BIOFUELS USE IN POLAND — BARRIERS AND BENEFITS

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ABSTRACT: In the paper authors are presenting actual situation in biofuels use in Poland. In Poland particular biomass energy conversion technologies are developed in different level: some of them are almost in market phase, some other - need further R&D works. As concerning solid biofuels biomass-fired boiler plants of various capacities are operated to supply heat both to private farms and to public buildings. There are nearly 50 straw-fired and over 5000 wood-fired boilers with total capacity over 500 MW(t). Several straw-fired district heating plants have been erected during last years with total capacity about 9 MW(t). Possibilities of novel energy crops introduction are also tested.
As concerning liquid biofuels first agrorefinery processing rape into biodiesel was established and ethanol is accepted as additive to gasoline in fuel standard.

1. BACKGROUND

Polish energy production sector traditionally has been based on hard coal as well as lignite. Other fuels were not in use in a wider scale. In Poland according to statistical data arable land covers about 59% of country total surface. In crop structure the biggest group is formed by cereals (together with corn grain) - 71,3%, potatoes - 10,5% and sugar beets - 3,4%. At present incomes of Polish farmers are rapidly falling down. Energy crops production and use of traditional crops for industrial purposes may be solution.

In Polish conditions the following sources of biomass are important:

- wood from forests, tree cutting, orchards and special plantations, wastes from wood processing industry;
- straw and other vegetable waste from cereals production;
- liquid/solid manure used for methane fermentation;
- oil seeds processed into estrified oil used as fuel;
- potatoes, cereals and other vegetable waste processed into ethanol.

Poland's geographical location as well as its diversified water and climate conditions may contribute to the growth of the potential of biomass allocated for energy purposes.

2. ANALYSIS OF IMPLEMENTATION OF CHOSEN BIOENERGY TECHNOLOGIES IN POLAND

Biomass use for energy purposes has gained more and more interest in the past few years in many countries, in that in Poland. Sustainable development, reduction of unemployment, security of energy and food supply, improvement of financial balance and reduction of pollution are the most important drivers.

2.1 Solid biofuels

Poland is starting a wider usage of biomass from forests and agricultural residues (straw) in district heating plants.
In rural regions especially important is usage of straw as energy source. In last years production of basic cereals was equal about 22 million of tons (grain). In Polish agriculture straw is utilised for various purposes: as fodder, as lining for live stock, as organic fertiliser and as insulation material. Till half of 80 s straw was mainly used in animal production. But at the beginning of 90 s together with animal production decrease a straw surplus was about 8 mln of tons, what has caused the problem of straw utilisation for energy production to be noted.
First installations were based on Danish technical solutions. Actually biofuel-fired boiler plants of various capacities are operated to supply heat both to private farms and to public buildings. On Polish market a few manufacturers of small straw-fired boilers (Elektromonta_, Gda_sk, GRASO in Starogard, Boilers Plant in Pleszew, ATEX in Zamo__) are operating. There are dozens straw-fired boilers in private farms. Several straw-fired district heating plants have also been erected during last years.
At present following straw-fired district heating plants are in operation:

Szropy k/Malborka	1 MW	import
Grabowiec k/Zamo_cia	1 MW	Danish licence
Wieniec k/Gda_ska	0,6 MW	Danish licence
B_czek k/ Starogardu Gd.	0,6 MW	own construction
Kamiennik k/Elbl_ga	0,3 MW	own construction
Trutnowy k/Tczewa	0,3 MW	own construction
Mort_gi k/I_awy	0,2 MW	own construction
Czernin k/Malborka	3 MW	import
Rybina k/Stegny	0,3 MW	Danish licence
Luba_	1,0 MW	Danish-Polish
ALL TOGETHER	**8,3 MW**	

2.2 Biogas from manure

In half of eighties in IBMER research and design works were started in area of small and medium scale biogas installations. According to IBMER designs or with our

co-operation installations were implemented in 10 farms up to 500 LU (large animal unit with weight over 500 kg). At present may be only one is working.
There is a necessity of modern technology solving problems connected with proper management of agricultural wastes (especially in animal production) in aspect of environment protection.
Within EUREKA programme technology of manure fermentation and compost production "BIOMET-IBMER-EUROTECHNOLOGY" was worked out for farms with animal breeding systems without bedding with concentration above 100 SD. It can be also used for disposal of municipal wastes mixed with manure.

2.3 Liqiud biofuels
The idea of using plant raw material as a fuel is not new one. As concerning e.g. bioethanol first production of anhydrous alcohol on industrial scale in Poland was began in 1928. During 40s and 50s total production of spirit was very high and mixtures of gasoline with 20% of alcohol were used. High prices of spirit on world markets and low prices of fossil fuels reduced production of anhydrous spirit to only one enterprise in Kutno. In 90 s we were reminded again of these fuels made from agricultural raw materials.

Polish standard, regulating gasoline quality and composition PN-92/C-096025 allows for the mixing of organic oxygen compounds, in that dehydrated ethyl alcohol, but not more than 5% by volume with petrol, with a maximum total oxygen content 2.8 % by weight. This standard was submitted by Ministry of Industry and Trade and introduced by Polish Committee of Standards, Measures and Quality on 31 January 1992 as standard obligatory from 1 March 1992 (Dz.Norm i Miar nr 2/1992, poz. 3). This standard allows use of ethanol additive in all types of gasoline used in motorisation.

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In Poland rape is the main oil plant, with traditionally known and accepted methods of cultivation. For that reason research works in our country are concentrated on processing of rape oil for biofuel. The project PBZ-056-01ªEpal - Polish rape biofuel for ignition engines financed by Polish Committee for Scientific Research (KBN) was going on in years 1994-97, as the result first Polish agrorefinery was established. Three research centres participated in it: IBMER as coordinator was dealing with whole problems connected with biofuel production (organisation, economics etc.), Technical-Agricultural Academy in Olsztyn was solving problems connected with fooder production on basis of rape meal and Warsaw Avionation Institute was testing quality of biofuels.
In aspect of actual price relations (cheap diesel fuel and high prices of rapeseed) a substitution of mineral energy products with rape based products in Poland is requiring large expenditures from the State budget for rape biofuel production subsidy.

3. IDENTIFICATION OF BARRIERS CONNECTED WITH BIOMASS-ENERGY CHAINS IN POLAND.
3.1 Economy
In case of heat production systems based on biomass combustion existing barriers are connected mainly with investment costs. However pay-back periods are quite attractive in analysed cases (shorter than 5 years) closing of financial balance is very difficult, especially local administration units, schools etc. have problems with gathering of financial means for investment.
When it comes to the introduction of biomass fuel into the energy systems the cost of energy produced from biomass, compared to production based on other energy sources is one of the most important factors. The competition with low-cost fossil fuels impedes market introduction.

3.2 Legal and regulatory framework
In Poland, the usage of biomass as an energy source in heating systems is regulated by several legal acts. Actual (1999) legal and regulatory framework on one hand encourages development of local biomass heating systems, but on the other one defines some limitations (barriers) to it.

On 2.02.1999 Minister of Economy issued a Regulation for purchasing electricity and heat produced from non-conventional sources (in that RES), including biomass cogeneration heat and power plants (Dz.U.nr 13/1999). According to this Regulation utility companies are obliged to purchase electricity and heat produced from non-conventional sources (in that RES) by national producers, but only if power of plant is smaller than 5 MW and price of offered heat unit is not higher than the highest price of heat unit offered by others from conventional sources.
Implementation of biomass heating plant project should be also consistent with Building Act of 7.07.1994 (Dz.U.89/1994 poz.414), which requires receiving a permission from authorities proper for given territory.
Requirements connected with installations for solid biomass combustion are specified in Polish Standard PN-87/B-02411. This standard concerns designing and erection of boiler plants placed inside building and water boilers (placed outside), with water temperature<100°C. Requirements concerning boiler plants with capacity up to 25 kW and for plants with capacity in range 25 to 2000 kW are distinguished in the standard.

In 1998, the Ministry of Environment Protection published a Regulation concerning the permissible levels of emissions arising from the combustion of fossil fuels and biomass (table1). This Regulation can encourage investors to select wood as a fuel and install newly developed wood-fired boilers, instead of up-grading or retrofitting existing coal-fired boilers with expensive gas clean-up system (Dz.U.121/1998 poz.793).

3.3 Non technical-economic barriers
Technical-economic factors are not always sufficient enough to explain the use or non-use of a given fuel. In order to analyse the situation, a large number of non technical-economic factors have to be considered, integrating four categories: sociological and cultural

aspects, organisational aspects, institutional, structural and political aspects, and environmental factors
However with the use of biomass energy is associated important benefit - the reduction of CO_2 emissions - people's perception of biomass burning remains ambiguous, and could constitute a strong barrier in some cases (visible atmospheric emissions, forest depletion). Another important insufficiency is connected with the lack of professional organisations (public entities or private companies) which could provide technical information and assistance, thus securing biomass supply. There is a strong necessity to implement a set of pilot projects showing positive impacts connected with biomass energy use.

4. CHANCES FOR THE BIOMASS USE FOR ENERGY PRODUCTION IN POLAND.

4.1 Possibilities of obtaining soft loans and grants from Environmental Funds (National, Provincials, EcoFund)

There is a Polluter Pays Principle applied in Poland. Every undertaking that emits pollution to the environment is obliged to pay environmental fees. Fees are similar to environmental taxes and could be calculated as a part of company production cost. This money is collected by the environmental funds and could be spend for environment improvement only. Also environmental fines supply the same funds. In this case the main difference is within the financial reporting within the company because fines could be only covered from the enterprise net profit. Even though problems with the efficiency of the environmental money collection that in the country scale is at the level of 80% it still creates huge flow of money which could be used only for the environmental purposes. Total income of environmental funds in 1998 was about 870 million EURO. This money is divided among National Fund of Environment Protection and Water Management, Provincial Funds of Environment Protection and Water Management and Communal Funds. The latter can mostly finance waste water treatment and waste management projects in local scale, however two first funds can support Renewable Energy Projects Funds recently increase interest with this category of investments.
National and Provincial Funds administer about 85% of environmental budget. Financial support is given usually in a form of soft loans. Average interest rate of these loans is at level of 50% rediscount rate so it is rather attractive. Moreover some categories of investors like charitable organisations, schools and state medical service can get not repayable grants.
There are also some additional possibilities to get financial assistance for Renewable Energy Projects. Most of them are based on international funds. In this group the most important is EcoFund that has been created to manage funds originated from debt-to-environment swap . This foundation offers about 40 M EURO/y in a form of not repayable grants only. Renewable energy sources use is one of the most important priorities of this institution. EcoFund wants to play a role of an effective catalyst in this area. Apart from funding the most interesting and best prepared renewable energy projects EcoFund also wants to promote some of the technologies not known and not popular in Poland, but well checked in other countries like biomass gasification or combined heat pumps-solar systems.
There are also some bilateral international programs mostly oriented for funding consulting services. Usually majority of this money is consumed by foreign companies preparing reports very often not useful in Polish conditions which doesn t fit˚to the needs of local investors.
Summing up it is worthy to say that Polish system of subsidies is a good incentive for investors in Poland and could play significant role in renewable energy projects development. It is especially important as there is no governmental supporting policy for this important sector.

4.2 Polish Energy Law (obligation of renewable energy purchase by the utilities, Third Part Access)

There was a new Energy Law adopted by the Polish Parliament in 1998. There are some articles beneficial for renewable energy sources in this act. First one is the obligation for the utilities to buy heat and electrical energy produced from the renewable energy sources. Unfortunately there are still some delays with issue specific regulation concerning the formula for sale price calculation. In practice it makes this regulation unworkable however for future it seems to be promising. In Energy Law the most beneficial section for the renewable energy sources is Third Party Access Principle. This regulation stops the monopoly of state owned utilities in the energy market. TPA provides possibility to fix direct contracts between energy producers (also renewable) and final users paying a lump sum to the state owned grid for the energy transmission. It makes possible to share profits gained from the low operational costs of renewable energy based installations between energy producers and users without excessive˚contribution˚paid˚to˚the˚utilities. These regulations could be very useful in future development of renewable energy source use in Poland.

4.3 Proposed method of evaluation of biomass projects

It is very important to compare the economic efficiency of projects undertaken to reduce the CO_2 emission, where various methods are employed to achieve that goal. The most common method considers capital costs only. This approach is not fair for the RES, which in comparison with traditional energy sources, usually have higher investment costs. That s why it should be used the unit cost of the reduction of carbon dioxide emission as an evaluation index. This index shows the dependence between the reduction in the carbon dioxide emission and the discounted capital expenditure incurred for this purpose plus the operating costs of the target system of energy generation.
This method represents very well the actual costs incurred to achieve the desired environmental benefit. We must remember that it is not enough to invest money in a project, because it is only the operation of a newly built or modernised system that brings about the actual reduction of emissions. The comparative analysis cannot, therefore, ignore the actual system operating costs incurred after the project is completed because such costs make an important constituent of the total cost borne during the system service life to achieve the specific reduction of pollutant emissions.

This method of project evaluation makes it possible to value a project at a higher level if the project operating costs are low, although the investment outlay is higher. Thus the projects aimed at using the renewable energy, where the investment outlay is usually high, but the

operating costs are considerably lower than those incurred in the case of traditional technologies, may successfully compete with the other projects designed to reduce the CO_2 emission.

Example:
The principle of representing the project efficiency by the unit cost of reducing the CO_2 emission may be visualised by an example shown below, where the said index is calculated for a project of modernising a boiler plant through the replacement of its coal-fired boiler with one fuelled with gas (option 1) or straw (option 2) and the calculations are carried out traditionally, i.e. with taking into account the investment outlay only, and according to the method discussed above.

Technical specifications of the boiler plants:

Coal-fired boiler plant (existing)
Power rating 1 MW
Energy demand 16 200 GJ
Efficiency 60%
Fuel calorific value 28 MJ/kg
Quantity of the fuel burnt 964 t
CO_2 emission 1 824 t
Operating cost 91 500 EUR

Gas-fired boiler plant (modernized)
Power rating 0.67 MW
Energy demand 16 200 GJ
Efficiency 90%
Fuel calorific value 45 MJ/m^3
Quantity of the fuel burnt 400 000 m^3
CO_2 emission 907 t
Reduction of the CO_2 emission 917 t
Operating cost 54 070 EUR
Investment outlay 60 976 EUR

Straw-fired boiler plant (modernized)
Power rating 0.71 MW
Energy demand 16 200 GJ
Efficiency 85%
Fuel calorific value 19 MJ/kg
Quantity of the fuel burnt 1 003 kg
CO_2 emission 0
Reduction of the CO_2 emission 1 824 t
Operating cost 42 630 EUR
Investment outlay 177 561 EUR

Modernisation type	*Calculation method*	*Index value [EUR/t]*
Coal-to-gas conversion	*A*	***66.6***
Coal-to-straw conversion	*A*	***177.1***
Coal-to-gas conversion	*B*	***69.5***
Coal-to-straw conversion	*B*	***39.0***

rediscount rate R = 15% and
the project service life n = 20 years
A - *Taking into account the investment outlay only*
B - Taking into account the operating cost and the discounted investment outlay

4.4 Activities of NGO — Polish Biomass Association
In November 1998 in Warsaw IBMER research workers together with other institutions and private persons founded the Polish Biomass Association (POLBIOM). The association was officially registered in February 1999, in April 1999 —became a member of European Biomass Association. POLBIOM has today 59 members, in those 8 collective ones. POLBIOM is a non-governmental, non-profit organisation the objective of which is to promote the use of biomass in non-food applications in accordance with sustainable development by:

1. Dissemination of information about biomass use for non-food purposes, in that for energy production,
2. Consolidation of all actors acting at that sector (researchers, producers, users, farmers, etc.),
3. Working out a strategy of wider introduction of biomass use to national and local energy plans.

5.CONCLUSIONS
The most important non-technical barriers connected with biomass-energy chains in Poland are as follows:

- Lack of state policy supporting biomass use for energy production (promotion, taxes, custom duties)
- Lack of state, country-wide programs financially supporting biomass use for energy production
- Traditional approach of the decision makers to the energy production based on hard coal and lignite burning
- Psychological barriers of energy producers who are afraid of biomass use as a fuel

As can be seen on example of other countries the intervention of local politicians or regional decision-makers is a key issue for the development of biomass projects.