institutions for the development of "biomass-energy" processes or industries.

"In Burkina Faso, since 2006 we have developed a strong partnership with the 2IE foundation. This higher education and research establishment, with a West African region-wide scope, works for the development of research activities in the fields of water, the environment and energy. The priority of this collaboration is the development of bioenergy and biofuel research, as well as capacity building through training and research. Following the inauguration in 2008, a joint research platform was developed. It hosts researchers from 2IE and the Cirad Biomass-energy research unit, as well as PhD students, post-doc students and Masters interns. It also hosts researchers from other countries. The fields of research developed cover the synthesis and optimisation of physico-chemical properties of agro-fuels, control of pyrolysis to target the properties of the products according to the intended applications, and matching bioenergy supply (in terms of technology and resources) and demand."

Sylvie Mouras, Cirad

> For further information: <http://www.2ie-edu.org/>



RESEARCH issues

Exploitation of biomass for the energy requirements of populations entails research issues covering production of the resource, the conversion technologies, the organisation and sizing of the industries. These issues take into account all resource usages, whether of the biomass itself, or the land or water necessary to produce it.

In terms of the technological aspect, the objectives of our research are to develop optimised agro-fuel combustion technologies, and lignocellulosic biomass pyrolysis & gasification technologies for specific contexts in the South. This requires a knowledge of the reaction mechanisms, identification of the conversion reaction limiting factors, study of the influence of biomass nature and of agro-fuel composition on the reactions. The second objective is to define how to set up sustainable energy supply industries, with particular focus on the sizing and organisation of the industries and assessment of their environmental impacts.

See also in "Perspective" on www.cirad.fr: "Food or biofuels, must we choose?", Marie-Hélène Dabat, Joël Blin.

The GFE project (2011-2012) ("Gasifier for Everyone") aims to develop a low-power biomass gasifier (10 to 200 kWe) for heat and electricity generation. This gasifier meets the requirements of rural populations or companies not connected to the grid. The GFE project is designed to accept a wide range of biomasses available in the South (fruit stones, savannah grasses, cotton straw, etc.). At the end of the project, a prototype should be installed in West Africa for the purposes of demonstrations, training and research.

Under this project, Cirad has teamed up with a gasifier manufacturer, which brings its skill in gasification reactions and the sizing of such reactors. It also brings its knowledge of the local contexts of the South and of the biomasses likely to be exploited.

Technical diagnostic of biomass pyrolysis and gasification processes

In parallel with its knowledge of the processes, Cirad has developed skills in sampling and analysis of pyrolysis and gasification products. These skills are essential for evaluating reactor operation, for diagnosing faults and optimising processes. It also enables us to measure the potential environmental impacts of the processes. A portable sampling line has been especially designed in Montpellier for *in situ* analysis of permanent gases and to sample condensable products. These skills have been deployed with private companies in France, Europe, Brazil and China.

Physico-chemical characterisation of solid or liquid biofuels

Many biomasses can be exploited for energy: wood and by-products of logging, primary agricultural residue such as straw, rice hulls, plant oils, etc. and residue from agri-business processing (olive cakes, nut and seed shells, etc.). These types of biomass have highly variable properties that need to be measured in order to optimise the processes. Our laboratories are equipped and competent to measure:

- higher heating value (HHV) and lower heating value (LHV)
- ash, moisture and volatile matter contents, as per standard NF EN 1860-2
- specific surface area,
- temperatures and kinetics of thermal decomposition by TGA
- chemical composition of liquid fuels (gas chromatography with TCD)
- water content, as per the Karl Fischer method.

Deployment of energy solutions in a tropical environment

There is a great variety of socio-economic contexts in which energy exploitation technologies of biomass can be set up, and these contexts should be studied before a technology transfer. This means expertise in:

- analysis of energy demand of consumer groups (island environment, localities, regions, development project, etc.) and matching this demand with the technical & economic characteristics of the biofuels available,
- study of conditions for transfer and uptake of technologies, especially in rural zones,
- technical & economic feasibility analysis of the energy solutions envisaged.

> UPR Biomass-Energy [Internal Research Unit]

> VIP contact: catherine.remondatt@cirad.fr

Other expertise...

- Dedicated crops sciences (Jatropha, sugar cane, fibre cane, sorghum, etc.)

> VIP contact: christian.didier@cirad.fr

- Biomass methanisation

> VIP contact: patrick.bisson@cirad.fr