BIOMASS ENERGY UTILISATION - ECOLOGICAL AND ECONOMIC ASPECTS

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***Abstract**: Biomass is the world's fourth largest energy source today and it represents about 35 % of the primary energy supply in developing countries. Biomass is a versatile source of energy in that it can produce electricity, heat, transport fuel and it can be stored. The problems (technical, economic, etc.) which have to be solved by treatment of biomass are discussed in this work. The average quantities of biomass resources of some European countries are presented and the structure, percentage of products and their calorific values are estimated.*

***Keywords:** Biomass Energy Potential, Ecological & Economic Aspects.*

1. INTRODUCTION

The beginning of the third millennium coincided with important challenges for the energy sector. Environmental concerns are gaining ground mostly on economic considerations, but above all, decisions makers are now facing critical long-term energy policy choices. The on-going liberalisation of the gas and electricity markets is profoundly changing the structure and dynamics of energy markets in Europe. Furthermore, world markets are becoming more fluid, and decisions affecting one country necessarily affect others. In the years to come, investments in energy, both to replace existing resources and to meet increasing energy requirements, will obligate economies to arbitrate among energy options taking into account environmental concerns. The opportunity should be seized to promote viable environmental and energy policies at the global level.

The environment has always provided a variety of options for alternative and renewable energy sources. Some alternatives have been used for years and others are still being developed. Biomass energy that has been used in developing countries is becoming increasingly common in industrialised countries.

2. BIOMASS AS RENEWABLE ENERGY SOURCES

An increasingly important source of fuel is biomass, which can include such diverse sources as agricultural crop waste, forestry waste, animal waste, sewage, municipal waste, and sea-weed. Definition of Biomass – it is biodegradable fraction of products, waste, residues from agriculture.

Energy from biomass can be obtained in processes of direct combustion of solid biofuels or after processing into liquid and gaseous fuels (Fig. 1).

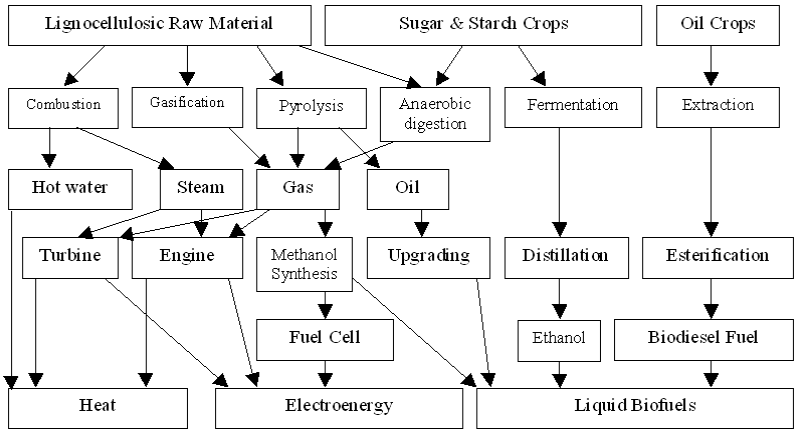

Fig. 1: Possible converting of biomass to end-products.

The common raw material are often defined as “waste materials”, e.g. human excreta, animal manure, sewage sludge, and vegetable crop residues, all of which are rich in nutrients suitable for the growth of anaerobic bacteria. Although some of these materials can be used directly as fuels and fertilisers, they could be used for biogas production to gain some additional heat value while the other benefits are still retained (Table 1).

Tab. 1: Definition of “renewable” and “waste” fuel sources in common use.

Renewable, sustainable biomass fuel sources	“Waste” fuel sources
Sugar cane waste	Sewage digester gas
Timbermill waste or sawdust	Landfill gas
Forestry and agricultural residues	Mines gas
Short-rotation forestry	Coke-oven gas
Straw	Refinery /process plant flare gas/ off-gas
Rice husks and coffee husks	Stripped crude gas
Peanut and other nut shells	Municipal solid waste incineration
Palm oil and coconut residues	Hazardous and chemical waste incineration
Meat and bone meal	Sewage sludge incineration
Poultry litter	Hospital and clinical waste incineration
Livestock slurry	Vehicle tyre incineration

Wood, straw, sewage sediments and other solid organic materials can be used to produce energy in processes of direct burning. Biomass can also be processed into liquid fuels (rape methyl ester - RME, alcohol, pyroly-

sis gasoline) or gaseous (farm biogas, biogas from purification plants or from refuse dumps, etc.).

Based on the value of the biogas (4,500 – 6,300 kcal/m^3), it is estimated [1] that on complete combustion 1 m^3 of biogas is sufficient to:

1. Run a 1 horsepower engine for 2 h.
2. Provide 1.25 kWh of electricity.
3. Provide heat for cooking three meals a day for five people.
4. Provide 6 h. of light equivalent to a 60 W bulb.
5. Run a refrigerator of 1 m^3 capacity for 1 h.
6. Run an incubator of 1 m^3 capacity for 0.5 h.

Therefore 1 m^3 of biogas is equivalent to 0.4 kg of diesel oil, 0.6 kg petrol, or 0.8 kg of coal. The biogas can be used to drive a turbine or internal combustion engine as well as to be used in boilers to produce heat [2]. Biomass as material for direct combustion, if not processed into briquettes or pellets can only be used in a local scale because of its low volumetric mass. In general, the production of biomass for energy will enable better use of land, labour and capital on farms.

3. CURRENT SITUATION IN EUROPE

Biomass production in 2001 was 56 Mtoe. To achieve 12 % by 2010 estimations show a need of more 74 Mtoe of biomass energy. The Directive 2003/30/EC promote of the use of biofuels for transport through:

• The Directive sets a minimum percentage of biofuels to replace diesel or gasoline for transport purposes in each Member State.

• Member States shall ensure by end of 2005 a 2 % minimum proportion of biofuels of all gasoline and diesel fuels sold on their market – by end of 2010 a 5.75 % minimum proportion.

In the frame of the Common Agricultural Policy (CAP) reform is estimated the impact of biofuels to increase through better opportunities for farmers to adapt production to increasing demand for biomass and by additional incentives:

- New energy crop premium
- Growing energy crops on set-aside land continued
- Premium of € 45 per hectare in addition to decoupled payments granted according to reference area
- Maximum guaranteed area of 1.5 million hectares
- All crops (except sugar beet) eligible for support, including some multiannual
- Processing contract required, if not processed on farm.

Share of biomass in energy production of the EU countries is shown on Fig. 2.

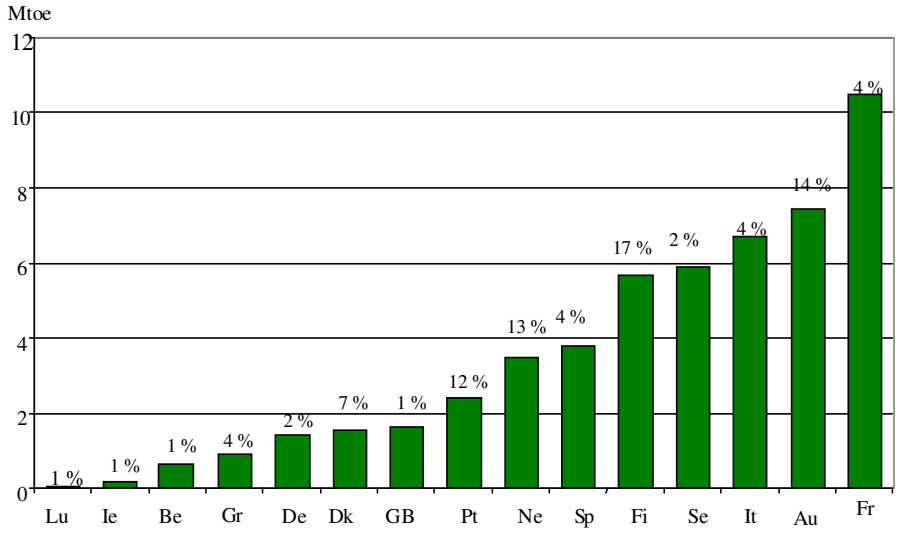

Fig. 2: Share of biomass in energy production of the EU countries during 1997 [3].

It can be seen that the greatest absolute amount of biomass produce France, although as a relative share Finland is the first in use of biomass for energy production.

Tab. 2: Current situation - Energy production from biofuels.

Energy production from biofuels, Mtoe			
Field	2001	Additional estimated amounts needed 2010	Total by 2010
Electricity	13	32	45
Heat	42	24	66
Transport	1	18	19
Total	56	74	130

To reinforce the effective use of biomass for energy purposes, in May 2004, the European Commission (EC) has announced a co-ordinated Biomass Action Plan with clear approach to securing adequate supplies of biomass through European, national and regional/local action. The plan will have to ensure effective co-ordination of Community policies in Energy, Agriculture and forestry, industry, rural development, environment and industry. Parts of the plan would be the following actions:

- Twinning actions of biomass energy generation under the existing directives and buildings including an efficient use of wood for energy.
- Landfill gas recovery and anaerobic digestion, which does not replace waste prevention and recycling.
- Fossil fuel substitution in coal plants and co-firing.

4. ENERGY FROM BIOMASS AND THE ENVIRONMENT

One of the main goals of the modern agricultural engineering is the environment conservation [4]. This fact should be taken into consideration in strategies of development of the agriculture and rural areas in general as well as in the energy policy.

Among different sources of pollution connected with agricultural production there are harmful products emitted during the combustion of coal and petrol fuels. Since the predominant production of the electric energy in Bulgaria is based mainly on the coal, therefore also using this kind of energy is bound indirectly with environment degradation.

More wide use of renewable energy sources, including biomass, would be favourable for environmental conservation. However, high unitary costs of production of energy from these sources are the main factor hampering their use.

5. CURRENT SITUATION AND BARRIERS IMPEDING THE BIOENERGY USE IN BULGARIA

It is estimated [5] that the total energy equivalent of plant and animal residues and wastes in Bulgaria is about 2 Mtoe/yr (Table 4). This value amount 22 % of the primary energy needs of Bulgaria for a year.

Tab. 3: Available resources of biomass in Bulgaria.

Type of biomass	Total yield, t	Yield, t/1000 ha
Primary yield of plant production	11 324 104	1 024
Ten most important crops		
Wheat	3 070 667	278
Clover	2 000 000	181
Maize	1 112 000	101
Oats	719 333	65
Forage maize	616 485	56
Potato	471 333	43
Sunflower	446 333	40
Tomato	408 667	37
Grapes	405 691	37
Meadow grass	310 000	28
Stock-breeding	Number	Number/1000 ha
Cattle	676 500	61
Birds	15 324 000	1 386
Pigs	1 616 500	146
Equivalent animal units	1 476 340	134
Wood industry	m^3	m^3/1000 ha
Firewood and wooden coals	1 607 000	145
Timber residuals	2 000	0

In spite of ecological, economic and social advantages, the use of biomass for energy is not enough widespread in Bulgaria. There are several

barriers of economic and organisation nature as well as some technological problems that impede using the biomass for energy:

- Large range of water contents (up to 60 %) making the preparation of biomass for energy use difficult.
- Rather low calorific value as related to the mass or volume.
- Low density of biofuels causing their transportation, storing and dosage difficult.
- High diversification of processing of biomass into energy carries.

Multitude and diversity of problems linked with the use of biomass for energy hampers the improvement and implementation of appropriate technologies. Only well-prepared biomass fuel with reduced humidity can ensure the performance over 70-80% in modern stoves.

6. CONCLUSIONS AND FUTURE DEVELOPMENT

1. Existing potential of land, labour and technologies enables significant increase in production of biomass in Bulgaria. There are also potentialities to produce RME.
2. Biomass energy production has positive effects on development of rural areas.
3. The local renewable energy industry offers possibilities to develop the infrastructure in rural areas and to create new jobs, and therefore enable professional activation of personnel leaving the agriculture without problems related to the mitigation. Creation of new jobs in rural areas may stimulate the positive changes in farm size structure.
4. The use of potential renewable energy from agricultural by-products (animal and municipal wastes for biogas) could contribute in an increase of the share of gaseous fuels and in decreasing the use of solid fuels. It also brings about the diminution of soil and water pollution problems connected with the use of slurry. Finally, the use of biomass for energy instead of the mineral fuels, is friendly to the environment.

7. REFERENCES

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