Proceedings

Biomass Utilization Technologies Workshop

Agenda

Date: 23-24 November 2004
Venue: Cui Gong Hotel (Jade Palace Hotel) Beijing
Sponsored by: Energy Bureau, National Development and Reform Commission
Organised by: EU-China Energy and Environment Programme

Day One		
Time	Presentation	Speaker
Chairman	Shi Lishan, Director of Division of Renewable Energy, Energy Bureau, NDRC	
09:00 - 09:15	Opening Remarks	Wu Guihui, Deputy Director, Energy Bureau, NDRC
09:10 - 09:30	Welcome Address	Alessandro Bianciardi ECD Li Baoshan, MOST
09:30 - 10:15	EU Biomass Technologies for Electricity Production	Heinz-Peter Mang, German Society for Sustainable Biogas and Bio-energy Utilisation
10:15 -10:30	Coffee Break	
10:30 -11:15	EU Biomass Technologies for Heat Production	Siegfried Rapp, Global Wood AG
11:15 - 11:45	Biomass Resource and Utilization Status in China	Yao Xiangjun, Deputy Director, International Cooperation Division, Ministry of Agriculture
11:45 - 12:00	EU China Energy and Environment Programme	Frederic Asseline, EEP PMU
12:00 - 12:15	Green Power Development in Europe: Comparison of Policy Instruments, Effectiveness and Implications for China	Gan Lin, Director, Energy programme Division, WWF
12:15 -12:30	The Utilization of Biomass in Europe	Video playing
12:30 - 13:30	Lunch	
Chairman	Wang Zhongying, CRED	
13:30 - 14:00	Gasification Technologies for Power Generation	Wu Chuangzhi, Guangzhou Institute of Energy Conversion
14:00 - 14:45	EU Biofuels Technologies	Bernhard Raninger, Shenyang Hangkong University Biomass Institute
14:45 - 15:15	Biofuels Technology Development in China	Wang Mengjie, China Institute of Agricultural Engineering
15:15 -15:30	Coffee Break	
15:30 - 16:15	EU Biofuels	Bernhard Raninger, Shenyang Hangkong University Biomass Institute

16:15 - 16:45	Three NDRC Pilot Plant for Straw Combustion	Zhou Huang, Energy Bureau, NDRC
16:45 - 17:00	Q&A	
17:00 - 17:15	Conclusions	
18:00 - 20:00	Banquet	

Day Two

Time	Presentation	Speaker
Chairman	Alessandro Bianciardi, ECD	
09:00 - 09:30	China National Biomass Development plan	Wang Zhongying, CRED
09:30 - 10:15	EU Biomass Policy Development	Grassi, President of European Biomass Association
10:15 - 10:45	Supporting Policies for Biomass Technologies Commercialization in China	Zhang Xiliang, Tsinghua University
10:45 - 11:00	Coffee Break	
11:00 - 11:30	Case Study - EU Biomass Heat Production Technologies	Siegfried Rapp, Global Wood AG
11:30 - 12:15	EU Biomass Project Development	Ekkehardt Schneider, Fachverband Biogas, Munich Germany
12:15 - 12:30	Q&A	
12:30 - 13:30	Lunch	
Chairman	Zhou Huang, NDRC	
13:30 - 14:00	Case Study - EU Biomass Electricity Generation Technologies	Hein-Peter Mang, German Society for Sustainable Biogas and Bio-energy Utilisation
14:00 - 14:30	Case Study- Liaoning Biomass Gasification Technologies	Bernhard Raninger, Shenyang University Biomass Institute
14:30 - 15:00	Case Study - EU Biomass Biofuels Technologies	Herbert-Peter Grimm, Senior Expert, WIP Munich
15:00 - 15:30	Cost Effective Production of Biofuels from Biomass	Li Shizhong, China Agricultural University
15:30 - 15:45	Break	
15:45-16:00	Grease Trap Garbage to Bio-diesel-New Development Option for Biodiesel	Ji Xing, University of Petroleum
16:00-16:15	Biomass Compression Technology	Che Zhanbin, Beijing Huizhong Sci-technology Co.Ltd
Chairman	Herbert-Peter Grimm ,Wip Munich	
16:15 - 17:00	Policy and Project Development panel	
17:00 - 17:30	Discussion	
18:00 - 19:00	Conclusions	
19:00	Dinner	
	Over	

Opening Remarks

Mr. Wu Guihui
Deputy Director, Energy Bureau
National Development and Reform Commission

Ladies and Gentlemen,

Good morning!

Today, we are holding a workshop on Biomass Utilization Technologies in order to let us exchange ideas on the state of biomass conversion technologies in China and in the EU and to discuss possible biomass resource development strategies for China. This is an important event from which we hope to broaden our knowledge of technological solutions for the conversion of biomass resources. We have invited a number of experts from the EU who will introduce a number of technologies covering notably biomass for electricity generation, heat production, and technologies to produce bio-fuels. The government of China is committed to promote the development of biomass conversion technologies nation wide in order to diversify energy supply, protect the environment, and support the sustainable development of China's energy structure.

Please allow me to express my heartfelt thanks for the presence of the EU experts and congratulations to the organizers for putting together this workshop. I express my warm welcome to all participants on behalf of the Energy Bureau of the National Development and Reform Commission.

Biomass is a major form of renewable energy, currently providing for a sizeable proportion of the world total energy consumption. At present, biomass accounts for about 14% of the world's total, with this share rising to more than 40% for developing countries. Biomass resources are very abundant in China; the annual production of straw from crops reaches 700 Mt, while agricultural residues such as rice husk and sugarcane bagasse amount to 100 Mt. Supply of firewood from forestry residues is considerable and organic waste from both animals and human settlements reach 400 Mt per year in a conservative estimate. In addition there is a very large amount of municipal waste that can be converted to heat and power production. The global biomass resource is estimated at 700 Mtce per year, of which the economically exploitable share is very large.

The development and utilization of biomass is of special significance to the rural areas of China. In China 80% of the population lives in the countryside, biomass such as straw and firewood constitutes the main fuels for heating and cooking purposes. Even though the use of coal for energy provision has increased rapidly in the rural areas, biomass conversion still accounts for a very sizeable part of the energy provision. At present, the total household energy consumption in the countryside amounts to 400 Mtce a year, of which straw and firewood account for about 56%. The

major share of these resources is burnt directly in kitchen stoves, which lowers the efficiency of energy provision, produces waste, but also causes serious pollution and health problems. Therefore, developing biomass conversion technologies for a more efficient and environmentally friendly energy provision in rural areas is a priority to achieve large scale poverty alleviation and further rural development.

At present, the main biomass conversion technologies developed worldwide include direct combustion of the resource for heat and electricity generation, straw gasification for concentrated gas supply and electricity generation, and biomass liquefaction. From these technologies, electricity generation accounts for about 50 MkW, mostly in Northern Europe and in the United States. Every year the worldwide production of liquid fuels such as grain alcohol and biomass diesel oil amounts to about 20 Mt oil equivalent, with most of the production located in Brazil and the USA. In addition, there is a large number of commercial marsh gas development projects, and of peasant household marsh gas pools.

Biomass conversion technologies have received a great deal of attention in China and demonstration projects have been developed for most technologies providing a foundation for future large scale industrialization efforts. There is a need to scale up the industrialization process by improving technology and introducing a more supportive policy framework. According to the estimate of national experts biomass will become a major component of future sustainable energy provision with its share potentially rising to 40% of total energy consumption by the middle of the 21st century. The NDRC' Energy Bureau has produced a medium and long-term development plan for biomass conversion technologies, which sets a target of 20GW of installed electric generation from biomass sources by 2020.

In order to realize this target, advances in technology and research and development will be essential, but not sufficient. It will be necessary in addition to develop policies supporting the development of new conversion technologies, and to reinforce cooperation with international public and private stakeholders.

On November 3, 2004, the EU China Energy and Environment Programme was officially launched in Beijing at a Conference on Sustainable Energy Development which laid the foundation for the activities to be developed under the renewable energy component of the Programme until June 2008. Today's workshop is the first follow-up activity after the launch of the Programme as a whole, and it will no doubt help define future cooperation priorities further.

The theme of the workshop is relatively comprehensive with a lot of ground to be covered. Let us all focus our attention, raise questions, and share experience extensively in order to make this meeting a successful one. I wish this workshop success!

Thank you!

Main Impact Note

PMU EV-China Energy and Environent Progravnme

Overview

The EEP convened a Workshop on Biomass Utilization Technologies in Beijing on November 23-24, 2004. The workshop attracted a total of 170 participants for two days, among which representatives from the National Development and Reform Commission (NDRC)'s Energy Bureau, representatives from provincial offices of the NDRC, officials from the Ministry of Agriculture (MOA) and the Ministry of Science and Technology (MOST).

The Guangzhou Institute of Energy Conversion, the Centre for Renewable Energy Development (CRED), Tsinghua University, the China Agricultural University, were also represented in addition to numerous local and international consultancies specializing in developing biomass conversion technologies.

The Delegation of the European Commission to China was represented by Mr. Alessandro Bianciardi during all sessions of the workshop.

During the closing sessions between Chinese and EU experts, participants to the workshop structured their discussions around three main issues:

* Identify biomass conversion technologies that are currently of major/common inter est to both China and the EU;
* Identify among these the technologies that are closest to the market and do not require significant development efforts to reach commercialization;
* Identify areas for establishing common cooperation activities and suggest methodologies for their implementation;

With regards to the first question, the workshop concluded that the following technologies were of common interest:

* Decentralised cogeneration;
* Utilisation of biomass residues for heating;
* Biological processing of wastes by anaerobic digestion;
* Production of biofuels for transport.

The present report will propose a summary of main findings of the workshop in terms of avenues for technical cooperation, priority sectors for intervention, proposed methodologies as well as concrete suggestions for developing activities under the EEP.

I - General Biomass Resource Characterization in China

Biomass resources are most extensively available and in use in the heavily populated regions of

Eastern and Southern China. Today, more than 14% of China's total energy consumption comes from biomass sources including wood, crop residue, animal waste, and other forms.

Bio-energy use declined slightly as a consequence of the development of coal use and extension of rural electricity grids. However, in rural areas biomass continues to account for 38% of overall energy consumption and 77% of fuel used on farms. In many parts of China, the biomass resource is sufficient to supply village-scale energy systems for both thermal and electrical energy.

Biomass conversion technologies can roughly be classified into direct combustion technologies, physical conversion technologies, biological conversion technologies, liquefaction technologies, and conversion technologies of solid waste. Current research in China focuses on the three following conversion technologies:

1) Large- and medium-scale biogas projects on animal farms;
2) Haemolysis gasification of raw material such as stalks; and
3) Landfill and/or treatment of municipal solid waste.

II - Main Recommendations from the Technical Sessions

Pelletisation

Stabilisation of humid agro-forestry biomass residues and wastes by pelletisation technologies is expected to represent in the medium term a major new energy support for all modern biomass utilisation and conversion technologies (heat, power, transport, biofuels), and for international trading. Specific attention must be brought to technologies able to produce simultaneous drying and compression of the resource, while introducing energy efficient compacting technologies, notably cold compression as developed in Italy.

Energy crops

Herbaceous grasses like sweet sorghum have high potential to help fight desertification and to serve as a major provider of energy. Energy crops can produce high yields at high economic value and can serve as potential substitution crops for corn plantations. Food, energy and industry crops can be cultivated in rotating harvests to maximize the yield of each while preserving fertility and sustainable use of arable land.

Waste conversion technologies

Anaerobic digestion technologies have reached high deployment levels in both China and in the EU. In China the technology has improved greatly, but there is still room to learn from EU experiences, notably in reducing the general waste disposal costs by developing compost production in addition to biogas.

Cost per KWh for landfill gas is at 0.45 RMB, and 0.6 RMB/kWh for both waste incineration and biogas plants. These costs amount to about twice the price of a kWh generated from burning coal. These cost calculations incorporate the entire cost of treating the waste prior to incineration, for which no public subsidies apply in China. In the EU basic waste disposal costs are considered public obliga-

tions and covered by waste disposal fees. This applies also to the production of compost, for which revenues derived from compost sales are used only to cover the fine processing costs. Remaining shares of the sales revenue in turn serve to lower the public waste disposal fee. Similar public policies need to be introduced in China.

Biogas production from waste has had limited success in China from both technological and economical points of views. China needs to introduce a legal framework to support biogas production and provide cost benefits to ensure the economical sustainability of projects. China can also benefit from technology transfer form key EU biogas countries like Germany, France, Austria and Italy.

The EU has introduced policies to phase out landfill disposal of bioorganic wastes by year 2019, participants to the workshop wondered why this policy had been introduced. EU experts stressed that engineered land filling of waste does not represent an optimal solution because even engineered landfills can only recover about 50%-60% of the landfill gas derived from waste.

Landfill degassing lessens the environmental impacts of existing landfills but it does not represent the preferred pathway for future disposal of both bioorganic municipal waste and municipal solid waste. Bioorganic municipal waste is furthermore an important source of landfill leachate, which may contain undesirable or toxic chemicals.

The Agricultural University of China stressed that every day over one million tons of organic substances are delivered from agricultural land into Chinese cities. A high percentage of this organic product is going to landfills as opposed to returning to the arable land, representing a significant loss of humus and organic fertilizer at a time when erosion and problems linked to loss of fertility are become more and more significant.

Technologies for heat production (low pollution stoves) & cool production

Heat pumps fuelled by pellets for residential and commercial buildings are of great potential interest in China as well as it is in the EU. In China in particular, modern stoves for heating and cooling domestic water supplies have a huge potential market estimated at 10 m units/a .

Cogeneration Technologies

There is a large potential for generators of a capacity range between 50-500 KW. There are three main technologies:

Steam engine co-generators fuelled with pellets: reasonable investment, good efficiency (η >22%), long life operation of 15 years (8 000 h/a),

Micro gas Turbine (hundreds of kW) fuelled with low quality Bio-ethanol, vegetal-oil, MHV gas. Specific investment in the range of 800€/kW,

Stirling Engine generators (1-10 kW) still under development but of considerable interest for residential use, SMEs, and farms.

Biofuels for transport

Bio-ethanol from Sweet Sorghum appears to be very promising in terms of production costs (~250

€/t) and in terms of yield per ha (4 t/hm^2), this makes it much more attractive than other vegetal-oils (700 €/t and 1.3 t/hm^2). Integrated processing of the entire sweet sorghum crop can allow a sustainable economic Bio-ethanol yield given China introduces:

* Centralised industrial schemes;
* Decentralised schemes for micro-distillery (1-10 mL/a);
* Innovative synthetic crystal absorption technologies now under development will modify considerably the entire current bio-ethanol industrial processes, reducing the production cost with high energy saving.

Thermal Gasification

A major focus of the ongoing international cooperation in this field is the use of biomass at the village level for electricity production. One system that is being introduced in China consists of a thermal gasification unit that delivers low calorific value cooking gas directly to households. This gas, which is cleaned and cooled for distribution, can also be used in efficient engines to generate electricity. One concept being evaluated is the use of a Sterling motor at around the 25 kW output level.

Under the Chinese experience the best performance stems from cogeneration technologies based on (bio) gas (wood, landfills or agricultural origin) and considerable further technical advances are expected in this area. The transformation of biomass into synthetic gas could nearly double the generating efficiency of most current biomass-fired power plants.

III - Suggestions for priority sectors under the EEP

Suggested topics of general (mutual) interest for co-operation in biomass / biofuels utilisation include:

* Pelletisation for stabilisation of humid biomass;
* Small capacity co-generation units - especially for solid biofuels - in rural and semi urban areas
* Biofuels development and demonstration from solid biomass utilisation;
* Dry waste for direct incineration and/or RDF preparation;
* Moisture wastes for biogas and compost;
* Energy crops, in particular C4 crops as Sweet Sorghum and other herbaceous crops;
* Bio-ethanol from Sweet Sorghum for industrial alcohol production and/or decentralised production in micro-distilleries with focus on rural development.

IV - Suggested Methodology

As a general conclusion it was stated that policy makers should set targets for the bio-energy industry, i.e. as a percentage of primary energy use for the short, medium and long term on a national and regional level.

Several priorities for EU - China cooperation have been mentioned by Chinese workshop participants:

1- Simple and efficient biomass combustion systems complying with European legislation and standards;

2- Development of a legal framework for emission limits and control systems;
3- Examination of limitations for ëmixed combustion;
4- Development of co-firing technologies;
5- Development of livestock residue treatment technologies;
6- Address problems of low organic content of soil post (straw) collection;
7- Create a network on cooperation in agriculture and crop development;
8- Create a ëCarbon Dioxide Trade Platform'.

The following aspects for the future development of biomass resources for energy and transportation were commonly agreed:

In China huge quantities of biomass resources, mainly agriculture residues, exist. However, these quantities are widely dispersed and unevenly distributed through the provinces. In the cities large quantities of biomass occur in the form of Municipal Solid Waste (MSW) and waste water. Both sources must be treated and used in the future development of the cities.

MSW can be separately collected for solid and dry residues for incineration and/or co-combustion. It can also be treated to produce Refuse Derived Fuel (RDF) that can be burned in more simple incineration systems having flue gas cleaning equipment. Wet biomass can be treated with anaerobic digestion units and the biogas then used for energy generation.

Once treated, the bio-chemically converted residues can be used as fertiliser for arable lands in the vicinity of the urban centres. There is, however, a strong request for size/capacity limitations to medium scale power because of logistics with biomass supply. For rural development decentralised solutions are needed.

Feasibility studies are required for demonstration facilities, either co-firing, combustion, combined heat and power, anaerobic digestion and/or liquid biofuels. The studies have to examine the biomass availability in regard to kind and quantity, biomass supply logistics, utilisation and distribution scheme for the produced energy, financial framework and environmental impact assessment.

V - Concrete Project Ideas

Conduct a nationwide assessment of Wastes as a Source of Biofuels

Waste types include: Biogas from bioorganic municipal waste, Wood waste, Waste tires, and Biodiesel from used cooking oils.

Potential domestic partners include: Tsinghua University Department of Environmental Sciences and Technology, Huazhong University in Wuhan Province, Department of Environmental Engineering, Beijing Environmental Sanitary and Science Research and Design Institute, Institute of Municipal Solid Waste Management, Ministry of Construction in Beijing, The Liaoning Academy of Environmental Sciences.

Conduct provincial level investigations (Liaoning Province) on Biogas from Wastes to Energy

The average content of bioorganic municipal waste (BMW) in Chinese municipal waste is significantly higher than in the average in EU countries. If BMW is converted into biogas and used for energy production in CHP schemes, a significant amount of nation-wide emissions from coal combustion can be abated.

The proposed assessment of resource and appropriate bio-waste technologies would develop a methodology for North Eastern China but could be applied to any other region of China.

Conduct provincial level investigation (Fujian Province) on Livestock Waste to Energy

Disposal and utilization of livestock waste is of particular significance to Fujian province, but not only to this province. Local authorities in Fujian have shown an interest in creating a project on investigating the best possible technologies and logistics to introduce anaerobic digestion of animal manure to produce biogas for CHP utilization. Potential partnership there with SYIAE in Shenyang, Liaoning province.

Conduct a Feasibility Study on Biomass to Energy (CHP)

The feasibility study would cover conversion of agricultural residue into energy via various technologies in rural areas of North China.

Conduct a Demonstration Project on Biomass CHP

The project would demonstrate biomass CHP from agro forestry sources in a middle sized city in Liaoning Province

VI - Suggestions for EEP study tours

Wels, Austria:

Integrated Solid Waste Treatment Project: biological waste treatment (biogas production) and incineration of the remaining waste, producing 1M m3 of biogas and 36 MW of power annually.
Salzburg, Austria:
Bioorganic municipal waste plant
Dornbirn, Austria:
Bioorganic municipal waste plant
Umea, Sweden:
Swedish University of Agricultural Sciences, Biofuels Technology Center