International Bioenergy Forum:
China –EU Cooperation

September 28 – 30, 2003
Guangzhou Oriental Resort

Conference Proceedings

The International Bio-energy Forum met in Guangzhou, P.R. China from 28-30 September 2003 to discuss cooperative efforts in the field of bio-energy between China, the EU and supporting countries. This forum was organized jointly by the Ministry of Environment of Guangzhou, the Guandong University of Technology, the European Biomass Industry Association (EUBIA) and the Global Network on Bioenergy.

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Updated information on this workshop is available at http://www.bioenergy-lamnet.org.

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FORUM PROGRAMME

SUNDAY 28th September 2003

14:00 – 18:00	Registration Meeting among Participants
18:00	Official Reception

MONDAY 29th September 2003

Morning Session: Welcome

Venue: Talent Hall in Triumph Palace

Moderators:	Prof. Wang Qinrou, Guangdong University of Technology Dr. Wolfgang Palz, Board Member of World Renewable Energy Council	
09:00 – 10:00	**Opening Session** Opening Address Welcome Address of China Authority Prof. Qinruo Wang, Director of Automation School of GDUT Introductory Speech of Guangdong Provincial Department of Science and Technology Mr. Xianmin Ma, Deputy Director General of Department of Science and Technology of Guangdong Province Welcome address of Chinese Organization Committee Prof. Huimin Huang, Vice-President of GDUT Welcome Address of European and other Overseas Guests Prof. Ottavio Antonio Angotti, Financial Consultant for Eastern Europe and Central Asia	
10:00 – 10:15	**Industrial Cooperation in the framework of the Global Bioenergy Network LAMNET** Dr. Rainer Janssen, WIP-Munich	7
10:15 – 11:00	**European Vision on Bioenergy** Dr. Wolfgang Palz, Board Member of World Renewable Energy Council	
11:00 – 11:30	**Coffee Break**	

11:30 – 12:30 **Presentation of three Bioenergy Projects under Implementation or exploratory phase in the frame of the EU – China Industrial Cooperation**

Bioenergy Village Complex 17

Large-scale Integration of Bioenergy (heat-power-biohydrogen) within a Crude-oil Refinery Plant 24

Biofuels for Transport

Dr. Giuliano Grassi (Technical aspects)
Prof. Ottavio Antonio Angotti (Economic aspects)

12:30 – 14:30 **Lunch Break**

Afternoon Session: Bioenergy Opportunities for Asian Countries

Moderators: Dr. Jeff Yang, Director of YP Environmental High Tech. Ltd.
Dr. Giuliano Grassi, Secretary General, EUBIA

14:30 – 15:00 **Fuel Ethanol in China**
Prof. Dehua Liu, Tsinghua University

15:00 – 15:30 **Bioenergy development situation in the countryside of Guangdong province**
Ye Cai, Guangdong Provincial Agriculture Department

15:30 – 16:00 **Management of Municipal Solid Waste for Electricity Generation** 28
Prof. Spyros Kyritsis, Agricultural University Athens

16:00 – 16:30 **Coffee Break**

16:30 – 16:50 **Bioenergy Supply for the Tourist Sector**
Mr. Francesco Cariello, ETA-Florence
Ms. Angela Grassi, Managing Director ETA-Florence

16:50 – 18:30 **Round Table with Industries.**
European Industries, potential suppliers of bioenergy technology and plants, will be invited for a short presentation of their commercial products: pelletisation technologies; pellets boilers, stoves, heat pumps, power cogeneration (gasifier-engine generators, micro-turbine generator, small steam-engine generators); microdistillery, bioethanol jelly as cooking fuel, pellet carbonisation kiln, bio-syn gas generator, small biohydrogen plant, liquid sugar unit, CO_2-solid ice unit, biogas plants, pulp for paper, etc.
Open Discussion will follows
Chair: O. A. Angotti, Qinrou Wang, G. Grassi, P. Helm, W. Palz

19:00 **Official Dinner**

TUESDAY 30th September 2003

Morning Session: Financing Bioenergy Projects

Moderators: Prof. Dehua Liu, Tsinghua University
Dr. Peter Helm, Chair Steering Committee Global Bioenergy Network

09:00 – 09:25 **A novel Technology for biodiesel production**
Dr. Wei Du, Tsinghua University

09:25 – 09:50 **Biodiesel Production from African Palm**
Dr. David F. Cala, Executive Director CORPODIB

09:50 – 10:15 **EU-China Cooperation in the framework of the Asia-Invest Programme**
Dr. Herbert-Peter Grimm, WIP-Munich

10:15 – 10:45 **Coffee Break**

10:45 – 11:15 **Transfer of Technologies, Joint Ventures, Opportunities for EU-China Business – International Legal aspects** 40
Dr. Antonio A. Massei, Managing Director, TIRA Energy A.G. (H.K.Y.P.) Ltd.
Dr. Harold Wouters, Berwin Leighton Paisner
Dr. John Ferrari, Lawyer / Technologist

11:15 – 11:40 **Bioenergy Strategy and policy issues in the World** 47
Prof. Gladys Hernandez, CIEM

11:40 – 12:30 **Open Discussion**

12:30 – 14:00 **Lunch Break**

Afternoon Session: Discussion, Summary and Conclusions

Moderators: Prof. Ottavio Antonio Angotti, Financial Consultant for Eastern Europe and Central Asia
Dr. Herbert-Peter Grimm, WIP-Munich

14:00 – 14:40 **Recycled Energy – the application of aqual-fuels gas**
Prof. Qinrou Wang, Guangdong University of Technology, China

14:40 – 15:10 **Biopellets for Space Heating and Industrial Use**
Mr. Tord Fjallstrom, Energidalen
Mr. Sten Eriksson, Managing Director Naturenergi

15:10 – 15:25 **The Utilization of nanometer Material in Gas Storage**
Prof. Haiyan Zhang, GDUT

15:25 – 15:40 **The Development and Utilization of Silicon Battery**
Dr. Jeff Yang, Director of YP Environmental High Tech. Ltd.

15:40 – 16:10	**Coffee Break**
16:10 – 17:30	**Round Table Discussion** Moderator: Dr. Giuliano Grassi, Secretary General of EUBIA
17:30 –18:00	**Results and Conclusions** Prof. Quinruo Wang, GDUT
18:00	**Banquet** Venue: Clean Spring Hall in Blue-Sea Mansion
20:00	Zhujiang River Night Tour

Industries Round Table – Bioenergy Technology Presentation

FORUM INAUGURATION

International Bioenergy Forum: China-EU Cooperation
4th LAMNET Workshop – Guangzhou, China 2003

Industrial Cooperation in the Framework of the Global Bioenergy Network - LAMNET

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Abstract

A global network on bioenergy involving 48 expert institutions (Knowledge Centres and SMEs) from 24 countries has been established in order to promote the sustainable use of biomass in Latin America, Europe, China and Africa. This network supports the elaboration of recommendations for the development and implementation of policy options for the promotion of biomass and bioenergy as well as the identification of commercially available and reliable biomass technologies worldwide. In the field of bioenergy technologies a variety of opportunities for international co-operation, technology transfer and joint-ventures between OECD and non-OECD countries have been identified, and the network actively supports the establishment of initial business contacts. Additionally, members of the global network on bioenergy are involved in the preparation and set-up of national and international bioenergy policy programmes and initiatives aiming at increasing the share of bioenergy and other renewable energies in the global energy supply structure.

Keywords: bioenergy, global network, international cooperation, sustainable development

1. Introduction

Good management of resources, alleviating poverty and improving the socio-economic conditions of living as well as the identification of sustainable technical and economical schemes are key objectives for research and development efforts in emerging countries and successful partnerships of OECD countries with non-OECD countries from Latin America, Asia and Africa. Projects focussing on scientific co-operation and policy research in general and especially in the field of renewable energies are of great importance today, as the creation of suitable policy frameworks is required prior to the development of more advanced technologies in order to tackle the main challenges of sustainable development.
Therefore, scientific co-operation and the linkage of scientists, decision makers and entrepreneurs in thematic networks is expected to gain an ever increasing importance in the relation between OECD countries and countries from Latin America, Asia and Africa. In order to contribute to these objectives the project 'Latin America Thematic Network on Bioenergy – LAMNET' is funded by the European Commission in the framework of the specific research and technological development programme 'Confirming the International Role of Community Research'.

2. LAMNET - A Global Network on Bioenergy

The project 'Latin America Thematic Network on Bioenergy – LAMNET' succeeded in setting-up a trans-national forum for the promotion of the sustainable use of biomass in Latin America, Europe, China and Africa. Currently, the global network LAMNET consists of 48 institutions (Knowledge Centres and SMEs) from 24 countries worldwide, thereby involving a large number of members with excellent expertise in the field of biomass [Janssen et al. (2002)].

LAMNET supports the elaboration of recommendations for the development and implementation of policy options for the promotion of biomass and bioenergy as well as the identification of commercially available and reliable biomass technologies worldwide.

The web site of this global network on bioenergy was established early in 2002 under **www.bioenergy-lamnet.org**. It provides detailed information on the objectives, activities and scientific publications of this trans-national forum as well as the contact details of all network members. Additionally, links are provided to other organisations and companies engaged in the field of bioenergy.

Further dissemination activities of the LAMNET project include the publication of a periodic newsletter
(2 issues per year), a project database providing information on the energy demand and resources in Latin America and other emerging economies as well as the organisation of several bioenergy workshops.

One week prior to the World Summit on Sustainable Development (WSSD) in Johannesburg a workshop on 'Biomass, Rural Energy and the Environment' was organised in Durban as a joint event of the three thematic networks CARENSA, SPARKNET and LAMNET, which are funded by the European Commission Fifth Framework Programme for Research. This workshop aimed at strengthening synergies and initiating future co-operation of the three multi-stakeholder networks in order to promote sustainable energy for development by assessing energy demand and resources, expanding the institutional knowledge base, and by creating a broad-based discussion forum to evaluate innovative policy options.

The 3rd LAMNET project workshop in São Paulo and Brasilia, 2-4 December 2002, on 'Bioenergy Policies and Innovative Bioenergy Technologies' included a 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 (Figure 1).

Figure 1: Visit at the Copersucar Technology Center

In 2003, the LAMNET network is continuing all activities in order to strengthen this trans-national forum for the promotion of biomass and bioenergy in Latin America, Europe, Africa and China. It will thereby contribute to the establishment of modern energy supply systems which are fully in line with today's crucial goals of poverty eradication and sustainable development.
The next LAMNET project workshop will take place in Morelia, México, in the framework of an International Seminar on Bioenergy and Sustainable Rural Development (26-28 June 2003). For the first time this international seminar will bring together in México more than 60 bioenergy specialists from the academic, governmental and industrial sector. The seminar is co-organised by the Universidad Nacional Autónoma de México (UNAM) – Instituto de Ecología, the Asociación Nacional de Energía Solar (ANES), the Food and Agriculture Organization of the United Nations (FAO), the State Government of Michoacán and the LAMNET project.

3. International Cooperation on Bioenergy Technologies

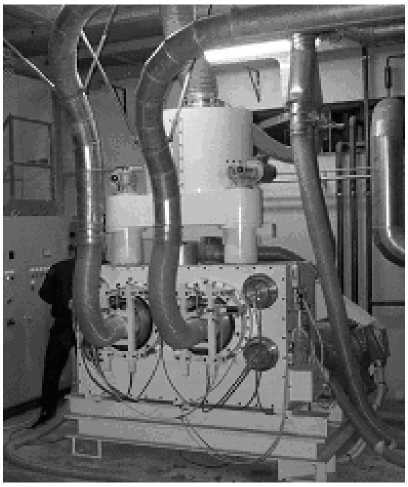
Within the framework of the LAMNET project it is one of the main objectives to identify currently available, efficient, cost-competitive and reliable bioenergy technologies which provide opportunities for the conversion of biomass to energy services in Latin America, Europe, Africa and China. Relevant technologies and systems are selected on the basis of maturity of the technology, cost-effectiveness, simplicity of maintenance, social acceptability and the impact on development. Moreover, opportunities for international co-operation, technology transfer and joint-ventures between OECD and non-OECD countries in the field of bioenergy technologies are identified and promoted by the LAMNET network. Within the framework of the LAMNET project the establishment of initial business contacts is supported through advice and recommendations by expert network members.

The LAMNET project is particularly focused on the promotion of small-scale, decentralised bioenergy technologies as their penetration is expected to be much easier in terms of the supply of biomass resources and the investment level [Grassi et al (2002a)]. Information documents describing bioenergy projects and technologies, which include a detailed technological and economical analysis, are elaborated by the European Biomass Industry Association (EUBIA) in the framework of the LAMNET project. Currently, information documents are available on biomass pellets and briquettes, micro-distilleries for ethanol production and modern bioenergy village complexes.

Pelleting technology for the South African sugar industry

On the occasion of the 2nd LAMNET project workshop on biomass, rural energy and the environment organised by WIP-Munich and Illovo Sugar Ltd. in Durban, South Africa, the Managing Director of network member Illovo Sugar, Mr. Don Macleod, stated that the production of energy from both sugar cane bagasse and molasses is a known technology and therefore sugar by-products can contribute to the global movement towards sustainable "green energy" whilst also improving the return to producers of sugar. Mr. Macleod showed strong interest in new technologies providing opportunities to improve the energy generation capacity. The pelletising technology for a variety of biomass feedstocks is an important step in providing energy from bagasse on a year-round basis and the workshop contributions on this subject are of specific interest to the Illovo group.

Figure 2: Pelletiser machine, Italy



Within the framework of the LAMNET project a cooperation agreement between Illovo Sugar and a European manufacturer of innovative pelleting technology (Figure 2) has been initiated and samples of South African sugar cane bagasse have been compacted at the European pelleting facility. Currently, the produced bagasse pellets are being scientifically investigated at Illovo Sugar in order to verify the future potential of this biomass technology for the southern African region.

Bioenergy technologies for the Cuban sugar industry

The Cuban LAMNET members Dr. Paulino Lopez Guzmán, Bioenergy Development Programme – Ministry of Sugar, and Julio Torres Martinez, Cuban Observatory for Science and Technology reported that the bioenergy sector in Cuba is almost entirely focussing on bagasse as a residue of the sugar cane processing industry and that 80% of the available agricultural land in Cuba is cultivated with sugar cane. This constitutes an enormous resource of biomass, but unfortunately Cuba has so far not exploited this enormous potential in an efficient way. Therefore, international cooperation on innovative bioenergy technologies for an efficient exploitation of sugar cane bagasse, such as High Pressure Steam Turbines, Biomass Integrated Gasification Combined Cycle (BIGCC) and Bagasse Pelleting Technologies, are of great strategic benefit for the Cuban sugar cane industry.

A strategic alliance between the Cuban network members and the European Biomass Industry Association has been accomplished and a technology cooperation agreement, including the installation of pilot pellet production facilities, between the Cuban Ministry of Sugar and a European manufacturer of pelleting equipment has been initiated.

Ethanol based fuel cell technologies for Brazil

On the occasion of the 3rd LAMNET project workshop in Brazil a session was organised on the two basic principles for the realization of ethanol based fuel cells, i.e. the direct electrochemical conversion [Iwasita (2002)] of ethanol and the reforming of ethanol to hydrogen [Rampe et al. (2000)]. Renowned international experts in the field of fuel cells discussed the future potential of this promising technology, especially for countries in Latin America.

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 (Figure 3).

Figure 3: Fuel Cell Vehicle, Germany

Bioenergy technologies for rural development in China

Bioenergy has an essential strategic and practical significance for China, as the exploitation of biomass resources involves rural development, energy development, environmental protection, resource conservation and the ecological balance. Therefore, China is striving to obtain support from international organisations, foreign governments and scientists and shows strong interest in cooperation to promote technological progress.

Within the framework of the LAMNET project a strategic alliance between the network members from China and the European Biomass Industry Association as well as other bioenergy experts from Europe and Latin America has been established in order to identify opportunities for technology transfer and joint-ventures in the field of modern bioenergy technologies [Grassi et al (2002b), Grimm et al. (2002)].

Cooperation on bio-fuels production: Latin America - Europe

The European Commission has recently adopted an action plan and 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 biofuels (such as ethanol) derived from agricultural sources is the technology with the greatest potential in the short to medium term. This action plan outlines a strategy to achieve a 20% substitution of diesel and gasoline by alternative fuels in the road sector by 2020.

In order to take advantage of these policies supporting the large-scale introduction of biofuels in Europe, a cooperation agreement has been initiated between representatives of the German and the Brazilian sugar industry sector on the occasion of the 3rd LAMNET project workshop in Brazil. Thereby, it is envisaged that the long-term experience of the Brazilian network members in the field of ethanol production from sugar crops [Correa Carvalho (2002)] will serve to stimulate and benefit the potential set-up of bio-ethanol production facilities and the distribution infrastructure in European regions.

4. Policy Options for the Promotion of Bioenergy

In order to identify opportunities for co-operation activities between OECD countries and countries from Latin America and Africa in the field of bioenergy, the LAMNET project monitors the development of national energy policy frameworks as well as the preparation and set-up of bioenergy policy programmes and initiatives in selected countries. In the following, recent national policy initiatives promoting the sustainable use of biomass are presented which facilitate the involvement of companies and multi-lateral organisations from OECD countries:

Brazilian energy initiative to the World Summit on Sustainable Development

An ambitious proposal for a revolution in the planet's energy matrix was brought to the Johannesburg Summit on Sustainable Development by Brazil. The Brazilian Energy Initiative, conceived by Prof. José Goldemberg, São Paulo State Secretary of the Environment, calls for extended use of alternative sources like solar, wind, geothermal, tidal, biomass and small hydroelectric facilities [Goldemberg (2002)]. Its goal is to raise the share of these sources from 2.2% today to 10% by 2010.

The LAMNET co-ordination partner Prof. José Roberto Moreira from the Brazilian Biomass Reference Centre (CENBIO) was involved in the elaboration of the technical background document on biomass [Moreira (2002)]. These technical papers served to quantify the world capacity to obtain significant amounts of energy by the year 2010 from new and renewable energy sources. It is shown that through the use of 300 million hectare of land it is possible to fulfil the total global energy demand by using the most advanced agricultural and industrial technologies. The document concludes with a list of practical actions promoted by the Brazilian Energy Initiative that, if implemented, would allow most of the 102 sugarcane growing countries to rely on energy from sugarcane in the short-term and would initiate the creation of a large-scale global bio-ethanol market with significant impact on several OECD countries:

Figure 4: Distillation Column

Source: Copersucar, Brazil

- Immediate increase of the ethanol production (Figure 4) by reducing the export of molasses and its use as feedstock for animal feeding.

  This action can be applied in about 150 sugar producing countries. The production of 100 kg sugar generates molasses for the production of at least 15 litres ethanol. From the production of 120 Mt sugar from sugarcane and sugar beet it would therefore be possible to produce 18 Mm^3/yr of ethanol, an amount sufficient to replace 0.7% of the total fuel consumption in the world within few years.

- Immediate conversion of a share of the sugarcane production from food to fuel.

  This action can be carried out in 102 countries. The present world sugar production from sugarcane is around 100 Mt/yr while the international market turns out to be approximately 30 Mt/yr. Additionally, several sugar producers have large stocks that are not being commercialised due to the risk of a further price reduction. Therefore, a reasonable decision would be to divert 10% of the sugarcane to ethanol production. This means 10 Mt of sugar, yielding 7 million m^3/year of ethanol, one or two years after the decision is taken. This is the maximum time required to install industrial facilities, whereas blending a few percent ethanol in gasoline is an easy task and can be initiated in a few months. Around 6 million m^3/yr equivalent of gasoline (representing 0.3% of the global fuel consumption) can be replaced by this practical action.

Brazil: PROINFA programme

The major objective of the PROINFA programme (Program to Foster Alternative Sources of Electric Power) is to raise the share of electric power generated by independent producers in the Brazilian market. The programme's first phase calls for the central utility Electrobras to sign electricity purchase contracts for the construction of 3 300 MW new capacity (Wind, SHP, Biomass) by 2006. These contracts will ensure the purchase of electricity from alternative sources over a fifteen-year period and this commitment is a way of guaranteeing subsidies that will cover the competitive differential of small producers. PROINFA will assure subsidies to producers of electric power from alternative sources until they can supply 10% of the national energy matrix. From that point on it is foreseen that these producers will have sufficient know-how and effective market share to compete in an open market.

The PROINFA programme, which is an integral part of the Brazilian Law 10438 already signed by the Brazilian President, is scheduled to be implemented in 2003. It will create opportunities for foreign investors which are planning to engage in the construction and operation of renewable energy based electric power generation facilities.

P.R. China: Bioenergy focus of the 10th Five-Year-Plan program

On the occasion of the 2nd project workshop in South Africa, Prof. Wang Mengjie, China Association of Rural Energy Industry, pointed out the vast potential of biomass resources in China (straw: 720 million t/year; firewood: 127 million t/year; livestock waste: 130 t/year; urban waste: 120 million t/year) which up to date are not utilised in an efficient way [Wang (2002)]. The Chinese Government always emphasised the importance of the bioenergy, and the Ministry of Science and Technology regards the development of biomass utilisation technologies as key and preferable research projects. The focus of the current 10th Five-Year-Plan Program will therefore be on the solution of technological difficulties and the demonstration of applicable technologies, including biomass gasification and electricity generation systems, ethanol from cellulose wastes, ethanol from sweat sorghum juice and biomass fast pyrolysis.

In order to realise the ambitious goal to significantly increase the application of innovative bioenergy technologies, China is striving to obtain support from international organisations, foreign governments and scientists and shows strong interest in cooperation to promote technological progress. Within the framework of the LAMNET project close collaboration links are established with the Chinese LAMNET members from the Ministry of Agriculture and the Ministry of Science and Technology.

Colombia: National Alcohol Program for Colombian gasolines

Recently, a promising initiative for the promotion of bioenergy was launched by the Colombian Government. The Congress of the Republic of Colombia on June 19th 2001 approved a new law, which mandates the use of bioethanol from sugar cane in Colombian gasoline and diesel fuel oil in order to improve the quality of these fuels and decrease emission levels. This law follows the example set by the Brazilian Proalcool programme (Figure 5) and it is an example to the world of how a congress of a developing country takes an advanced initiative to promote the use of renewable fuels for the development of a new agro-industrial industry leading to the creation of a significant number of new employments.

Figure 5: Bioethanol-gasoline blend sold at Brazilian gas station

The new law will allow private industry (national and international) to start production of bioethanol to be blended with gasoline (10% volume) in the year 2006, thereby saving 6 million tons of CO2 per year. The LAMNET member CORPODIB (Corporation for the Industrial Development of Biotechnology and Clean Technology) has been actively working in this project during the last seven years. It has elaborated the feasibility study and the implementation plan, and will follow the project during its implementation stage [Echeverri (2002)].

For the implementation of this National Alcohol Program in Colombia private investors are invited to participate in the production of fuel ethanol in an open market. In order to guarantee attractiveness for foreign investors the Colombian Government grants tax exemption for bio-ethanol, and the discount cash flow rate of return for investors is estimated to exceed 20 percent.

Costa Rica: Bioenergy focus of the National Plan for Development

Within the framework of the LAMNET project the potential for ethanol production and utilization in Costa Rica was investigated. 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 of representatives from the Ministry of Agriculture, RECOPE, the Ministry of Environment and mayor interest groups. Currently, the terms of reference for a pioneer study are being developed and the LAMNET member CINPE is joining the group as part of the University Academic Consortium [Vargas (2002)]. The mayor aim of this study is the quantification of the potential substitution of MTBE by bio-ethanol, as well as the investigation of the technical and economic implication of this substitution process.

Cuba: Energy Development Program – Cuban Ministry of Sugar

The large energy potential of sugarcane biomass can be taken advantage of in Cuba as well as most of the Caribbean countries, if modern technologies are used for the production of electricity and alcohol. For this, a profound technological change is required affecting not only the sugar factories, but also agricultural and harvesting practices. The production of electric energy and alcohol from sugar cane can help to alleviate the dependence of Caribbean countries on imported oil and contribute to the mitigation of GHG emissions. But the persistent lack of funds in these developing countries proved to be an obstacle to the introduction of modern technologies until now. Therefore, a regional or local production of the required equipment is necessary in order to reduce the cost of the technological change.

When the Cuban Development Program for National Energy Sources was formulated in 1993, the importance of the Sugar Agroindustry for the development of the National Electroenergetic System (NES) has been analysed. Currently, the Cuban Observatory for Science and Technology, in partnership with the LAMNET members, Centre for World Economy Studies (CIEM) and the Cuban Ministry of sugar (MINAZ), is investigating the main implications concerned with the transformation of the Sugar agro-industry into a modern, flexible and more decentralized NES, which is able to satisfy Cuban electricity needs while avoiding or reducing GHG emissions. The study which is supported by the LAMNET project entails an analysis of technical, economical and social problems related to the introduction of the profound technological changes turning the sugarcane agro-industry into a reliable, competitive and environmentally friendly source of electricity and liquid fuel [Torres (2002)].

Senegal: Regional strategy for sustainable cooking fuels

Traditional energies such as firewood, charcoal and agro-forestry residues dominate the national energy balance in the Sahelian countries. Thereby, wood is mainly used in rural areas whereas charcoal and petroleum are almost exclusively used in urban areas [Fall (2002)]. Today, this non-sustainable energy supply poses serious threats to forest ecosystems as well as to the food supply for the Sahelian population.

Within the LAMNET project it is envisaged to establish cooperation schemes between scientists, decision makers and entrepreneurs from Sahelian and OECD countries in the field of bioenergy applications in order to alleviate major health, social and environmental problems currently afflicting the region such as the deforestation of vast areas of the land and respiratory diseases due to indoor charcoal use.

Republic of South Africa: White Paper on Renewable Energy and Clean Energy Development

Honourable Narend Singh, KwaZulu-Natal Minister of Agriculture and Environmental Affairs, acknowledged the role of the 2nd LAMNET workshop as an input to the United Nations World Summit on Sustainable Development in Johannesburg intending to turn the world away from a self-destructive course in which the economic and other activities of humankind threaten to deplete the natural resources and destroy the basis of human existence. He stated that South Africa represents a microcosm of the challenges to be addressed by the WSSD, as it is unique in having a developed industrial economy, with all its challenges of sustainability caused by over-consumption of vast quantities of the planet's natural resources such as oil, gas, timber and metals, virtually side by side with an under–developed rural economy with all the evils of erosion, contamination of water resources, destruction of natural foliage, over-stocking and exhaustion of the soil's fertility through unscientific cropping.

For sustainable development a balance is required between environmental/conservation, economic and social interests adjusted appropriately to suit every particular circumstance, and it is generally the role of Government to serve as a catalyst and regulator, in partnership with the private sector wherever possible. With respect to the supply of green energy in the province of KwaZulu-Natal Honourable Singh pointed out the opportunity provided by the sugar and timber industry as well as the production of alcohol fuel and bio-diesel from biomass resources such as sugar cane, sunflower seeds and the Jatropha plant. In conclusion, he stated that the near future may well be bright for energy from biomass as the demand in South Africa will exceed electricity generation capacity within three to five years, and decisions will have to be made about new generation, while a White Paper on Renewable Energy and Clean Energy Development requires a five percent increase in the use of Green Electricity by 2012.

This White Paper supplements the Government's policy on energy which pledges 'Government support for the development, demonstration and implementation of renewable energy sources for both small and large-scale applications'. The White Paper sets out the Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa.

The 10-year target for renewable energy laid out in the South African White Paper aims at 'An additional 10 000 GWh renewable energy contribution to final energy consumption by 2012, to be produced mainly by biomass, wind, solar and small hydro'. The South African authorities acknowledge that the financial resources for the realisation of this ambitious target will have to come from a combination of South African and international resources. International co-operation, technology transfer and joint-ventures are therefore strongly encouraged by the South African Government.

5. Conclusions

Within the framework of the global bioenergy network LAMNET a variety of opportunities for international co-operation, technology transfer and joint-ventures between OECD and non-OECD countries have been identified in the field of bioenergy technologies. These opportunities include the application of innovative bioenergy technologies (i.e. biomass pelleting, biomass integrated gasification combined cycle, ethanol production from alternative sources, fast pyrolysis and bio-ethanol based fuel cells) in the Brazilian, South African and Cuban sugar cane industry as well as for rural development in the P.R. of China. Additionally, the long-term experience of the Brazilian network members in the field of ethanol production and infrastructure can be exploited to achieve the goals of an action plan recently adopted by the European Commission aiming at a 20% substitution of diesel and gasoline by alternative fuels in the European road sector by 2020.

Further opportunities for co-operation activities between OECD countries and countries from Latin America and Africa in the field of bioenergy are identified by the LAMNET project through the direct involvement of LAMNET members in the development of national energy policy frameworks as well as the preparation and set-up of bioenergy policy programmes and initiatives. Recent programmes to promote the sustainable use of bioenergy are implemented in Brazil (PROINFA programme), Colombia (National Alcohol Programme), Costa Rica (National Plan for Development), Cuba (Energy Development Program), the Republic of South Africa (White Paper on Renewable Energy and Clean Energy Development) and the P.R of China (Bioenergy focus of the 10th Five-Year-Plan).

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FORUM INAUGURATION

International Bioenergy Forum: China-EU Cooperation
4th LAMNET Workshop – Guangzhou, China 2003

Small-scale Modern Autonomous Bioenergy Complexes – Development Instrument for Fighting Poverty and Social Exclusion in Rural Villages

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EXTENDED SUMMARY

EUBIA (European Biomass Industry Association) has conducted a wide range of analysis of potentials of bioenergy since 1997. Meanwhile, it has been making special efforts for the development and implementation of modern concepts of integrated "food-animal feed-energy" biomass scheme.

With the help of ETA, WIP, Energidalen Co., EUBIA has identified a series of typical, small-scale, sustainable "bioenergy complexes" through their research activities, which are partially sponsored by the E.C.. These complexes are especially attractive for remote villages. When implemented they will be able to not only satisfy the villagers' basic energy needs, but also provide sufficient amount of clean energy for comfort and production activities. **The bioenergy complexes might prove to be solutions to the sustainable development of rural areas**.

Hereafter two types of typical bioenergy complexes will be described: one is based on the exploitation of agro-forestry residues and/or herbaceous crops. The second one is more sophisticated. This integrated biomass scheme will be able to supply a wide range of commodities: food, animal feed and modern clean energy. (therefore of more general strategic interest) It is based on the exploitation of dedicated crops, specific varieties of sweet-sorghum in particular, which have high yields of grains, sugar and lignocellulosic.

The village size considered in the following demonstration examples is in the range of 100-300 inhabitants. With the presently available commercial technologies, a small-scale bioenergy complex can support **a village population of 100 to 5,000 people**. A typical bioenergy complex can also provide numerous employment opportunities to the village inhabitants (approximately 10% of the total population). The village's "Index of Human Development" will be increased considerably, from a common low level of 20% in remote rural areas up to an acceptable level of 60 – 70% four or five years after a bioenergy complex comes into operation.

After two years' operation, the outputs of bioenergy complexes, i.e. grains, liquid sugar, bioethanol, charcoal, dry ice, will exceed local village consumption, and the sales of these surplus outputs can bring in reasonable cash flows, part of which can be used to pay back initial investment and cover the operating costs of the complex. The presence of a "**Revolving Fund**" is highly recommendable to support start-up activities of such bioenergy complexes.

The second type of bioenergy complex, based on small-scale plantation of sweet-sorghum, **with a modest investment of $1,500/capita, will be able to satisfy most of the vital /comfort /production needs of the village inhabitants and lead to general social and economical improvements in the village**.

Other types of bioenergy complexes can be designed and optimized based on biomass resources available such as agro-forestry residues, agro-industrial wastes and dedicated crops, and needs to be satisfied.

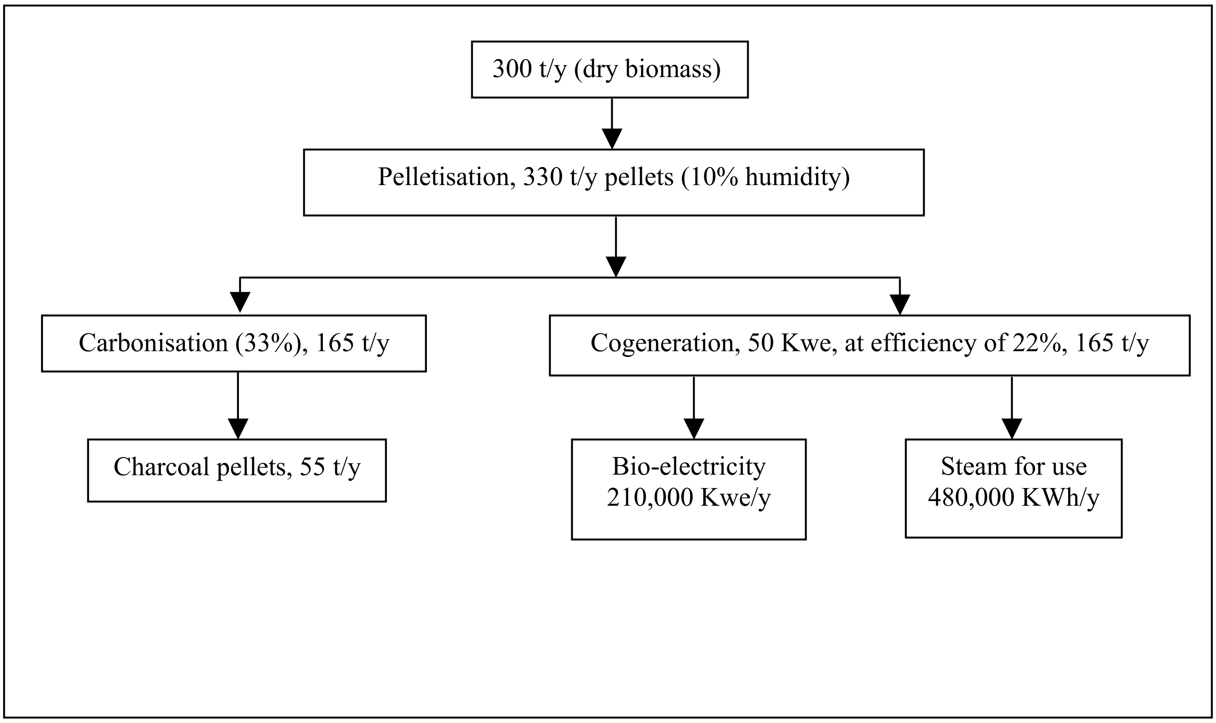
EXAMPLE 1: SIMPLE BIOENERGY VILLAGE COMPLEX

This simple complex is based on the exploitation of 300 dry ton/year of agro forestry residues and/or herbaceous crops. It is illustrated as follows:

CONCEPTS

RESOURCES	PROCESSING	PRODUCTS
• Recovery of all types of agro-forestry residues • Small-scale plantation of herbaceous crops on marginal / semi-arid land and requiring low water irrigation	• Chopping • Mixing • Drying /pelletisation • Carbonisation • Cogeneration • Use of steam for producing cooling or freezing by an absorption unit	**Power** for: • Vital needs (vaccine, family food preservation, water purification, etc.) • Comfort needs (TV, light, telecommunication, etc.) • Production activities **Steam** for: • Food processing • Cooling / freezing (village unit) **Charcoal** for: • Cooking

ACTIVITY FLOW SHEET



After being dried properly in the field, all types of agro-forestry residues and / or cultivated herbaceous crops will be pelletised (15mm / L = 40 mm / density, about 1.6 g / cm^3), with the help of innovative fixed (in future mobile) units which are currently able to carry out simultaneously the final drying and compactation of biomass for permanent storage (humidity of pellets: 8% - 10%) and easy handling.

The pellets can be utilized as solid fuel for modern efficient steam engine co-generators with power ranges of 50-100-250-500 Kwe (1 Kwe = 2.3 KWh). The heat available can be used in many ways, for instance, cooling, freezing, processing, backing, drying, sea-water desalination / treatment, hospital air conditioning, etc. Compared with conventional cogeneration systems, these systems have the following advantages:

- These electric generators have wide power elasticity (10% to 120% of nominal power), with nearly constant efficiency. At night a 100 Kwe generator runs at 10% of its nominal power and supplying 10Kwe. The pellets fuel consumption is reduced proportionally to 10% of the nominal level, about 9kg/h, instead of 90kg/h, which leads to significant fuel saving.

- When more steam is temporarily required for special applications, the power level can be reduced while the boiler is kept running at nominal capacity.

- This generator is a multi-fuel system and can also utilise any type of liquid gaseous fuels such as vegetal oil, low grade bioethanol, LHV / MHV gas, biogas, etc.

Part of the pellets will be fed to a small (50 Kwe) steam-engine generator with efficiency of approximately 22%. Part of pellets obtained by the above mentioned technology can be converted directly into ready-to-use charcoal pellets without any binding compound.
In summary, the energy products that will be available for the village will be

- Charcoal for cooking (self-use and sales)
- Power (8,500 hr/year)
- Steam (food processing, cooking, freezing, etc.)

Assuming a village of 100 – 200 inhabitants has such a bioenergy complex installed, the amount of power available per capita will be considerable, which can not only meets the inhabitants' basic and comfort needs, but also enhance the social and economic development of the village.

When using imported European technology, the following financial projection can be obtained:

Investment ($)

Chopping	5,000
Pelletisation / Drying	160,000
Storage	2,000
Carbonisation	25,000
Cogeneration	50,000
TOTAL	212,000

Expenses per year ($)

Biomass 20$/t	6,000
Interests (i = 5%)	23,200
O & M (3% of invest.)	6,000
TOTAL	35,200

Income per year ($)

Power	
(210,000 Kwe/year x 0.06$/kwh)	12,600
Steam	
(480,000 kwh x 0.02$/kwh)	9,600
Charcoal	
(56 t/y x 250$/t)	14,000
TOTAL	36,200

Annual benefit

Income	36,200
Expenses	35,200
	1,000

As can be observed from the above projection, the annual benefit is comparatively small. However, if pelletisation, carbonisation, etc. can be done locally, the financial benefits can improve considerably. Furthermore, the environmental benefits are not included due to the difficulty of quantifying those benefits.

EXAMPLE 2: BIOENERGY-FOOD-FEED VILLAGE COMPLEX

This more sophisticated system is based on the exploitation of very versatile crop plantation: special varieties of sweet-sorghum (30 ha for a population of 200-300 people). These new varieties which are developed in China have good yields: on average, 5 t/ha of grains, 7 t/ha of sugar, 15.7 t/ha of ligno-cellulosics.

This bioenergy complex can yield the following outputs:

- Food: 100 kg/y per capita grains and 20 kg/y per capita sugar
- Animal feed: 150 kg/y per capita, leaves and bagasse
- Energy:

  charcoal pellets (from bagasse) - 68 t/y for cooking and/or sales

  Power – 50 Kwe for basic, comfort and production needs

  Steam (for food preserving, etc.) – 115 KWh

  Bioethanol – 80 t/y for cooking, agricultural machinery, sales, etc

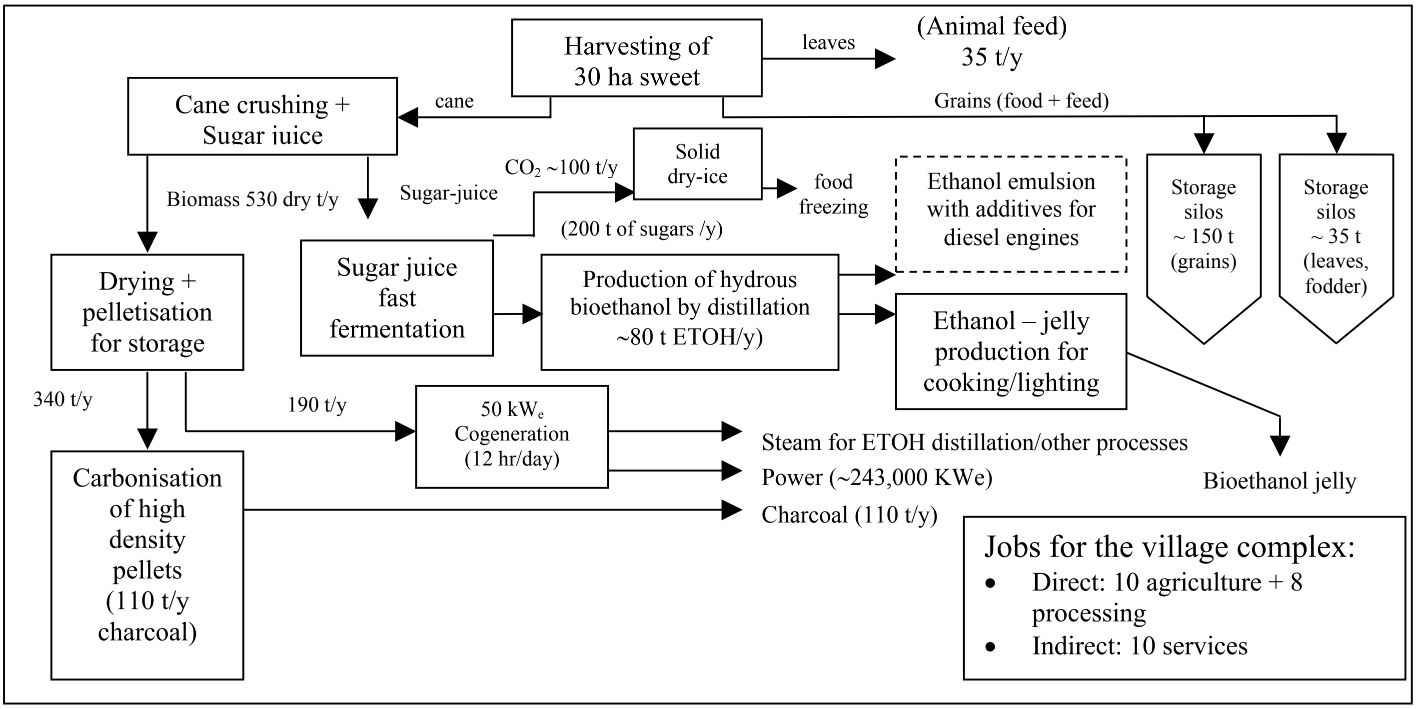
This more sophisticated bioenergy system is illustrated as follows:

CONCEPTS

RESOURCES	PROCESSING	NEEDS SATISFACTION
Plantation: • Area: 30 ha • Crop: Sweet Sorghum • Variety: Chinese * Outputs: • Grains: 150 t/y • Sugar: 200 t/y • Bagasse: 470 t/y • Roots: 60 t/y	• Drying & storage of grains • Sugar-juice extraction/filtration • Sugar-juice fast-fermentation • Beer first distillation for 96° Bioethanol production • 96° Bioethanol jelly production (cooling fuel) • Drying-pelletisation of bagasse (pellet humidity = 15%) • Power/heat production • Charcoal production (pelllets) • CO_2 solid- dry ice (food preserving)	**Food:** • Grains: 200 kg/cap x year • Sugar: 20 kg/cap x year **Animal Feed:** • Grains: 300 kg/cap x year • Leaves & bagasse: ~200 kg/cap x year **Energy:** • Bioethanol: 330 li/cap x year • Electricity: 5600 kW_e/cap x year • Charcoal: 330 kg/cap x year • CO_2 – solid-dry ice: 330 kg/cap x year • Compost: from roots, etc. + ashes for recycling into the soil

* (average) productivity: 5 t/ha grains, 6.7 t/h sugar, 15.7 dry t/ha bagasse, 2 t/ha crop roots.

ACTIVITY FLOW SHEET



In tropical regions, it is feasible to plant crops twice a year with crop cycles equal to approximately 120 days and thus the amount of resources available for the integrated bioenergy complex will double.

Preliminary evaluation leads to the following results:

INVESTMENT ($)

Sugar Extractor:	50,000
Microdistillery:	130,000
Power Generation:	60,000
Pelletisation:	160,000
Charcoal	50,000
Civil Work, etc.	60,000
TOTAL	510,000

EXPENSES PER YEAR ($)

Plantation/harvest:	15,000
Investment (20 y) with interest (i=5%):	40,000
Operation (10 people):	10,000
Maintenance (2%):	12,000
TOTAL	77,000

INCOME PER YEAR ($)

Grains (120$/t):	18,000
Sugar as food (200$/t):	1,200
Electricity (0.06 $/kWh):	14,500
Bioethanol (0.25 $/li):	25,000
Charcoal (250$/t):	27,500
Dry ice for freezing (50 $/t)	5,000
Steam (0.02 $/kwh) 11,000	
TOTAL	102,200

ANNUAL BENEFIT

Income per year:	102,200 $/y
Expenses per year:	77,00 $/y
BENEFIT:	25,200 $/y

For the successful implementation of this type of bioenergy complex, proper training of staff and management is critical. Meanwhile, technical and general assistance should be made readily available

CONCLUSION

It is now possible to start the development of modern bioenergy complexes for remote rural villages based on the exploitation of agro-forestry residues or dedicated crops such as sweet sorghum. A bioenergy complex utilizing sweet sorghum crops can not only meet the essential needs of the village population (food, animal feed and energy), but also provide reasonable cash flows so that an economically sound operation can be assured.

These Integrated Complexes could make considerable contribution to the general social and economic development of the rural areas and consequently increase the Human Index of Development of village up to reasonable levels of 60 – 70%.

Today not many commercially sound technologies are available for such small bioenergy complexes. A project to build such a bioenergy complex is not economically feasible because of the high costs of small-scale manufacturing. In developing countries, additional costs of technology transfer from industrial countries can make the financial results of such projects even worse-

The integrated complexes can process and utilize the biomass resources in a comprehensive and efficient way and produce several commodities of high economic value, which can greatly improve the financial performance of the complex and make it economically feasible and even highly profitable.

To ensure sustainable operation of such bioenergy complex, significant efforts have to be made to educate and train the staff and management properly and make technical assistance readily available.

APPENDIX

List of future publication on examples of good commercial technologies, now available for decentralized bioenergy production.

FORUM INAUGURATION

International Bioenergy Forum: China-EU Cooperation
4th LAMNET Workshop – Guangzhou, China 2003

Large-scale Integration of Bioenergy with Petrochemical Complexes

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OVERVIEW

Modern bioenergy is expected to make a significant contribution to the world's sustainable development. It will be used mainly in the heating/cooling, co-generation and transport sector. The EC aims at increasing biomass supply from the current level of 45 MTOE/y to 130 MTOE/y by year 2010.

Bio-fuels such as bio-ethanol, bio-methanol, bio-syngas and bio-hydrogen can make considerable contribution to the improvement of environmental conditions in congested urban areas. Furthermore, such fuels can help improve the quality of conventional fuels for the strategic transport sector by means of blending, reformulation and substitution. This paper is to summarise the main characteristics of a large-scale bio-energy project, which could be integrated with petrochemical complex. Data on the economic performance of the project is also presented.

In 1997, EUBIA initiated an extensive study to identify large-scale integrated energy complexes that are able to provide a wide range of products and that are economically feasible and sound. The study result indicated that a large-scale bio-energy complex based on sweet sorghum could represent an attractive investment opportunity. The study showed that the sale of grains could recoup a large proportion of the initial investments. Even if the selling prices of by-products such as sugar and lignocellulosic bagasse are very low, such a complex could still bring farmers considerable income.

Given low costs of sugar and lignocellulosic feedstock, the complex could also produce commodities with high value added, such as power, heat and paper, as well as strategic fuels like bio-ethanol, bio-methanol, biohydrogen and bio-syngas. Relevant commercial technologies are already available in EU and only modest adaptation is necessary.

Large-scale plantation of sweet sorghum in an area of 80,000 ha, located in the Pearl River Delta of Guangdong province, China, as proposed in the framework for EUChina industrial cooperation, could provide sufficient feedstock for

1. Co-generation: 50 MWe using 270,000 tons of bagasse pellets per year

2. Bio-ethanol (de-hydrated): 660,000 m3 per year from sugar juice

3. CO2 recovery (high purity): 510,000 tons per year, used for bio-methanol synthesis

4. Bio-hydrogen: 71,000 tons per year, by means of steam reforming of charcoal pellets and CO shifting from 1.4 million tons of pellets per year

5. Activated coal: 36,000 t/y from charcoal pellets obtained from 300,000 t/y of pellets

6. Bio-methanol: 460,000 m3 /y from catalytic synthesis of CO2 and H2

7. Animal feed pellets (mixture of sweet sorghum grains + 30% of bagasse): 1,160,000 t/y

LARGE-SCALE INTEGRATED INDUSTRIAL COMPLEX

Sweet sorghum is a very promising energy crop with high yields of grains, sugar and bagasse. Sweet sorghum is preferable because it could be a very competitive energy crop. With some special varieties, it is estimated that the sale of grains alone (yield of 5-8 t/ha) can cover nearly all the cost of crop production ($400/ha in China and $800/ha in EU). The other products of the complex, sugar and lignocellulosic bagasse could bring in surplus income of around $200/ha to farmers, given modest estimation of selling prices of there two commodities ($30-50/t for sugar and $10-15/dry t for the bagasse).

To produce bio-ethanol from sweet sorghum seems to be most profitable and promising and the justification is as follows:

- Sweet sorghum can be grown almost anywhere, in temperate and tropical regions as well as on lowquality soils, hence, it can be a valuable crop for all continents.
- Sweet sorghum is a C-4, with short growing period (4-5 months) and high yield, multi-component crop (starch, sugar and lignocellulosics).
- Sweet sorghum demands little inputs of water and fertilizer. For the whole growing period, it requires 1/3 of the water necessary for sugar cane and half of that for corn.
- Plantation of sweet sorghum requires small amount of seeds. The seeds needed for sweet sorghum is 10 kg/ha, while those for corn are 40 kg/ha and for wheat, 150 kg/ha.
- An integrated complex based on sweet sorghum could produce a number of valuable products in the fields of food, animal feed and energy, for instance, grains-sugar, grains-leaves-bagasse, power-heatbioethanol- charcoal, etc.
- The ratios of energy output to input are positive (2- 4), for the production process to obtain bio-ethanol, DDG, co-generation fuels and biofuels.

According to preliminary estimation, the integrated bioenergy complex based on exploiting sweet sorghum to produce bio-ethanol and other energy and industrial commodities, could be economically viable. This could be a new path to sustainable production of bio-ethanol, which is considered to be strategic fuels for transport sector. The success of such a bioenergy project in China could be replicated worldwide. Previous studies and trials have shown that such a project could be economically sound in regions with different climate.

Such an integrated complex, if implemented on a large scale (or broken into series of small-scale complexes) could keep the production costs of ethanol as a byproduct at a reasonable level of $200-250/t. It is particularly advisable to utilise some special varieties of sweet sorghum to get the optimal results. Almost all parts of sweet sorghum can be commercially processed, for example, starch, sugar and lignocellulosic. This distinguish sweet sorghum from other crops that are currently utilised for producing bio-ethanol.

Sweet sorghum has its origin in China. Today there exists many varieties of this crop. By utilising sweet sorghum of different varieties, an integrated bioenergy complex could obtain various yields of grains, sugars and bagasse. In tropical regions, sweet sorghum could be planted twice a year, which would further increase the economic performance of such an integrated complex.

One point worth attention in ethanol production is that harvesting and juice extraction and fermentation shouldbe done as quickly as possible, to reduce sugar losses. The maximum harvest time for sweet sorghum is two months. The total running time of a bioethanol plant can be maximised (8-10 months) by means of selecting particular varieties of sweet sorghum and delaying and alternating the seeding process in tropical regions, which could also reduce operating costs considerably. For the Chinese integrated complex examined in this paper, two plantations are planned for each year.

The preliminary estimation of the economic performance of the integrated complex in Guangdong province is as follows:

Investment (EU tech)

Cane crushing:	$40 mio
Bioethanol plant:	$460 mio
CO2 recovery:	$20 mio
Pelletisation:	$80 mio
Power plant:	$71 mio
Activated coal:	$55 mio
Biomethanol:	$360 mio
Total:	$1,086 mio

Operating Cost

Financial costs: (i = 5%, no. of years = 15)	$103 mio/y
Operating cost: (4% of investment)	$43 mio/y
Maintenance: (2% of investment)	$22 mio/y
Plantation:	$98 mio/y
Total:	$266 mio/y

Income

Bioethanol:	$198 mio/y
Biomethanol:	$77 mio/y
Animal feed:	$116 mio/y
Activated coal:	$47 mio/y
Sale of pellets:	$23 mio/y
Total:	$461 mio/y

Profit

Income:	$461 mio/y
Expenses:	$266 mio/y
Revenue:	$195 mio/y
ROI: 18%	

The estimated ROI of such a project is 18%, which is based on the assumption of adopting EU technology. All the amounts of investment and expenses are comparable at EU level. Given China's less expensive manufacturing facilities and cheap labour, the investment for a Chinese project could be considerably reduced. Accordingly, the ROI could be increased to about 25%.

CONCLUSION

Sweet sorghum of special varieties is very promising energy crop. It can be used to produce large amounts of liquid biofuels such as bioethanol, biomethanol and biohydrogen. An integrated complex based on sweet sorghum in tropical regions could be very profitable.

In Guangdong province, China, sweet sorghum can be planted twice a year and by selecting specific varieties, delaying the seeding process and intercropping, a long operating period for the complex can be achieved. The production costs of bioethanol and biomethanol are estimated to be \$250/t and \$210/t respectively. The yield of biofuel there is expected to be 13.8 m3 /ha per year.

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4th LAMNET Workshop – Guangzhou, China 2003

THE MUNICIPAL SOLID WASTES (M.S.W): AN ENERGY IMPORTANT BUT ENVIRONMENTALLY PROBLEMATIC RENEWABLE ENERGY SOURCE

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The M.S.W. is a Renewable Energy Source (R.E.S)

Around 60% by weight of household waste is Paper and bio-waste and, as such, their combustion or the combustion of their degradation products is CO_2 neutral.

This means that the energy released by combustion is revived wholly from R.Sources, such as wood and green wastes, that absorb CO_2 whilst they are growing.

So, generation of energy from landfill gas or from the combustion of the wastes reduces the use of fossil fuels and diverts the methane produced, when waste is landfilled, thereby contributing strongly towards greenhouse gas (methane + CO_2) reduction targets.

Table 1. Typical Composition of M.S.W
(Source: Waste Management Paper No 26A, 1992 U.K.)

Constituent	Weight % (as received)
Paper	29.2
Putrescibles	19.0
Textiles	3.0
Unsorted Fines	8.6
Miscellaneous Combustibles	5.8
Miscellaneous Non-combustibles	4.0
Wood	2.2
Glass	8.4
Garden Waste	3.8
Ferrous Metal	8.0
Non-ferrous metal	1.0
Plastic Film	4.2
Dense Plastics	2.8

Moisture content = 33% by weight
Bulk density, uncompressed = 170 kg/m^3
Gross calorific value = 9,260 kJ/kg
Net calorific value = 7,630 Kj/Kg

The Energy, Economic and Environmental problems of E.U.

The Energy, Economic and Environmental problems of E.U. are summarized in the following figures 1, 2 and 3.

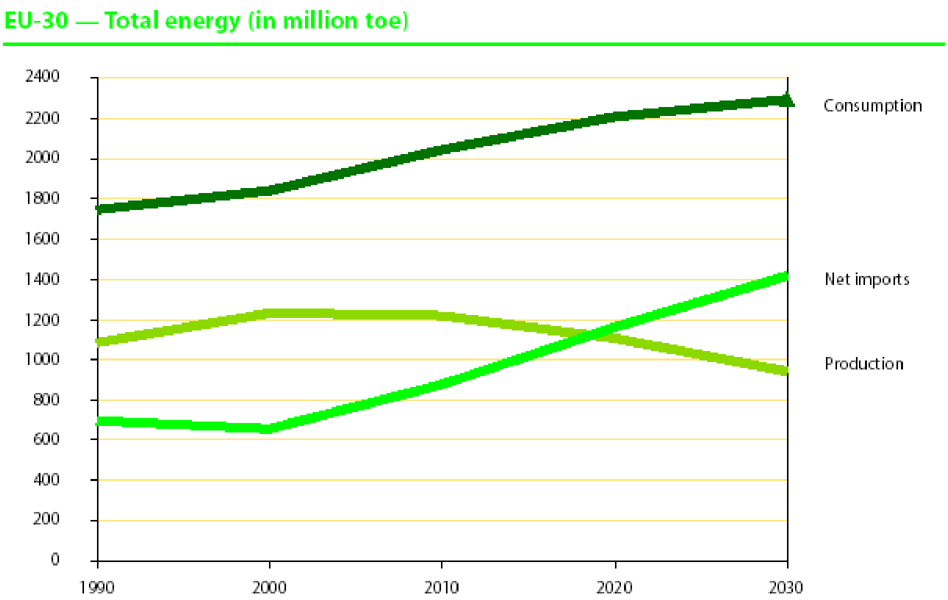

Fig. 1. The Dependency on Energy imports of EU-30. The total imports are composed from Solid fuels, Oil, Natural gas and Uranium.
(From. E. Commission's Green Paper)

The European Community energy resources will be depleted depends not only on the extent of known reserves, but also on the price of oil and gas on the world market, and on technological progress, as the new extraction technologies may mean that, in time, the recovery rate could rise from 20-40% of deposits, to 60%

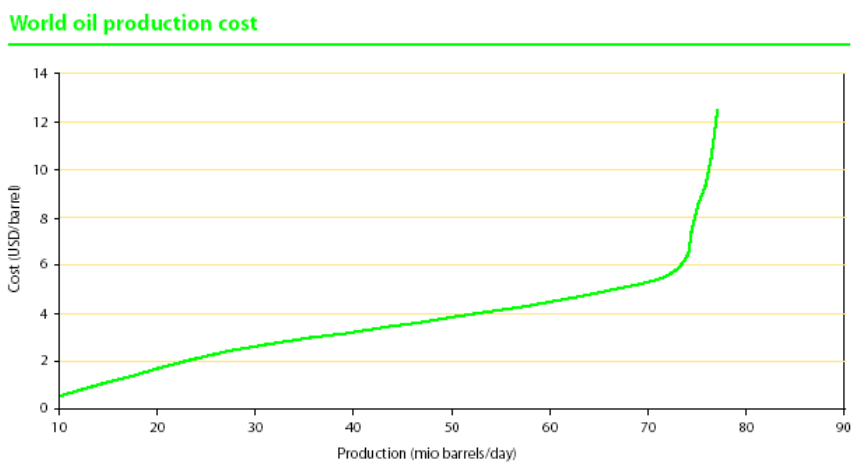

Fig. 2. The evolution of the World Oil Production Cost and quantities.
(From. E. Commission's Green Paper)

The biggest part of CO_2 production is due to the fossil fuels (oil, gas and coal) consumption

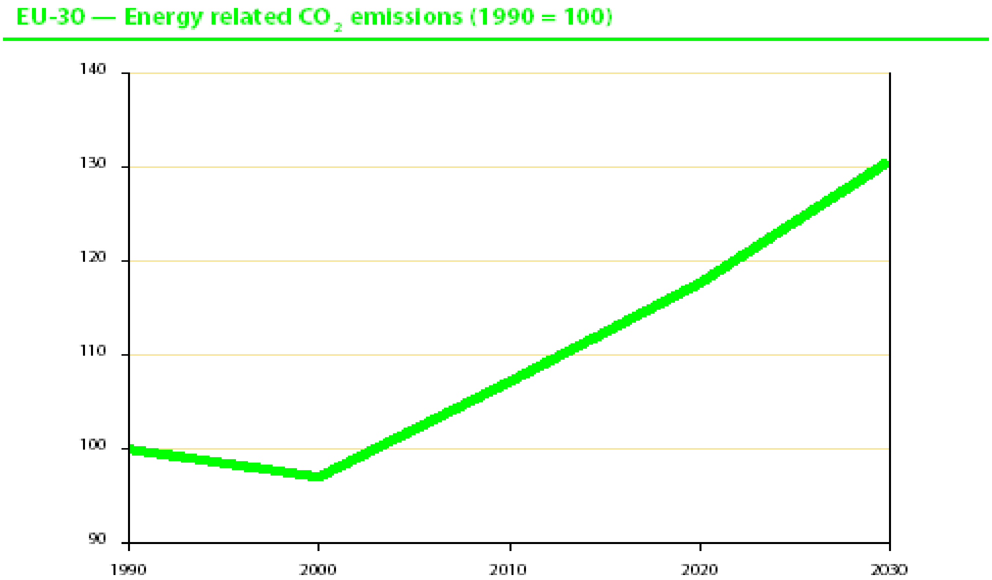

Fig. 3. The EU-30 energy related CO_2 emissions (1990=100) quantities.
(From. E. Commission's Green Paper)

Finally according to the E. Commissions' Green Paper the following three main points are emerging concerning the Energy problem of the EU-30

- The European Union will become increasingly dependant on external energy sources and enlargement will not change the situation, based on current forecasts, dependence will mach 70% in 2030.
- The European Union has very limited scope to influence energy supply conditions. It is essentially on the demand side that the EU can intervene, mainly by promoting energy saving in buildings and the transport sector
- At present, the European Union is not in a position to respond to the challenge of climate change and to most its commitments, notably under the Kyoto Protocol.

The Renewable Energy Policy of E.U.

According to the E. Commissions' Green paper (1), priority must be given to the fight against global warming. The development of new and renewable energies (including biofuels) is the key to change, doubling their share in the energy supply quota from 6 to 12% and raising their part in electricity production from 14 to 22%, objectives to be attained between 2000 and 2010.
In a Study (3) made in the frame of the Altener Programe of E. Commission, the penetration of Renewable Energy Sources for the E.U.-15 could reach 228 TOE by the year 2020. (see fig. 4). In that figure we can see also the estimated biomass energy from the M.S.W., that represents almost 25% of the expected total energy from R.E.S.

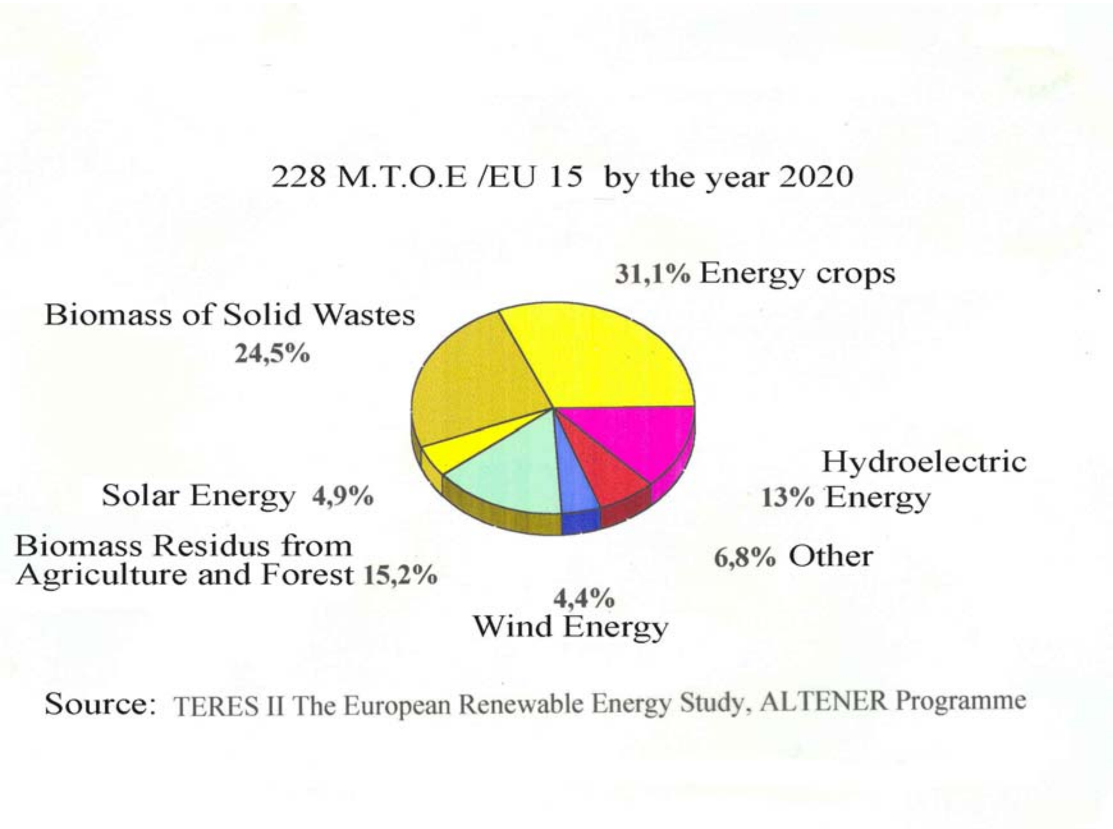

Fig. 4. The possible penetration of different renewable energy sources by the year 2020 in the 15 Countries of E.U.

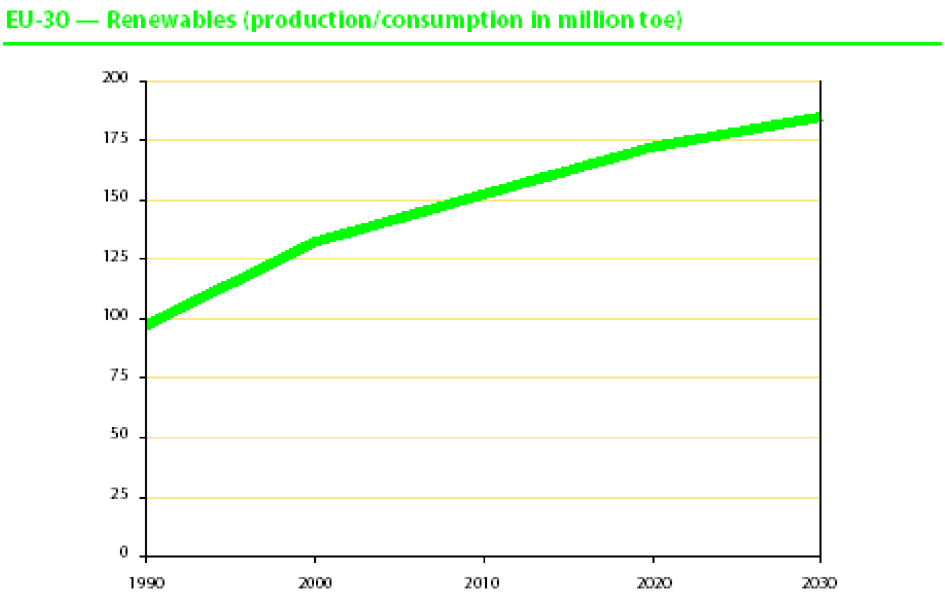

Fig. 5 The Estimation of the E.Commissions' green paper for the penetration of the Renewables to the E.U.-30 Countries

The Energy Content of M.S.W

The energy content of waste can be calculated by a number of techniques, including the modified Dulong equation which is based upon the percentage content of carbon (C), hydrogen (H), oxygen (O) and sulphur (S), and by the use of calorimetry. An equation based upon the percentage (by weight) of food waste, cardboard and paper, plastic, and rubber has also been developed (Khan and Abu-Ghararah, 1991). Using this method, derived values have been shown to be approximately 1-10% higher than values derived using the modified Dulong equation. (It is not necessary to go into the details of these calculation techniques, as it is their results that are of use in this paper). The energy stored within wastes can be utilised in a number of ways. The most common methods are energy from waste (EfW) incineration (with or without energy recovery), and the collection and combustion of landfill gas (in which case much of the stored energy is retained within the methane gas).

Material	CV MJ/kg wet weight (moisture content 20-30%)
Dust and cinders	9.6
Paper	14.6
Vegetables	6.7
Metal	nil
Glass	nil
Rag	16.0
Plastic	37.0
Unclassified	17.6

Table 2 Average calorific value (C.V) of components of M.S.W (2)

The technologies for the energy valorization of M.S.W

Considering the composting of the organic content of M.S.W and the Recycling of other components, as an indirect energy source, there are several technologies for the energy valorization of M.S.W. in practice. From all these technologies in practice we have to look for the Best Practicable Environmental Option (B.P.E.O) in each case, because there is no any technology without disadvantages.
In our days the most applied in practice technologies for ENERGY VALORISATION are the land filling of M.S.W and the incineration of M.S.W (EfW plant).

1. **Landfilling of M.S.W**

According to the European Landfill Directive and RCRA in the U.S.A, a landfill is considered as sustainable if the final quality of the landfilled M.S.W is completed within 30 years, (or in one generation), that means that, waste must be either pre-treated to a state close to final storage quality, or the stabilization within the landfill must be accelerated.
Disposal of M.S.W. to a landfill means that either all the mass of the M.S.W , or part of it is dumped in places with special conditions in order to avoid the leaching of the produced liquids and the emissions of the produced gases and to create anaerobic conditions for the biodegradable elements.

The **biodegradable** elements of waste disposed to landfill are vegetable matter, paper and cardboard and to some extent, textiles. The composition of municipal refuse varies from country to country and will vary from season to season. In the developed world it typically contains about 60% carbohydrate, 2.5% protein and 6% lipid, the balance being comprised of "inerts" and plastics. Carbohydrates therefore comprise approximately 85% of the **biodegradable** material within municipal refuse, the overall breakdown of which can be represented by the equation:

C6H1206 > CH4 + CO2 + Biomass + Heat
(Carbohydrate) > (Methane) + (Carbon dioxide) + (Bacteria) + Heat

Methane gas is a high-energy fuel with approximately 90% of the energy stored in carbohydrate being retained in the methane. The conversion of carbohydrate to methane is therefore a highly energy efficient process, and much of the energy stored in the carbohydrate is contained within the methane gas. **Because of the high-energy value, the methane can be used beneficially as a heating fuel and for other energy production.**

Table 3. Typical Composition of landfill gas

Component	Typical Value (% volume)	Observed Maximum (% volume)
Methane	63.8[1]	88.0[2]
Carbon Dioxide	33.6[1]	89.3[1]
Oxygen	0.16[1]	20.9[1,3]
Nitrogen	2.4[1]	87.0[2,3]
Hydrogen	0.05[4]	21.1[1]
Carbon Monoxide	0.001[4]	0.09[2]
Ethane	0.015[4]	0.0139[2]
Ethene	0.018[4]	-
Acetaldehyde	0.005[4]	-
Propane	0.002[4]	0.0171[2]
Butanes	0.003[4]	0.023[1]
Helium	0.00005[4]	-
Higher Alkanes	<0.05[2]	0.07[1]
Unsaturated Hydrocarbon	0.009[1]	0.048[1]
Halogenated Compounds	0.00002[1]	0.032[1]
Hydrogen Sulphide	0.00002[1]	35.0[1]
Organosulphur Compounds	0.00001[1]	0.028[1]
Alcohols	0.00001[1]	0.127[1]
Others	0.00005[1]	0.023[1]

1 Data taken from Waste Management Paper No 26
2 Published data supplied by Aspinwall & Company
3 Entirely derived from the atmosphere
4 Taken from Guilani, A J "Application of conventional oil and gas drilling techniques to the production of gas from garbage" American Gas. Association Transmission Conference, Salt Lake City, Utah, 5-7 May 1980
5 Landfill gas is usually saturated with water vapour, up to 4% by weight, depending on the gas temperature. At 25^{0}C a value of 1.8% by weight is typical
6 When undertaking initial confirmatory analysis by gas chromatography, the first five compounds listed above are usually identified when looking for the presence of landfill gas.

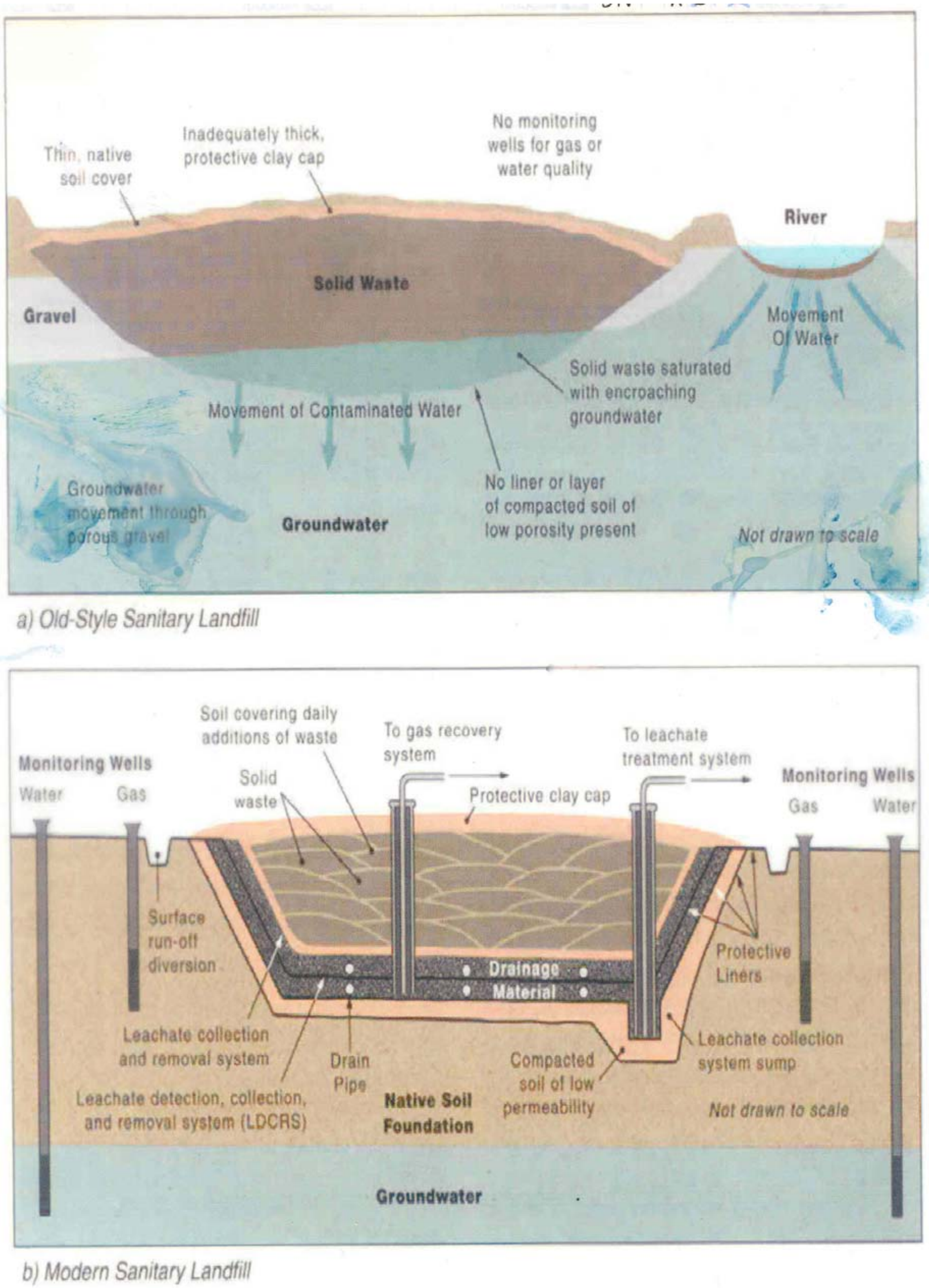

Fig. 6. Characteristics of two different Landfill sites (4)

Table 4. Typical Composition of Leachates from Domestic Wastes
(fig. In mg/l except PH)

Determined	Fresh Wastes	Aged Wastes	Wastes with high moisture contents
pH	6.2	7.5	8.0
COD	23800	1160	1500
BOD	11900	260	500
TOC	8000	465	450
Volatile acids (as C)	5688	5	12
NH_3-N	790	370	1000
NO_3-N	3	1	1.0
Ortho-P	0.73	1.4	1.0
CI	1315	2080	1390
Na	9601	300	1900
Mg	252	185	186
K	780	590	570
Ca	1820	250	158
Mn	27	2.1	0.05
Fe	540	23	2.0
Ni	0.6	0.1	0.2
Cu	0.12	0.03	-
Zn	21.5	0.4	0.5
Pb	0.40	0.14	

Source: Waste Management Paper 26A (DoE)

In a modern Landfill considering as sanitary, we have to control the Leachate and the Cases.
The control of the Leachate can be obtained by Natural Liners (like argile, bentonite etc.) and by Geomembranes. (plastics)

For better results we use a combination of natural liner and geomembranes and we collect the penetrated (by accidents or by other means) liquids.

The control of landfill gases can be partially avoided by

- controlling waste inputs
- controlling the processes of biodegradation
- controlling the migration process (reduce pressure, barriers etc)

We distingue the **passive control**, opening gas wells, and putting vent trenches and the **active control** installing array of vertical and horizontal pipes and blowers.

The Energy Production in a landfill

In practice (2) only a little more gas than 100 m^3/t is collected, but the production is much more.
For effective utilisation in gas engines or turbines, the methane content of landfill gas should be approximately 50%. However, where gas collection is used primarily for the control of migration and the protection of `sensitive targets, then the methane content of the gas is often much less than 50% in order to maintain a flame at the gas flare. For this reason, **it is important to clearly identify at the outset whether the gas collection system is for gas control or energy generation**. Local site conditions may require the use of both types of system where, for instance, peripheral wells are used for gas migration control and central wells are used for collection with subsequent utilisation for electricity production.

It is also possible for wells to be designed and built to accommodate both systems and to be switched from one purpose, to the other, when the situation demands. In this case, the cost of such a system will be much higher than a simple system and this must be accounted for when calculating the **economic feasibility**.
The high moisture content of landfill gas and the presence of trace corrosive gases requires that the collected gas should be pre-treated before combustion in a gas engine.

The future of Landfilling of M.S.W

Today we consider that there is no future of Landfilling of M.S.W and so there is no future of Landfill Gas, because of the:

- limited Void Space
- E.Commission Landfill Directive
    - biodegradables to landfill (75% in 5 years, 50% in 8 years, 35% in 15 years)
    - gas collection on all sites is an obligation
    - pre-treatment before land fill is an obligation
    - packaging waste regulations

2. Waste – Incineration

The combustion of waste as a fuel is more and more seen in Europe as a preferable alternative to landfill, where appropriate, and is receiving much support as a waste treatment. Especially after the E. Commission" decision to prohibit gradually the landfilling of the organic part of the M.S.W., incineration is the Most Practical Environmental Option (M.P.E.O.)
On the other hand, the today progress of the technology reducing the release of the toxic and other emissions (Dioxins, Heavy metals, No_x, So_x etc) from the incinerated M.S.W., gives may be to the EfW plants the unique B.P.E.O today.

A better solution, environmentally speaking, is the recycling of several materials before the incineration.

Wallis and Watson (1995) had estimated that recycling materials can save 2-5 times the amount of energy recoverable by incineration. However recycling is not always feasible, for reasons of material contamination (e.x. heavy metals into compost), or because of the lack of interest in the market. (ex. glass)

The reality in practice is that, if all combustible waste were incinerated, it could provide as much as 5% of western Europe's domestic energy needs. Russotto (1996) and ETSU (U.K.) has calculated that electricity – only schemes from M.S.W. will reduce fossil carbon emissions by 29% and for CHP schemes 78%.

Recycling prior to incineration does not mean that the energy content of M.S.W. per Kg is not interest anymore, see fig. 7.

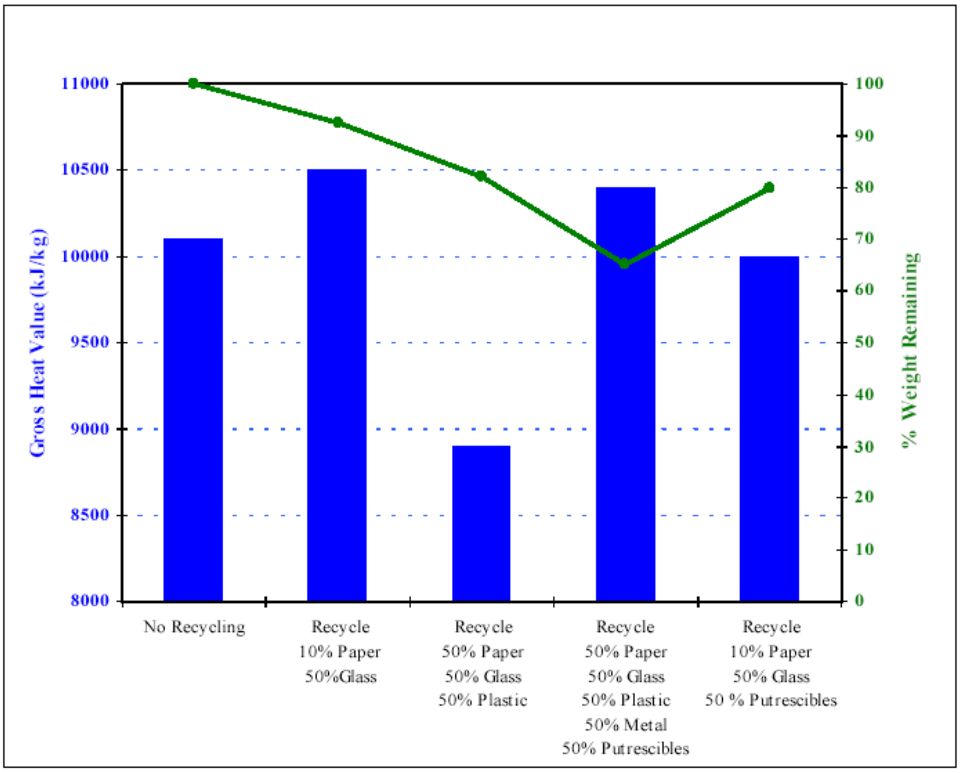

Fig. 7 Recycling scenarios and Heating Value of the remaining part of M.S.W (2)

The Energy from Waste incineration

According to Porteous (1997) the main energy properties of M.S.W. can be summarized to the following table:

CV	10,600 MJ/kg
Moisture	31.2% w/w
Combustibles	44.6%
Inerts	24.2%

Incineration is a thermal oxidation process in which carbon is oxidised to carbon dioxide and hydrogen is oxidised to water:

C + O2 = CO2

2H + ½ O2 = H2O

The Relative Atomic Mass (RAM) of each of the elements involved is shown in the following table.

The relative atomic masses of carbon, oxygen and hydrogen

Element	RAM
Carbon	12
Oxygen	16
Hydrogen	1

This means that 12g of carbon require 32g of oxygen and produces 44g CO_2. Therefore 1g of carbon requires 2.67g (=32/12g) of oxygen and produces 3.67g (44/12g) of CO_2.
Also, 1g of hydrogen requires 8g of oxygen to produce 9g H_2O

From the ultimate analysis (table) MSW contains 24% carbon and 3.2% hydrogen by weight i.e. 1g of MSW will contain 0.24g of carbon and 0.032g hydrogen.

0.24g carbon requires 0.24 x 2.67g = 0.641g oxygen

0.032g hydrogen requires 0.032 x 8g = 0.256g oxygen.

But there is 0.159g oxygen already present (from the ultimate analysis in table 5) and hence the amount of oxygen required to complete combustion = (total required)-(oxygen already present) = (0.641g + 0.256g) - 0.159g = 0.738g (per g MSW).

Now air comprises 23.15% oxygen and 76.85% nitrogen by weight and hence the air equivalent to 0.738g O_2 is 3.21g. So 3.21g air is required to burn 1g MSW.

From Porteous (1997): if we assume 100% excess air (i.e. twice as much air present as is needed) then 6.4g air will be required to burn 1g MSW and therefore the total input will be 7.4g material. The output from the combustion of MSW is shown in Table 5.

Table 5. Outputs from M.S.W incineration (Porteous 1997)

Material	Mass (g)
CO_2	0.881
H_2O	0.288
O_2	0.738
N_2	4.9
HCl	0.007
Ash residue	0.242
Water vapour (from MSW)	0.312
Total output (rounded off) = 7.4	

The advantages of M.S.W incineration are:

a. Energy from waste**:**

- Provides an alternative energy source saving finite resources by replacing fossil fuels (every 3 tons of MSW burned saves 1 ton of coal)
- Extracts value as energy from materials that are not recyclable
- Sterilises waste enabling safe disposal of residues
- Offers an efficient and cost-effective method of recovering materials such as metals for recycling

- Destroys contaminants and pollutants in waste allowing for more easily controlled monitoring and measuring of these products
- The today Dioxin removal technologies and the technologies and methods for the Heavy Metals neutralization meet by far the E.U. directive for the M.S.W. incineration (89/369/EEC).
- Reduces the volume of waste by 90% and the weight by 70% saving landfill space and transport costs

b. Other Products from the M.S.W incineration

From the incineration of 1 t of M.S.W. it could be obtained on average:

- 225kg bottom ash
- 23kg ferrous metals
- 20kg fly ash from the flue gas cleaning equipment
- 1kg non-ferrous metals (mainly copper and aluminum)
- 15kg air pollution control (APC) residues

Other M.S.W. Management options

Some of the most promising technologies for the M.S.W. Management are:

- Recycling and Treatment of cellulose for Levulinic Acid production and other Chemicals production from hemicelulose
  This technology developed in U.S.A. (presidential award), has succeed to reduce by more than 90% the cost of the Levulinic Acid production in comparison with the known procedures.
- Recycling and Composting
  This technology can be run in parallel with the combustion and recycling. It is considered as the most **green** option if the final product (compost) is clean from toxic elements (this can be reached only in a part of the organics)
- Plasmolysis

This technology is under investigation in the Research Laboratories

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Main Steps for Developing and Implementing a Bioenergy Project in China through International Joint Ventures

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The object of this paper is to briefly summarize the four most important steps that need to be taken when considering developing and implementing a bioenergy project in China:

- The first step for a foreign investor is to determine whether or not the project or the industry concerned is regulated.
- The second step is to identify the main administrative approvals that need to be obtained from the Chinese authorities
- The third step is to structure your investment and choose a legal vehicle that is the most appropriate for implementing and running your bioenergy project
- The fourth step is to identify the means through which you will contribute rights on your technology to the project

A) First Step: Determine whether or not the Project or the Industry is Regulated

China and WTO

- In December 2001, China became the 143rd member of the World Trade Organisation (WTO).
- Many regulations governing foreign investments in China have therefore been modified since then to take into account the internationally accepted standards.

The Regulations on Foreign Investment Orientation and the Guidance Catalogue for Foreign Investment

- In order to determine whether or not the project or the industry concerned is regulated, two sets of regulations governing foreign investments in China must be consulted:
    - Regulations on Foreign Investment Orientation as enacted by Decree No. 346 of the State Council on 21 February 2002 (***"the Foreign Investment Regulations"***);
    - the Guidance Catalogue for Foreign Investments, as enacted by the State Development and Planning Commission, the State Economic and Trade Commission and the Ministry of Foreign Trade and Economic Cooperation in 1997 and as amended in March 2002; the revisions entered into force on 1st April 2002 ***("the Foreign Investment Catalogue")***;

- The Foreign Investment Regulations divide industries into four categories:
    (i) encouraged
    (ii) allowed
    (iii) restricted
    (iv) prohibited

- Under the Foreign Investment Regulations, *"new technologies, new equipment, energy and raw material saving, integrated utilization of resources and renewable resources, and environmental pollution prevention"* are encouraged foreign investment projects (see, Article 5, 4) of the Foreign Investment Regulations).

- The foreign invested projects falling within the encouraged category
    - enjoy a tax holiday (customs duties and V.A.T.) for imported equipment
    - might enjoy additional preferential treatment according to relevant laws or administrative bylaws (i.e. preferential treatments granted to Foreign Investment Enterprises)
    - may, upon approval, expand their related business scopes if they are characterized by a huge investment and a long return period, such as construction activities related to energy, transportation, urban infrastructure construction (coal, petroleum, natural gas, electric power, railways, highways, harbours, airports, urban roads, sewage and garbage treatment)(see, Article 9 of the Foreign Investment Regulations)

- The Foreign Investment Catalogue lists the industries falling within each of these categories other than the allowed category.

- Since April 2002, many areas in which foreign investment was in the past prohibited or severely restricted have listed in the Foreign Investment Catalogue.

- These areas include foreign trade, distribution of goods, financial services, insurance and telecommunication, and liberalization is scheduled to comply with the commitments China made in the WTO accession protocol.

- The Foreign Investment Catalogue also relaxes foreign investment shareholding restrictions for some entities in China in this respect.

- It should be noted that the Foreign Investment Catalogue does not, unlike for other types of projects, impose that the Chinese party should hold a majority equity whenever the project involves *"construction and operation of power station using new energy such as solar energy, wind energy, magnetic energy, geothermal energy, tidal energy and biomass energy"* (see, item 4, 7) of the encouraged categories under the Foreign Investment Catalogue).

B) Second Step: Identify the Main Administrative Approvals that need to be obtained from the Chinese Authorities

Administrative Authorisations – Approval by the State Council

- Certain particularly large-scale projects - such as projects on environmental protection, product safety, technical standards on products, food safety, etc. - need to be approved by the State Council, without prejudice to any other procedure.

Administrative Authorisations – Approval by the SDPC

- In November 2001, the State Planning Development Commission (SDPC) announced that it did not any longer have to approve the following projects:

  (i) Urban infrastructure projects;

  (ii) Agricultural, forestry, and water conservancy projects that do not need any governmental funding;

  (iii) Social projects where investments are raised by Chinese individuals or enterprises;

  (iv) Construction projects (real estate);

  (v) Infrastructure projects for commerce and trade.

- Nevertheless, any project falling within one of the following categories must still be approved by the SDPC:

  (i) projects that require financing from the central government,

  (ii) projects that, though using non-governmental financial sources, can concern strategic exploitation and utilization of resources or may cover several water streams or provinces,

  (iii) projects that affect the regional economic coordinated development, and

  (iv) projects that the central government considers as strategic for the national industry or that are subject to a limitationunder some specific regulation.

- The stage at which the SDPC has to approve a project depends on the type of project:
  - For projects requiring some financing by the central government, the SDPC has in any event to approve the feasibility study report; if all or most part of the financing is supplied by the central government, the SDPC has also to approve the project proposal and the construction starting report; if governmental financing is required from the Central Banks or if the government is requested to guarantee the reimbursement of a loan granted by foreigner(s), the project should also be approved by the State Economic and Trade Commission (SETC), the Ministry of Finance, and the Central Banks.
  - For projects that, though using non-governmental financial sources, can concern strategic exploitation and utilization of resources or can cover several water streams or provinces, the SDPC has only to approve the project proposal;
  - For projects that affect the regional economic coordinated development or that the central government considers as strategic for the national industry or that are subject to a limitation under some specific regulation, the SDPC must approve the project proposal, the feasibility study report, the primary design and must check the project at the end of project construction.

The enterprise first prepares its proposal and takes it to either the appropriate power bureau or the provincial branch of the Development Planning Commission (DPC) – for construction projects - or of the Economic and Trade Commission (ETC) – for renovation projects. If the proposal is approved, it is sent to the central branch of the State Development Planning Commission (SDPC) or State Economic and Trade Commission (SETC) for their approval. After the central State Development Planning Commission (SDPC) and State Economic and Trade Commission (SETC) review it with the Central Banks, the proposal is either approved or rejected. If approved, both the local bank and the enterprise will prepare a feasibility study, which needs the approval of the provincial Development Planning Commission (DPC) or Economic and Trade Commission (ETC). After the feasibility study is approved, it is sent to the central State Development Planning Commission (SDPC) and State Economic and Trade Commission (SETC) for authorization. At the same time, the local branch of the Development Planning Commission (DPC) or Economic and Trade Commission (ETC) is notified, and it, in turn, notifies the enterprise. Both the enterprise and the local bank will prepare a project appraisal that goes through the same approval procedure as the feasibility study. Once the project appraisal is approved, the project is ready to be developed. If the project's budget is particularly significant, the State Council must approve the proposal.

Administrative Authorisations – Approval by the local DPC or ETC

- Any other project must be approved by the local Planning Development Commission (DPC) in so far as the project affects only one single province.
- The local Development Planning Commission (DPC) is competent for construction projects, while the local Economic and Trade Commission is competent for renovation projects.
- The total need for foreign capital must be reported to the SDPC in Beijing.
- First of all, the enterprise should prepare its proposal and takes it to either the appropriate power bureau and the provincial branch of the DPC or ETC. If the proposal is approved, both the local bank and the enterprise should then prepare a feasibility study, which has to be approved by the provincial DPC or ETC. Once the feasibility study has been approved, the local bank and the enterprise will have to prepare a project appraisal that goes through the same approval procedure as the feasibility study. Once the project appraisal is approved, then the project is ready to be developed.

Administrative Authorisations – Additional Approvals

- Approval of the joint venture agreement by the MOFTEC. As described above the MOFTEC or its local bureau is responsible for examining the contractual terms of the foreign investment, and will examine and approve the joint venture contract and articles of association; Authority to approve joint ventures is delegated to the provincial municipal and county levels, depending on the project size, its categorization under the Foreign Investment Catalogue and other conditions.
- If the project is partially financed by Chinese funds, it will have to be approved by the Ministry of Finance.
- Even though a biomass project has an agricultural aspect to it, it does not need to be approved by the Ministry of Agriculture.
- Other authorisations might be required based on the specifics of the project

C) Third Step: Structure your Investment and choose a Legal Vehicle that is the most appropriate for Implementing and Running your Biomass Project

Direct Investment Structures

- Foreign investors may adopt one of a number of structures for direct investment in China:
    - Joint venture
    - Wholly foreign-owned enterprise (WFOE)
    - Branch office
    - Representative office
- A Chinese partner may be of valuable assistance to the enterprise in applying for PRC approvals and licences, clearing equipment import and purchasing raw materials locally. The practical difficulties of operating in China without a local partner is a major reason why foreign investors have historically tended to favour joint ventures

Joint Ventures

- Two forms of joint ventures are available to foreign investors:
    - The equity joint venture (EJV)
    - The co-operative joint venture (CJV)
- An EJV must take the form of either:
    - a limited liability company; or
    - a joint stock company.

- A CJV may be either:
  - An Unincorporated CJV, which does not involve the creation of a legal entity separate and distinct from the contracting parties; or
  - A Legal Person CJV, which is a separate legal entity with limited liability

- To establish a joint venture, the parties should:
  - Sign a letter of intent or heads of agreement and must follow the similar approval procedures prescribed by the EJV Regulations and the CJV Rules.
  - Submit a feasibility study and subsequently the joint venture contract together with its articles of association to the Ministry of Foreign Trade and Economic Co-operation (MOFTEC) or its local branch for approval. A decision should be made within three months of submission of the application for an EFV or 45 days for a CJV.-
  - Within one month of obtaining approval, the applicant should register with the industry and commerce administrative authorities and obtain a business licence.

- As compared with EJVs, CJVs offer
  - a more flexible profit distribution structure
  - earlier recovery of foreign investment in certain circumstances
  - a more flexible operational accounting and auditing procedures
- As a result CJVs are seen by the Chinese authorities as a less certain legal structure and providing the Chinese party less security than EJVs. Consequently CJVs will be under a higher scrutiny from the authorities and it seems that their approval may be more difficult to obtain
- In any case, it must be noted that EJVs are generally preferred to CJVs by the Chinese parties and have become the most popular form of joint venture

Legal Background for Chinese-foreign Equity Joint Ventures

- Chinese-foreign equity joint ventures are governed by

  (i) the Law on Chinese-Foreign Equity Joint Venture adopted by the 2nd Session of the 5th National People's Congress on 1st July 1979, as amended on 4 April 1990 and 15 March 2001 (hereafter the ***"Chinese-Foreign EJV Law"***); and

  (ii) the Regulations on the Implementation of the Law of the People's Republic of China on Chinese-Foreign Equity Joint Ventures, which was enacted by the State Council on 20 September 1983 and amended by the State Council on 15 January 1986, on 21 December 1987 and on 22 July 2001 (hereafter the ***"Chinese-Foreign EJV Regulations"***).

D) Fourth Step: Identify the Means through which you will contribute Rights on your Technology to the Project

Technology Transfer as a Contribution-in-kind to a Chinese-Foreign EJV by the Foreign Partner

- The Chinese-Foreign EJV Regulations provides, at Article 22, that the parties to a joint venture should determine the value of contributions in kind through joint assessment or by a third party agreed upon.
- Furthermore, the Chinese-Foreign EJV Regulations imposes, at Article 25, two restrictions as to the possibility of contributions in kind by the foreign partner to the joint venture under the form of industrial property rights or special technologies. Said contributions have to be able (i) to remarkably improve the performance and quality of the existing products and production efficiency or (ii) to remarkably save raw materials, fuels and power. Of course, biomass technology meets this requirement.
- The Chinese-Foreign EJV Regulations (see, Article 27) requires that all contributions in kind by the foreign partner should be submitted to the approval of

  (i) the Ministry of Foreign Trade and Economic Co-operation of the People's Republic of China (***"MOFTEC"***) and

  (ii) the people's governments in the provinces, autonomous regions and municipalities under the direct jurisdiction of the Central Government or the competent authorities under the State Council (altogether the ***"Approving Authorities"***).
- Moreover, in the case of contributions by the foreign partner under the form of industrial property rights or proprietary technologies, all relevant data concerning said industrial property rights or special technologies - including the copy of patent certificate or trademark registration certificate, the validity status and associated technical specifications – must be submitted to (the approval of) the Approving Authorities (including MOFTEC)(see, Article 26 of The Chinese-Foreign EJV Regulations).
- For the purpose of this submission, the price evaluation agreement jointly signed by the foreign partner and the Chinese partner must be attached to the joint venture contract.

Technology Transfer to a Chinese-Foreign EJV

- Generally, all technology licences, know-how transfer contracts, technical assistance contracts and other types of technology contracts obtained from a third party or the foreign joint venture party shall be separately examined by the relevant division of MOFTEC or its local branch, and then filed for the records (see, Article 43 of the Chinese-Foreign EJV Regulations).
- Similarly, although there are no restrictions affecting the payment of royalties by a Chinese-Foreign EJV to the foreign partner for the use of technology, the terms and conditions for the payment of royalties and methodology for calculation of royalties will be examined closely during the approval process (see, Article 43 of the Chinese-Foreign EJV Regulations).

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BIOENERGY STRATEGY AND POLICY ISSUES IN THE WORLD

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Humanity is witnessing the beginning of a revolution in biosciences and engineering that will transform life during this century. Day by day new opportunities are open to develop economically competitive alternatives to fossil energy resources and to significantly reduce countries dependency on foreign oil; improve, and reduce the cost of consumer and industrial products; improve the environment; greatly increase opportunities for enterprises (particularly in the rural, farm, and forest economies); and reinvigorate exports.

Biomass is material originally produced by photosynthesis - such as wood or plants or related municipal and agricultural wastes. New technologies use biomass to produce heat, electricity or fuels that substitute for petroleum, petrochemicals, or
other energy intensive products.

Bioenergy resources such as woody crops, biomass residues and wastes already provide about 14% of the world's primary energy supplies. For the future, bioenergy offers cost-effective and sustainable opportunities that have the potential to meet up to 50% of world energy demands during the next century, and at the same time meet the requirement of reducing carbon emissions from fossil fuels.

The vision statements for many governments focus on overcoming the environmental, institutional, technological, and financial barriers to the near- and long-term deployment of bioenergy technologies.

It is also true that the speed and degree of these future changes largely depend on how wisely and effectively people can work together in national partnership of industries, academia, federal, state, and local governments, and non-government organizations to develop and harness biobased products and bioenergy.

This is not only a challenge to increase the nation's use of biobased products and bioenergy in a short period. Nor is it only a challenge to promote and accelerate
A viable, integrated industry that would enable nations to reach or exceed specific goals.

Rather, this it is a challenge to the way people do business—to the way, people see their roles and relationships. Traditionally, governments have had a very specific and insular view of biomass.

Some have viewed it from the perspective of wood and paper products. Others have viewed it from an agricultural perspective, concerned with planting, harvesting, processing, and distributing crops and derived products, including some liquid fuels. Some have been involved with its use as a source of energy in the forms of electricity and heat, usually coupled with the management of biomass residues. Others have dealt with the environmental effects of planting, processing, distributing, and using biomass.

Some have vested interests in the interstate commerce of biomass-derived goods. Several governments have adopted policies that spurred the growth of power and fuels from biomass and increased the use of recycled products.

Bioenergy is a more complex renewable energy system than other renewable energy systems such as solar or wind. It involves multiple feedstocks, conversion systems, and coproducts. Energy is unlocked from plant components such as lignin and cellulose through thermochemical and biochemical conversion processes. The resulting sugars and other chemicals are converted into liquid fuels and other biobased chemicals. Thermochemical processes of combustion or gasification from biomass produce both heat and electricity. While wastes from municipal collection systems or concentrated animal feedlots can also be used to generate bioenergy, the collection and conversion processes are often accompanied by intense public scrutiny and controversy.

In addition to this basic technological complexity, the authorities are confronted with multiple uncertainties about the potential of expanding bioenergy based on mostly undeveloped feedstock supply systems. There is no generally available market established for energy crops and agricultural residues. Most of the infrastructure required to support a renewable energy fuel cycle dependent upon farm produced feedstocks has yet to be developed.

Bioenergy is currently being asked to compete on an uneven playing field where its fossil fuel competitors (coal, oil and nuclear) are heavily subsidized. These uncertainties affect stakeholder views and concerns and their general support for bioenergy

To accelerate the development and growth of an integrated 21st century Bioenergy Industry, then the challenge is to move beyond these narrow points of view. The first approach should recognize that the scope of biomass, bioprocessing, biotechnology, biobased products, and bioenergy is not limited to food, wood, chemicals, fuels, or power alone.

Actually, it embraces all of these fields and more, and needs all sectors— their missions, and all of the relevant policies, sciences, and technologies.

Today, the world depends on biomass to provide energy now and in the future. With no doubt the advances in biological and physical sciences and engineering would accelerate the use of biomass.

This revolution will have important impacts on:

- stimulating economic growth, especially in rural, farm and forest economies, and industries.
- reducing emissions of carbon dioxide and airborne pollutants, reducing soil erosion, sequestering carbon, protecting water supplies and quality, and increasing the diversity of crops and products.
- increasing energy security by securing domestic production and reducing our enormous dependence on foreign sources of fossil fuels.
- securing a competitive position by opening up new technologies, industries, and export opportunities.

The Challenges:

- To advance science and develop technologies to overcome difficulties posed by the complexity of biomass resources and processes.
- To coordinate government policies to meet the national and international goals.
- To accelerate the commercialization of new and emerging technologies and products to meet the national goal.
- To ensure that new technologies and increased use of biomass will not adversely affect land, water, air, and public health, but rather provide environmental benefits.
- To provide information for institutions, enterprises, industry, farmers, landowners, and the people in general that will help them understand biobased products and bioenergy .
- To coordinate efforts to encourage the growth of an integrated industry.

The advances in the science and technology of biobased products and bioenergy present a great opportunity to expand the renewable carbonbased industries while simultaneously moving toward a more environmentally sustainable economy.

Biobased products and bioenergy offer considerable environmental benefits. They often require less energy to produce than the fossil and inorganic products they replace. Biobased products often reduce waste as well as improve air and water quality relative to the products they replace. In addition, biobased products can sequester large amounts of carbon while adding little if any net carbon emissions to the atmosphere.

However, biological feedstock growth, processing, and use can pose environmental challenges as well. Changes in land use, pesticide, fertilizer, water,
and other requirements could carry risks to habitat, public health, diversity, and air and water quality. To ensure that this initiative maximizes environmental benefits and minimizes potential risks, the environmental benefits and costs have to be assessed at all stages, from planning to commercialization.

The challenges of developing new biobased products and bioenergy are formidable. Biomass resources are more complex and harder to process than petroleum or coal. A large number of production, conversion, and utilization technologies are possible.

There are many ways to integrate individual technologies. Because of the fast pace of progress in biological sciences and technologies, the number of alternatives will increase rapidly.

Carbon-based products from both fossil and renewable sources play a critical role in the world economy. They are present in fuels, in packaging and clothes, in vehicles and homes, and in workplaces and leisure activities.

Renewable resources such as trees, grasses, and crops were the primary source for such products until the mid-19th century. Then gradually, as understanding of chemical, geological, and physical sciences and engineering progressed, and the demands of industrialization grew, fossil fuels began to replace renewable resources and became the dominant raw material for energy, chemicals, and products in the 20th century.

Today, the cost and security risks of fossil fuel imports, environmental concerns with increased pollution and with global greenhouse gas emissions from fossil fuel use, the desire to improve the rural economy, and breakthroughs in biological sciences, technologies, and processes have renewed the interest in biobased products and bioenergy.

For example, sugars and biosynthesis gas from biomass are two examples of building blocks from which can derive many other products. These building blocks should be supported by developing critical technologies such as biomass hydrolysis and gasification. These critical technologies can unlock a wide range of products—just like thermal and catalytic cracking did for petroleum in the 20th century.

Sugars could be as important to the bioproducts industry as ethylene is to today's petrochemical industry. The chemical industry uses ethylene as a starting material to make thousands of consumer products, including polyethylene bags and polyethylene terephthalate (plastic bottles for soft drinks).

Analogously, with sugars derived from lignocellulosics found in trees, grasses, or residues from agriculture crops, we can use fermentation and chemistry to make hundreds of products including:

- Alcohols, such as ethanol, glycols, and sorbitol.

Ethanol is used as an oxygenated fuel that helps reduce toxic air pollutants and increase gasoline octane numbers. Glycols are used for making antifreeze, brake fluids, and solvents.

And sorbitol is used in adhesives, as a softening agent, and as a sweetener.

- Acids, such as lactic acid, which is used for preparing cheese, soft drinks, and other food products. It is also developing into a starting material for biodegradable plastics.

- Polymers, such as xanthan gum, which is used as a food-thickening agent and as a gel in toothpaste, medicines, and paints.

On the other hand, Biomass gasification uses heat to convert solid biomass into a biosynthesis gas—which is primarily a mixture of carbon monoxide and hydrogen, with carbon dioxide, water vapor, and small amounts of tar. Once this biosynthesis gas is cleaned of tars This can be used it to produce:

The biosynthesis gas can be used in advanced turbines or in fuel cells to produce electricity at more than twice the efficiency of today's combustion systems. By using gasification technology to replace aging power and heat-generating equipment, the pulp and paper industry could become energy self-sufficient and could even export electricity.

Two of many important classes of biobased products are plastics and surfactants.

- Plastics. The chemical industry today produces more than 80 billion pounds of plastic products annually. The great majority of these products are derived from fossil resources. Biomass resources account for only a small percentage, many filling high-price, value-added applications. Accelerated R&D could help biomass-derived plastics in two ways.

First, it could help lower the costs of a wide range of biobased plastics, which would then enable these plastics to penetrate high-volume applications that could offset increased petroleum- based plastics production.

Second, it could help continue the development of a slate of highquality plastics with unique properties, which would penetrate many markets based on their performance. A variety of important specialty plastics could be sold at premium prices.

Finally, the common starting point for all these products is the biomass feedstock— green plants. Research and development are critical for increasing the supplies of sustainably grown crops and for reducing the cost of biomass so that it will become the worlds green petroleum of the 21st century.

Feedstock research includes plant science, understanding and using plant productivity factors, and the growth and selection of plants with specific attributes. As selected plants move into development, cost-effective, regionally adapted, and environmentally beneficial crop production methods are needed.

Improved crop harvest, handling, storage, and transportation methods could further assure reliable biomass supplies. In this way a broad range of cost-competitive products can be made from biomass feedstock.

Already known Biobased Industry

- Paper and packaging Writing papers, newsprint, magazines, and packaging cartons
- Wood-based composite materials Lumber, plywood, flooring, furniture, laminates, engineered wall systems, and structures wood/polymer and structural composites, and lignin-based polymers

Emerging Biobased Industry in many countries

- Plant-based plastics and polymers Polylactide plastic, starch biodegradable polymers, and films spider silk polymers
- Lubricants and functional fluids Biodegradable soybean oil-derived lubricants, used grease-refined products
- Inks Soybean-derived inks
- Enzymes Cellulase for orange juice clarification and stone-washed jeans, amylase for corn industry, enzymes for nutrition enhancement, novel property enzymes
- Renewable alternative fiber papers and Kenaf, milkweed, and other agriculture products used for fibers, packaging packaging, and products.
- Absorbents, adsorbents, and Odor control, spill absorbents, animal bedding, pet litter, biocement masonry and road materials support, roofing, insulation, road oil, and asphalt
- Adhesives and bonding products Sealants, glues for building products, glues for envelopes, wall paper adhesives, soy-based adhesives, marine glues
- Biocontrol products Soil amendments, such as topsoil, aggregate, and enrichment, fertilizer and pesticide carriers

- 11 Solvents, chemical intermediates, and Methyltetrahydrofuran from levulinic acid, methanol from synthesis gas, cleaning agents cleaners, conditioners, and surfactants

- Coatings and paints Paints using cellulose-derived water soluble polymers

- Cosmetics and personal-care products Biobased products in toothpaste, lotions, and shampoos

- Landscaping products Decorative bark, railroad ties

- New fibers, fillers, yarn, and insulation Cotton fibers and rayon (cellulose derivative) textiles. New insulation using cotton processing trash and recycled textile fibers, filler for auto fenders, and panels for vehicle liners

- Pharmaceuticals and veterinary products for cancer treatment

Biomass in the United States

Biomass resources supply the United States with 3 percent of its primary energy. From this primary biomass input, nearly half is lost in conversion processes. The other half is consumed in the form of heat, electricity, and liquid or gaseous fuels. Major bioenergy uses by sector include the following:

- Buildings. About 25 million homes use wood for primary or supplemental heating, and wood provides 10% of total residential heating in America.

- Electricity. Biomass residues, municipal wastes, and landfill gas are used to generate heat and 60 billion kilowatt-hours from 10 thousand megawatts of electric power (nearly 1 percent of the generating capacity in the United States). The
- electricity derived from the biomass residues avoided 7 million tons of carbon emissions per year because of diversion of biomass from landfills and their resulting emissions.

- Industry. Biomass process streams and residues provide 56 percent of the electricity and heat used by the pulp and paper industry and 75 percent of the electricity and heat used by the solid and engineered wood products industries and composites.

- Transportation. Ethanol (primarily derived from cornstarch) accounts for 0.4 percent of liquid fuels and is provided as an ethanol-gasoline blend in 3 percent of U.S. gasoline supplies. Of the 35 billion gallons of diesel consumed in 1998, 6 million gallons were biodiesel.

Bioenergy in the Asian Countries.

Some studies have been conducted to assess the energy supply from biomass plantation in some Asian countries. The energy potential of plantation biomass is 5-6%, 5-24%, 0.2-0.8%, 2-11%, 7-35%, and 3-31% of the projected total energy consumption in 2010 in China, India, Malaysia, Philippines, Sri Lanka and Thailand, respectively. (S.C. Bhattacharya , Ram M. Shrestha, H.L. Pham 2000)

Are these countries, the key barriers to biomass production for energy include some of the barriers already analized.

- *Technical barriers:* high investment costs of dedicated plantations, and low biomass productivity.
- *Financial barriers:* lack of investment in the forestry sector, difficulty in accessing finance, and lack of incentives.
- *Institutional barriers:* lack of co-ordination among different government agencies, lack of mechanism for their interaction with private sector, lack of a designated agency for promoting biomass energy/plantation and lack of access to expertise on plantation in degraded land.
- *Policy barriers:* unclear, unsupportive and biased government policy and absence of national strategy or priority for promoting biomass energy use.Some Asian countries have come up with clear mission/policy objectives statement on renewable energy

China: Raising efficiency and reducing cost in order to boost the share of RE in national energy supply.

India: Meeting minimum rural energy needs, provision of decentralised energy needs and grid quality power generation and supply.

In all study countries renewable energy is now recognised as important for providing energy services, particularly in remote and rural areas. For this purpose, investment subsidy is provided to all major renewable energy technologies and is also available to a lesser extent in China and Thailand.

In India, 100% depreciation in the first year is allowed for certain equipment. Other fiscal incentives available in India include exemption/reduction in excise duty, and customs duty concessions on imports. Tax incentives for biomass energy projects are also available in Malaysia, China and Thailand.

Provisions for Power Purchase Agreements are quite well established in India, China and Thailand. Wind farms in China have a right to sell electricity to the grid at a price giving them a reasonable profit even if the price is higher than the grid's average price level. Improved cookstove programs have been undertaken in practically all countries.

Relatively less has been done regarding traditional biomass energy systems in rural industries. In Asia, only India and China have achieved some success in R&D efforts on modern biomass energy systems.

Bioenergy for the world in the near future

There are significant opportunities to improve the efficiency of converting primary biomass to convenient electricity, heat, and transportation fuels.

For bioenergy to become more competitive and more widely used, increased
use of combined heat and power would help. But even greater increases in efficiency are needed.

And this can be achieved only through advanced technologies like advanced biomass gasification coupled with advanced turbines in combined cycles, possibly with fuel cells (which could reach conversion efficiencies of 60 percent or higher).

The technical and commercial risk of these technologies must be reduce so that industry can adopt them in an expeditious manner as they replace capital equipment and develop additional supplies.

Some bioenergy deployment is compatible with the current fossil energy infrastructure. Gasification of biomass is a feasible way to combine biomass energy with coal at very high proportions of biomass.

It is also a way to couple biosynthesis gas (processed to pipeline quality) to increase natural gas supplies for distribution and home applications.

Cofiring solid biomass residues along with coal directly could lead to biomass efficiency increases with relatively low capital investments.

Bioenergy Strategies

1. Bioenergy and environment

- Monitor and evaluate the environmental and ecosystem impacts of biobased products and bioenergy systems at all stages of development and apply this information toward improving these systems' safety and environmental benefits.

- Identify and foster R&D on biobased products and bioenergy areas that have substantial potential to replace fossil-based fuels, power, heat, chemicals, and materials (including inorganic products replacement) with substantial potential to provide environmental benefits.

- Establish specific review committees with broad public representation and open processes to oversee environmental monitoring and evaluation, in-field biomass production, and facility conversion processes.

- Conduct ongoing life-cycle analyses to evaluate integrated systems and determine areas for environmental improvement.

- Utilize advanced information technologies to collaboratively assemble, analyze, and publicly disseminate information on relevant environmental and ecosystem impacts.

2. R&D and Human resources

- Strengthen and integrate basic scientific research programs and complementary competitive grant programs across the nations and their laboratories, academic institutions, and private-sector firms.

- Enhance human resource development to support scientific R&D programs.

- Strengthen partnerships between the public and private sectors.

- Evaluate biobased products and bioenergy R&D portfolio to identify gaps in frontier science and technology.

- Identify opportunities for technology transfer from other functional genomics and metabolic engineering R&D, such as on human systems.

- Identify R&D issues that would be appropriated, extend existing or develop new programs that address key challenge areas.

- Reserve a portion of the R&D funding for highrisk frontier science opportunities to nurture innovation.

- Support research fellowship programs at universities and national laboratories in key science areas that benefit biomass feedstocks, biobased products, and bioenergy.

- Identify in detail the principal barriers to the research, development, demonstration, and deployment of biobased products and of bioenergy and systematically develop coordinated policy mechanisms to overcome them.

- Develop science-based education and outreach programs and materials, directed toward classroom teaching and consumer education to explain the environmental sustainability and product performance of biobased products and bioenergy.

3. Market and other policies

- Incentives to stimulate the creation and early adoption of technologies needed to make biobased products and bioenergy competitive with fossil-fuel-based alternatives

- This may include tax incentives, environmental offsets, risk mitigation mechanisms in early deployment, buy-down mechanisms, and others.

- Identify existing state authorities that can be used to facilitate early adoption of biobased technologies and products.

- Link environmental benefits of biobased products and bioenergy to public policy development.

- Resolve infrastructure, performance, environmental, and health testing issues that present a barrier to the market adoption of biobased products and bioenergy.

- Encourage early development and adoption of standards and labels for biobased products and bioenergy. Work with the private sector and nongovernmental organizations to identify the appropriate role of government in this effort.

- Inform consumers and government employees about the benefits of biobased products and bioenergy so they will support the effort.
- Facilitate enactment of legislations to assist purchases of biobased products and bioenergy.
- Use targeted demonstration programs to collect data over time and quantify benefits and costs of biobased products and bioenergy use.
- Collaborate with the appropriate state, and local agencies to facilitate private-sector investment in key areas of biobased products and bioenergy for widespread implementation of technologies.

4. Assistance and R&D.

- To promote the utilization of technologies and systems for enhanced sustainable energy production from biomass.
- Advance understanding of technologies that can reduce emissions of greenhouse gases to the atmosphere.
- Promote the deployment of technologies with important local and global environmental benefits.
- Recognize technologies with local or regional economic benefits or employment opportunities that contribute to a secure energy supply.
- Examine the implications for embedded generation and the role of utilities in deployment of bioenergy products and services.
- Encourage deployment of bioenergy products and services in developed and developing countries.

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International Bioenergy Forum: China-EU Cooperation
4th LAMNET Workshop – Guangzhou, China 2003

Industries Round Table – Bioenergy Technology Presentation

Microdistillery Technology

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Frilli Impianti Srl, located in Poggibonsi, in the centre of Chianti region, between Florence and Siena, is an Italian private Company, founded in 1912. To-day Frilli Impianti is in business to provide state-of-the-art technology and equipment to the ethanol industry. The services offered range from turnkey supplies to services such as plant design, engineering, construction, troubleshooting and revamping of existing units. All ethanol production processes from a wide variety of biomass (grain, molasses, fruit, wine, wine by-products) are covered with its own know-how and in-house technology. The 70% of Frilli Impianti's activity is abroad: Frilli Impianti is working in the entire world and is in continuous development, because the ratio between quality and price, the assistance to the Clients and the reliability on the market put Frilli Impianti on the very first places at international level.

Frilli Impianti's technologies include, among others:

Wine by-products

- Continuous dealcoholization of fermented marc for alcohol and "Grappa" production
- Distillation of wine lees
- Production of wine distillates (brandy), pure alcohol, raw alcohol
- Production of calcium tartrate from marc and lees
- Batch distillation with traditional pot still for the production of top quality brandies and "Grappa"

Molasses and cereals

- Design of "turn-key" units for the production of "Surfin" alcohol
- Design of "energy saving" saccharification, fermentation, distillation and rectification plants of any size

Fruits

- ❖ Fruit distillates (pears, apples, plums etc.)
- ❖ Rectified alcohol

Aromatic and medicinal herbs

- ❖ Essential oils
- ❖ Extracts
- ❖ Aromatic waters
- ❖ Alcoholates

Pharmaceutical and chemical field

- ❖ Plants construction also on design of third parties
- ❖ Design and construction of plants for solvents recovery

Effluent liquids treatment in distilleries, wine cellars and agro-alimentary industries

- ❖ with chemical-physical plants, multiple effects concentration plants, anaerobic digestion plants with biogas production and other technologies for the effluent liquids treatment.

Supply of special items

- ❖ Construction of columns, heat exchangers and distillation trays for distilleries, chemical, petrochemical and pharmaceutical plants, in stainless steel, copper, iron or special alloys.

Revamping of old plants

Frilli Impianti can study existing installations and design changes and technical modernizations to improve:

- ❖ Alcohol quality
- ❖ Yields
- ❖ Production capacity
- ❖ Operation reliability
- ❖ Saving in energy consumption
- ❖ Treatment of slops and stillage (waste waters)

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Biopellets for Space Heating

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Naturenergi is located in Sweden and we started our businesses in the 1930s and have been manufacturing heating equipment since 1955. This makes us one of the oldest and **most experienced manufacturers** of systems for burning biomass fuel **in Europe.**

Bio energy will play an important role in our future energy supply, to the advantage of both the **environment and the economy. The earth that** we once inherited and **our grandchildren will inherit from us is threatened**. One of the **major threats** to the climate is due to the **increasing amounts of carbon dioxide in the atmosphere**.

All burning of fossil fuel such as oil, coal and natural gas will increase the level of carbon dioxide. Wood pellets and other Bio fuels do not have that effect on the environment and will not contribute to the global heating at all.

In **Europe**, the price of electricity and oil will rise dramatically over the next few years – nuclear power stations or not. However, even today a conversion to **pellets heating** instead of oil heating or electrical heating will **reduce our heating costs by 40% to 50 %.** I don't know exactly what will the future will bring to **China,** but you **most likely will go in the same direction.**

Bio fuels make both environmental and economical sense. The pellet energy source is renewable and a part of natures own cycle which is based of evolution and progress.

Sweden has since ancient times been heating houses, industries and official buildings with bio fuel and we continue this tradition. One of our reasons for heating with bio fuel is first of all our **big forests.** They have for hundreds of years been giving us large quantities of bio fuel. We also have a **large wood industry** leaving waste products such as sawdust and wood chips suitable for heating.

Due to the fact that these forests have been very well taken care of we today have more forests than ever before in Sweden. **This resource will continuously supply our society with energy in the future.**

Like Sweden, China has big forests with the capacity to supply parts of your population heating with bio fuel. In your country you **also have waste products from rice, grain and other agricultural products**. They are also bio fuels and I am sure we ca use them for heating in our burners.

Why choose bio energy?

1. Bio energy is **renewable** energy
2. It is **domestically produced** and therefore has an positive effect on your balance on current account.
3. Bio fuel **creates jobs** in your own country
4. Pellets are **refined fuel** and can bear transport costs. It can be transported over long distances. In Sweden we by from different countries in Europe and even from Canada.
5. Bio energy will **not contribute to the global heating**
6. Heating with bio energy is **cheaper** than heating with electricity or oil.

In Sweden and in most of the countries in **Europe heating with pellets is rapidly increasing**. I have already given you six reasons why but I can give you **one significant reason more**. On the **Kyoto agreement** a lot of countries **promised to reduce its carbon dioxide emissions** and to fulfil these promises **we** are forces to find ways to change from fossil energy to other energy sources.

Now I tell you a little about my company and our products:
In Europe our products are to be founnd on most of the markets. Our pellet burner is warming up houses in Denmark, Norway, Finland, The Baltic states, Germany. Austria, Italy.

The **combustion in Naturenergi pellet burners** is accomplished through a **controlled processing technique with the highest degree of efficiency and environmental discharge** far below current limits. Naturenergi produce burners with an output from 10 kW to 450 kW. We have tree different lines with burners for bio fuels.

Line No. 1. Burners for wood pellets
Line No. 2. Burners for wood chips
Line No. 3. Burners for saw dust and wood chips.

In our factory we develop new equipment and do tests regarding emissions, efficiency and safety demands from authorities on different markets.

The factory set up.

Our focus is apart from Marketing & Sales to control the crucial processes, this set-up enable us to be very cost efficient. (We have a minimum of man load during the seasonal variations 60-70% of all sales concentrated to Aug-Nov).

- **R&D (Research & Development)**
- **Assembling**
- **Quality**
- **Customer support**

Some additional words about our assortment and the specific strengths.

All our burners are known as safe and simple to handle. When we develop new products our **main goal is to** produce **a safe, efficient burner with few moving parts** because the high temperature most likely will cause problem on moving parts.
Now I tell you a little about my company and our products

Pellets

Villa-S1

Main features	***Benefit***
Electrical Ignition (Best on the market)	Better economy and safer use
Special steel construction (253 MA)	Allmost impossible to wear out
No moving parts	No problem with parts worn-out.

30 kW

Main features	***Benefit***
Electrical Ignition (Best on the market)	Better economy and safer use
Special steel construction (253 MA)	Almost impossible to wear out
Unique steering	Could be operated in various modes for best economy.
Combination burner	Use the best raw material from time to time (Availability Price)

50-200 kW

Main features	***Benefit***
Electrical Ignition (Best on the market)	Better economy and safer use
Special steel construction (253 MA)	Almost impossible to wear out

General for all Pelletburner

- To be fired with pellets from 6 to 12 mm in size.
- Can be adapted to most of the boilers on the market
- Few components of the best quality (Swedish & German)

Recap of what I have said today

1. Bio fuel in general and Pellet specificly

- Is a very **cost efficient** alternative to Fossilfuels
- Is a much more **environmental friendly** alternative

2. The Swedish development

- The trend is that the Bio energy alternatives will **increase in use rapidly** over the coming years out of 4 reasons.
- The stabilisation of the **trade balance** for Sweden as a country
- The **labour generating** factor.

3. Naturenergi

- Oldest and **most experienced** company in the field (1954)
- **Broadest assortment** on the market (Pellets, Woodchip, Sawdust, Grain)
- One of the **leading actors** in Europe
- Products that all carries the features that they are of a sturdy construction with conscious chosen **quality** components.
- Products with the absolutely **safest and reliable** ignition on the market
- Products that all are **easy to handle** due to few components and smart control devices.

I am honoured to have had the opportunity to chare my experience with you and thank all of you for your attention.

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Industries Round Table – Bioenergy Technology Presentation

Activated Charcoal Technology

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Fax: +39-0362-85 15 55

Presentation:
Prof. Leonetto Conti
Email: conti@ssmain.uniss.it

Company name:	MONT-ELE s.r.l.
Company's capital:	199.000.000 Lit.
Employees:	22
Year of establishment:	1972
Group member:	GRUPPO MAGGIONI
Turnover:	1991 3.000.000.000 Lit. 1992 6.000.000.000 Lit. 1993 3.500.000.000 Lit.
Main executives:	E. MAGGIONI (Administrator) E. VIGANO' (Manager)

MONT-ELE works in the fields of energy, industry, transports, environment. It develops engineering, supply and erection of systems and plants, for sections of electricity, automation, instrumentation, software, mechanical-piping. It coordinates a highly qualified engineering and technical manpower for engineering, erection and start-up. As far as the external business relations are concerned, the company proposes and carries out co-operations and collaborations between local, international, contracting and manufacturing companies. It is a dynamic company which carries its own know-how (treatment plant and activated carbons from biomasses) and is able to turn different know-how.

MAIN ACTIVITIES

ELECTRICAL, INSTRUMENTATION AND AUTOMATION ENGINEERING, ERECTION, START-UP AND TRAINING

Investigation, general studies and feasibility studies

Investigation, general studies and feasibility studies for energy saving in the industrial sector and for renewable energy (wind plant, photovoltaic plant, etc.).

Engineering

Basic, preliminary, executive and detailed engineering; cost estimation, cost control, quality assurance; tenders and technical specifications; certified documents according to Italian standard and law.

Consulting and assistance

Project management, project control, procurement service, offer evaluation and tabulation; tests, supervision and work management, assistance to erection and start-up.

Erection and maintenance

Electrical, instrumentation and automation boards construction and supply.
Erection and start-up of electrical, instrumentation and automation plants and systems.
Turn key plants supply.
Routine and special maintenance.

OPERATIVE SECTORS

The main sectors of activity for engineering and erection are the following:

- photovoltaic and wind generating plants
- thermal power plants
- hydroelectric power plants
- primary transformer substation
- transformer substation
- conversion stations for train railway, underground railway and tram supply
- mobile and modular substations
- electric cabin
- pharmaceutical plants
- chemical plants
- petrochemical plants

QUALITY ASSURANCE

Mont-ele operates with Quality Assurance System according to EN 29001 European Standard. The Quality Assurance System is certified (N. 101 date 22/06/94) by CERSA, SINCERT recognized institute reg. No. 022/A.

China Project Coordination
Prof. Ottavio Antonio Angotti, Financial Consultant for Eastern Europe and Central Asia
Prof. Wang, Guangzhou Technical University
Dr. Giuliano Grassi, Secretary General European Biomass Industry Association

LAMNET Coordination Partner

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