Latin America Thematic Network on Bioenergy - LAMNET

3rd Project Workshop - Brazil

Timing: 2nd December 2002 – 4th December 2002

Location (3-4 Dec): National Confederation of Industry – CNI
Brazilian Banking Sector North (SBN) – Square 1 – Block C
Edificio Roberto Simonsen
70040-903 Brasilia – DF, Brazil

WORKSHOP SUMMARY

This workshop was **organised by WIP-Munich**, Germany, **in collaboration with ETA-Florence**, Italy, **and the Brazilian National Reference Centre on Biomass - CENBIO** within the framework of the LAMNET project funded by the European Commission, DG Research.

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Updated information on this workshop is available at www.wip-munich.de, www.etaflorence.it and at www.bioenergy-lamnet.org.

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Workshop on Bioenergy Policies and Innovative Biomass Technologies 2-4 December 2002, São Paulo/Brasilia, Brazil

This workshop on Bioenergy Policies and Innovative Biomass Technologies was organised by WIP-Munich, Germany, in collaboration with ETA-Florence, Italy, and the Brazilian National Reference Centre on Biomass - CENBIO within the framework of the LAMNET project funded by the European Commission, DG Research.

The workshop took place at the venue of the National Confederation of Industry – CNI in Brasilia and the scientific contributions by members of the LAMNET project and invited speakers focussed on national and international programmes and strategies for the promotion of bioenergy. Presentations were given on bioenergy implementation opportunities in several Latin American countries (Brazil, Costa Rica, Cuba) as well as bioenergy technologies such as ethanol and bio-oil production, biomass densification, biomass fermentation and biofuel driven micro-turbines.

Additionally, this workshop included a Thematic Priority Session on ethanol based fuel cells and a technical tour to the Copersucar Technology Center - CTC, one of the world's most advanced research and development centres in the sugar and ethanol sector.

Technical tour: Copersucar Technology Center - CTC

The Cooperative of Cane, Sugar and Ethanol Producers of the State of São Paulo (Copersucar) is a private association whose basic objective is the competitive development of the agro-businesses of its 91 associates, including 32 sugar and alcohol production units. In the season 2001/2002 the cane production capacity of Copersucar amounted to 54 million tons (about 20% of the total Brazilian production) which was almost equally used for the production of ethanol (2.4 billion liters) and sugar (3.5 million tons).

Technological research has played a very fundamental role among Copersucar´s objectives since the end of the 1960´s, when the program to improve the varieties of sugarcane was created. In 1979, the associates created the Copersucar Technology Center, which is today one of the most advanced technological research centres in the cane, sugar and ethanol producing sector.

The technical tour included an introductory presentation of CTC activities by Manoel Regis Leal, Head of the Industrial Technology department, a presentation on recent research and development efforts in the ethanol production sector by Jaime Finguerut as well as a guided tour to the research and technological development facilities by Manoel Regis Leal and Tadeu Andrade, CTC Technology Manager.

Based in Piracicaba, São Paulo State, the CTC is responsible for the development and implementation of new technologies. The CTC has analytical and development laboratories, three experimental stations and a research field. The activities of CTC include, the development of new varieties of cane, the technology for agricultural production, the technology for transformation of sugar cane into sugar and ethanol, the development of new products such as biodegradable plastic as well as research into technology development in association with local and foreign universities.

Inauguration Session: Bioenergy Strategies and Policies

Prof. José Roberto Moreira, President of Council of the Brazilian National Reference Centre on Biomass (CENBIO), welcomed the participants of the 3rd LAMNET project workshop on behalf of the workshop organisers WIP-Munich, ETA-Florence and CENBIO. In his introductory remarks he presented the results of a detailed investigation on the future worldwide potential of primary and secondary biomass energy based on sugar cane as a high energy content biomass resource.

This study shows that with the utilisation of a variety of renewable energy sources it is possible to fulfil the energy requirements of all scenarios for the year 2100 presented in the Special Report on Emission Scenarios (SRES) of the Intergovernmental Panel on Climate Change (IPCC), thereby confirming the findings of the IPCC that it is possible to stabilize CO_2 atmospheric concentration at low levels of 350-500 ppm by implementing available renewable energy technologies.

The political impact of the workshop was underlined by the inauguration speech of Marcelo Khaled Poppe, Director of the National Department for Energetic Development of the Brazilian Ministry of Mines and Energy. The Brazilian R&D targets in the bioenergy sector focus on a variety of biofuels such as sugarcane ethanol, bio-petroleum and bio-diesel from vegetable oil as well as biomass based electricity generation through biomass gasification, ethanol driven fuel cells and the utilisation of sugarcane residues. Furthermore, the Brazilian Government provides several incentives for the development of non-conventional renewable energy projects. Thereby, the latest PROINFA legislation calls for the insertion into the grid of 1,100 MW from each of the renewable resources Wind, Small Hydro and Biomass until December 2006. By 2019, PROINFA aims at realising a 10% share of renewable resources in the total Brazilian energy consumption matrix. This ambitious target is believed to boost the initiation of renewable energy project and especially bioenergy projects in Brazil, thereby strengthening Brazil's role as a pioneer in adopting measures for the effective reduction of greenhouse gas emissions in the energy sector.

A brief report on the structure and activities of the project 'Latin America Thematic Network on Bioenergy – LAMNET' was presented by Dr. Rainer Janssen, LAMNET project co-ordinator. The main objective of this global network on bioenergy is to establish a trans-national forum for the promotion of sustainable biomass use in Latin America and other emerging countries. Within this project recommendations are elaborated for the development and implementation of policy options and an efficient dissemination of the project results is realised through the publication of a periodical newsletter and the establishment of a project web site (www.bioenergy-lamnet.org). Additionally, several workshops and seminars focussing on bioenergy related topics are organised during the implementation of the LAMNET project.

As former member of the 'German Enquete Commission on Sustainable Energy Supply' Harry Lehmann, Institute for Sustainable Solutions and Innovations, Germany, presented an insider view on the results elaborated by this Enquete Commission of the German Parliament. Three groups of energy scenarios (focussing on 'Reducing emissions in the conversion sector', 'Renewable energy sources and energy efficiency' and 'Increased use of nuclear energy') were used to study the concrete implementation of a GHG reduction target of 80%, which is necessary to stabilise the global climate.

It was found that even the most conservative scenarios resulted in a significant future contribution of renewable resources. Moreover, it is possible to cover the total energy demand in Germany by means of solar energy until 2050. The costs of 170-700 € per capita per year involved in this scenario are comparable with the costs of other energy supply scenarios. According to Mr. Lehmann the most favourable scenarios are based on renewable energies, energy efficiency measures and the introduction of an intelligent Demand Side Management. Finally, Mr. Lehmann emphasised the fact that decisions paving the way for sustainable energy scenarios have to be taken now as the construction of new centralised facilities will determine the energy supply structure for the next 50 years.

Luiz Carlos Corrêa de Carvalho of the São Paulo Sugarcane Agroindustry Union (UNICA) reported on the opportunities of sugar cane as a perfect biomass for energy. Sugarcane energy is stored equally in sugar juice, bagasse and straw and these resources can be utilised for the production of sugar and ethanol as well as the co-generation of electricity. Harvested on an area of 5 million ha (1.5% of the Brazilian total agricultural area), the sugar cane production amounts to an energy equivalent of 300.000 barrels of oil per day. Potentially, the sugar cane cultivated area can be extended up to 10% of the agricultural area (33 million ha) for the production of 2.000.000 barrels of oil equivalent per day. This extension can be achieved in a sustainable and competitive way without the need for technology improvements and it would lead to the production of a large variety of valuable by-products in addition to the substitution of oil as an energy source. With a current consumption of oil of about 1.500.000 barrels per day, Brazil therefore is a country with an actual possibility of energy self sufficiency based on renewable energy sources.

Discussion Round:
Impact of the WSSD in Johannesburg on the future of bioenergy

The moderator Prof. José Moreira, CENBIO, led the audience of about 50 people through this round table discussion, introduced the speakers and co-ordinated the questions and discussions.

Prof. Suani T. Coelho presented a brief overview on the Impact of the World Summit on Sustainable Development (WSSD) in Johannesburg, August 28th to September 4th, on the Future of Bioenergy. As Executive Assistant of the Secretary of State for the Environment of São Paulo State she had been member of the Brazilian delegation at the World Summit.

The crucial issues discussed at the WSSD with respect to energy policies were the sustainability of large hydro projects, traditional biomass utilisation (mainly fuel wood) and nuclear energy. Considerable disagreement existed among the summit delegates concerning above topics as well as the set-up of ambitious targets and timeframes for the introduction of renewable energies and the cost-effectiveness of renewable technologies.

Two main energy initiatives were proposed at the World Summit being the Brazilian Energy Initiative '*to increase the global share of renewable energy to 10% by 2010'* (supported by Latin American and Caribbean countries) and an initiative presented by the European Union which aimed to 'd*iversify energy supply by developing cleaner, more efficient and innovative fossil fuel technologies, and by increasing the global share of renewable energy sources to at least 15% of global total primary energy supply by 2010'.* The latter proposal included large hydro and traditional biomass and therefore was a very modest proposal, practically to be seen as a business as usual approach. Both initiatives were not adopted by the summit due to strong opposition by the US, Japan, Korea, Australia, Russia as well as the OPEC countries.

The shortcomings of the final approved text of the WSSD in the view of renewable energy supporters were the inclusion of nuclear technologies and large hydro without environmental constraints and the exclusion of quantified targets and timeframes. On the other hand, the passage of the WSSD text reading '*With a sense of urgency, substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply'* marks a progressive point of no return realised through the continuous pressure by environmentalists, the press and private companies. Additionally, regional initiatives by Latin American and European countries will in future strengthen the role of renewables and the World Summit has provided new impulses to the Kyoto commitment and it has broadened the discussion on sustainability.

Dr. Wolfgang Palz, Member of the World Council of Renewable Energies, Germany, reported on recent initiatives in the European Union in the field of bioenergy. The European Commission has adopted an action plan and two proposals for Directives to foster the use of alternative fuels for transport, starting with the regulatory and fiscal promotion of biofuels. The Commission considers that the use of fuels (such as ethanol) derived from agricultural resources is the technology with the greatest potential in the short to medium term. The action plan outlines a strategy to achieve a 20% substitution of diesel and gasoline fuels by alternative fuels in the road sector by 2020. Additionally, the German Chancellor Schröder has anticipated the organisation of a World Conference on Renewable Energies in Berlin in 2003 as a follow-up of the measures initiated at the WSSD.

Hon. Rivacoba, Ambassador of Cuba in Brazil, stated that it is of utmost importance to keep in mind all aspects of the broad concept of sustainable development including distribution of wealth, conditions of life and international economic relationships. The Millenium Development Goals which formed the heart of the WSSD include environmental sustainability, the eradication of extreme hunger and poverty, the provision of a minimum primary education with equal opportunities, the reduction of child mortality, the improvement of living conditions, the ensuring of access to potable water as well as the establishment of a global partnership to development. The latter includes non-discriminatory international systems of trade and finance, which are suited to the special needs of developing countries.

Mr. Harry Lehmann presented a different view on the strong opposition to quantified targets and timeframes for renewable energies by countries such as the US, Japan, Korea, Australia, Russia and the OPEC. He claimed that this lack of consensus will provide opportunities to those countries dedicated to the promotion of renewable energies whereas in the case of a broad consensus 'the slowest ship would make the pace'. Today, there is no doubt about the supporters and opponents of a stronger role of renewable energies and partnerships can be formed along these lines. As renewable energies are among the key technologies for the 21st century a head-start may well soon turn into considerable business opportunities. Effective networks as well as strong regional, national and international initiatives and cooperation schemes have to be formed today which are dedicated to the substantial increase of the global share of renewable energy sources.

Biofuels and Sustainable Electricity Generation in Latin America

Dr. Nasir El Bassam of the German Federal Agricultural Research Centre (FAL) pointed out the great opportunity of biomass based transport fuels to substitute fossil fuels, as their similar nature facilitates distribution through the existing infrastructure. These alternative fuels can be converted into a wide variety of energy carriers such as biodiesel, ethanol, methanol, DME, diesel, gasoline and hydrogen by utilising existing technologies, and thus have the potential to be a significant source of energy for the 21st century.

The presentation of Leiner Vargas Alfaro, ECOMAP Unit - International Center for Economic Policy (CINPE-UNA) in Costa Rica, focused on the potential for ethanol production and utilization in Costa Rica. Due to the fact that the Costa Rican economy has been strongly affected by external shocks caused by the international oil market in the past, the Government is very interested in the exploitation of ethanol and other biofuels. The recent Costa Rican president mandate in the National Plan for Development (2002-2006) includes the substitution of MTBE (methyl tertiary butyl ether) in gasoline by ethanol or similar options for the utilisation of biofuels.

For the implementation of this mandate, the public authorities have organized a group with representatives from the Ministry of Agriculture, RECOPE, the Ministry of Environment and mayor interest groups. The first exploited option will be the substitution of MTBE by ethanol. Currently, the terms of reference for a pioneer study are being developed and CINPE is joining the group as a part of the University Academic Consortium. The mayor aim of this study is the quantification of the potential use as well as the investigation of the technical and economic implication of this substitution process.

Dr. Antonio Valdés of the Centre for Managing Prioritised Programmes and Projects (GEPROP), Cuban Ministry for Science, Technology and Environment, emphasised the role that biomass can play in the Cuban electricity generation sector in order to alleviate the current dependence from fossil fuels. Since the beginning of the last century, electric energy has been co-generated in the Cuban sugar industry. In order to improve the economic performance of co-generation and to ensure sufficient supply of electricity to the national grid, co-generation units have to run on a year-round basis. Therefore, a secondary fuel is required for the sugar cane off-season for which other biomass resources are regarded as the best option. Today, approximately 30% of the sugar cane factories in Cuba offer the opportunity for co-generation and the implementation of electricity generation projects are currently being prepared by the Cuban sugar cane industry.

Guilherme Machado of BTG Brazil reported on recent developments in the production of bio-oils. Biomass residues such as wood, bagasse or rice husks can be converted into bio-oil through a process of fast pyrolysis. In the Netherlands, the construction of a 40 ton/day bio-oil demonstration plant is expected to be in operation by the end of 2003. Bio-oil can be considered as an important breakthrough in the transition from power generation using conventional fossil fuels to the future use of clean sustainable green fuels. Success of bio-oil production and its applications will open new perspectives for biomass technologies, especially in biomass rich countries such as Brazil, and may lead to international trade with western countries. A first assessment carried out together with local partners has shown that the cost for bio-oil production in Brazil is expected to be around 25 to 40 Euro/ton.

Ethanol based Fuel Cell Technologies

In this thematic session the two basic principles for the realization of ethanol based fuel cells, i.e. the direct electrochemical conversion of ethanol and the reforming of ethanol to hydrogen, were presented and discussed by renowned international experts.

As an introduction, Prof. Wolf Vielstich, University of São Paulo – Chemistry Institute of São Carlos, gave a lecture on the principle and application of fuel cells. The electrochemical conversion of chemical energy into electricity is not limited by the 'Carnot factor' as in coal or natural gas power stations and basic thermodynamics show that fuel cells can offer high energy efficiencies, especially at low power. For the cold combustion occurring simultaneously at the anode and cathode in fuel cells, the power density strongly depends on the electrocatalysis of the charge transfer reactions. Therefore, optimising the charge transfer through the choice of suitable catalysts is essential for the realisation of efficient fuel cells. Whereas today the conversion of hydrogen in low temperature fuel cells is reasonable well understood, there is still considerable need for research on the charge transfer in direct ethanol fuel cells. Currently, the energy stored in ethanol can not be exploited satisfactory through direct electrochemical conversion.

Monica Saraiva Panik, Ballard Power Systems AG, Germany, stated that fuel cell technology will strengthen the future of ethanol as a fuel for automotive application in Brazil. It will open new markets for the use of ethanol, create new business opportunities, encourage the use of renewable energies and increase international commerce.

Ballard Power Systems AG is recognized as the world leader in developing, manufacturing and marketing zero-emission proton exchange membrane ("PEM") fuel cells for the use in transportation, electricity generation and portable power products. The most recent fuel cell vehicles from DaimlerChrysler and Ford are equipped with Ballard fuel cell systems. Ballard appreciates the important role of the Brazilian market in the commercialization of fuel cell technologies, as Brazil is the world leader in the use of bio-ethanol as transportation fuel. Therefore, a collaboration project with ethanol and sugar-cane producers and the Brazilian Government has been initiated. This project will include tests and analyses on the reforming of ethanol and a study on potential applications of fuel cell systems in Brazil.

Dr. Peter Hübner of the Fraunhofer Institut für Solare Energiesysteme (ISE), Germany, presented the results of an EC co-funded research project on the reforming of ethanol. Ethanol can be used as a feedstock for a steam reforming process to generate a hydrogen rich gas stream. The produced hydrogen is used as fuel for a polymer electrolyte fuel cell (PEFC) with a high electric efficiency of about 50 %.

The main target of this project was to develop and investigate a fuel cell system in the kW range. The research performed at the laboratories of ISE included a catalyst screening for the reforming process and the investigation of the shift process for gas purification. Based on these results a combined burner/reformer unit was developed supplying a hydrogen flow with an energy content of about 3 kW. This pilot unit has been operated successfully proving the feasibility of ethanol reforming for the application in hydrogen driven low temperature fuel cells.

Prof. Teresa Iwasita, University of São Paulo – Chemistry Institute of São Carlos, reported on recent studies of ethanol oxidation on platinum electrodes. It has been scientifically proven that platinum is a good catalyst for the dehydrogenation of C-H compounds. However, complete oxidation of ethanol requires the breaking of C-C bonds, a process for which a good catalyst has to be found. In conclusion, the direct electrochemical conversion of ethanol in fuel cells offers a large potential for future exploitation, but this process still has to be optimised.

Dr. Newton Pimenta Neves Jr. of the Brazilian National Reference Center for Hydrogen Energy (CENEH) pointed out that currently fuel cell technologies are not ready for commercialisation, as few models are commercially available and the costs are still very high. Nevertheless, market niches may be profitably exploited, especially back-up systems and portable applications, for which the efficiency and durability requirements can already be fulfilled. In November 2002 a Brazilian Program on Fuel Cell Systems was launched in order to coordinate investment and R&D projects in this field. This program aims at opening up new markets for the use of ethanol and creating new business opportunities in Brazil.

Within the discussion round on 'challenges and opportunities of ethanol based fuel cells' it was agreed upon that fuel cells will contribute to the world's future cleaner energy supply by exploiting their high efficiency and low pollution levels. Thereby, the introduction of bio-ethanol based fuel cells will have to take advantage of the existing bio-ethanol infrastructure in Brazil providing a suitable fuel supply with a low level of contaminants. Nevertheless, extended research on the micro-contaminants in bio-ethanol has to be performed to ensure safe operation of the fuel cells. Furthermore, ethanol fuel cells, both direct conversion or via reforming, are currently still in the R&D stage. Especially the charge transfer in direct ethanol fuel cells still needs to be optimised and further research is required in order to find a suitable catalyst. Although commercialisation of ethanol based fuel cells is therefore not expected in the very near future, there is a great opportunity for cooperation between countries developing innovative fuel cell technologies and Brazil with its long term experience in the production and processing of bio-ethanol.

Innovative Bioenergy Technologies

In the first presentation of this session Ms. Susanne Kimmich, Institut für Solare Energie-versorgungstechnik e.V. (ISET), Germany, reported on newly developed decentralised energy self-sufficient supply and disposal systems. Current concepts for the supply of electricity to islands and island systems are mostly based on the use of solar cells with battery storage and a diesel power unit to bridge the peak loads and periods of bad weather. In order to include water supply and waste disposal into the system in a sustainable manner, new and comprehensive concepts for supply and waste disposal are called for, which can ensure reliable and self-sufficient operation. For this, the separate components of energy and water supply as well as sewage purification and treatment of organic waste have to be integrated in a holistic and ecologically sound concept.

Dr. Giuliano Grassi, Secretary General of the European Biomass Industry Association (EUBIA), presented a technological and economical analysis of innovative bioenergy systems. The following bioenergy technologies are regarded as ready for commercialisation and offer opportunities for large-scale implementation in the near future:

- Innovative, cost effective and low energy-input pelletisation technologies can be used for a variety of types and mixtures of humid biomass. This will benefit the exploitation and large scale deployment of biomass, because the problem of permanent storage is solved and the logistics of biomass is simplified.
- Small cogeneration units can facilitate decentralised power production with small size plants (50 –500 kWe), providing opportunities for remote energy supply to houses, villages, hotels, tourist centres and small sea-water desalination units at remote sites.
- Microdistilleries utilising a variety of sugar and starch crops can be used for decentralised bioethanol production.

- Biofuel-driven microturbine systems for power/heating applications are considered to be a short-term option to deploy an innovative, efficient technology for distributed power generation.

The main goal of EUBIA is thereby the sustainable and rapid development of European bioenergy industries and the promotion and deployment of innovative bioenergy technologies.

Denis Tomlinson of Illovo Sugar Ltd., South Africa, reported on the Renewable Energy Strategy employed by the Republic of South Africa. This strategy runs along the 3 lines of 'independent industry action', the 'co-operation with the National Electricity Regulator (NER) and the main national energy provider ESKOM' and 'green energy independent power producers'. Especially within the sugar cane industry there is a great potential for an increased generation of green energy, either for the industry's own energy consumption or for feeding into the grid. This potential may be exploited through the use of innovative technologies such as high pressure boilers, biomass integrated gasification combined cycle (BIGCC) systems as well as pelletisation and ethanol production units.

A new market perspective offered by pelletisation of biomass residues was presented by Francesco Cariello, ETA-Florence, Italy. Current estimations prove that the overall energy potential of biomass residues (e.g. organic byproducts of the food, fibre and forest industries) is about 85 EJ/year which is a significant fraction of the annual total world energy consumption (459 EJ). Pelletisation of these biomass residues leads to an increase of the calorific value (about 17 MJ/kg) and a reduction of the moisture content (≤ 10%), thereby facilitating biomass management, transportation and storage as well as ensuring an exploitable energetic value for biomass waste.

Finally, Dr. Rainer Janssen of WIP-Munich, Germany, pointed out the opportunities offered by microturbine systems with an output of 20 kW to 100 kW. These simple and compact systems require moderate investment and maintenance costs and operate at low emission levels. The modularity of microturbine units makes them well suited for base load and peak shaving, delivering reliable electricity for both stand-alone and grid-connected applications. Additionally, their high flexibility with respect to the fuel (natural gas, diesel, gasoline, methane) will facilitate the use of biofuels for the operation of microturbines. Today, microturbines are a highly efficient and commercial technology and experiences with the utilisation of liquid biofuels are on-going. Thererfore, it is expected that the market of biofuel-driven microturbines is large if targets for parameters like cost, efficiency, durability, reliability and environmental emissions are met.

The 3rd LAMNET workshop was concluded with a discussion round summarising the results and providing an outlook to future activities of the network.

More detailed information on the workshop including the proceedings and presentations are available at the LAMNET project web site www.bioenergy-lamnet.org.

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