BACKGROUND TO THE PRODUCTION AND USE OF BIOETHANOL AS FUEL IN HUNGARY

RÉCZEY, GÁBOR – Dr. BAI, ATTILA

Keywords: biofuels, tax, corn as raw material, ethanol factory.

SUMMARY FINDINGS, CONCLUSIONS, RECOMMENDATIONS

In Hungary difficulties in the utilisation of bio-fuels are mainly caused by problems of economy and not by technical problems. Currently, the key factor in development – according to the authors of this article – would be a new version of the relevant legal provisions, which would allow MOL (the Hungarian Gas and Oil Company) and other big consumers (like transport companies BKV, DKV), to mix bio-fuels in a higher proportion than 5% with 0% excise tax. Environmental, technical, and rural development aspects support such a change in the law. Moreover the 0% excise tax on bio-fuels is used in many other countries as well without significant deficit in the national finances. This would have a positive effect on the production and utilisation of bio-fuels, even in the present agricultural situation. Moreover, this would provide a sound economic basis for future developments and a perspective for other bio-fuel producers.

INTRODUCTION

The utilisation of bio-fuels is spreading in the European Union as well as in other countries. In the background there are mainly environmental and energy efficiency aspects. However, driving forces also include the overproduction of food and the indirect agricultural subsidisation of rural areas.

Growing agricultural products that supply bio-fuel provides several advantages for these countries such as the elimination of import costs and green house gas emissions and increased wage rates in the agricultural sector. At the same time the spreading of biodiesel eases the oil supplement difficulties of the oil refining industry, which ordinarily works at the limits of its capacity. This causes increases in fuel prices.

The utilisation of energetic heat appears generally more profitable both economically and energetically, however on the macroeconomic level bio-fuel production is needed on a national and regional scale. These processes require subsidisation, the means and degree of which depends on the technique and the primary material being utilised. These subsidies however will return to the national budget (1).

The national transport policy for the period 2003-2015 has three priorities one of which is the development of an environmentally friendly transport system based on environmentally friendly transport measures. Since the spread of air pollution deriving from urban transport is high because of its concentrated presence, the elimination of its impact is of great importance. One possible solution to the problem is to develop public transport systems rather than motor car transport, the impact of which would be even more effective by using renewable fuels at the same time.

PRODUCING BIOETHANOL

In synthetic processes the prime material is mainly natural gas while in fermentation processes ethanol can also be produced from other primary materials that contain carbohydrates. The former and costlier process is appropriate to gain alcohol of laboratory purity (99.9%), which is used in the pharmaceutical industry. However bioethanol, that is, alcohol made from plants by fermentation, is perfectly appropriate for other means of utilisation such as in motor fuels. Appropriate primary materials for the latter process are sugar, starch and plants containing cellulose - the process becoming less and less effective respectively. In principle 51.1% of 1 kg of glucose can be converted into ethanol, but in practice this will be about 48% at most, supplemented by 1200 J/kg of thermo energy. The main characteristics of the different processes are summarised in Table 1.

Table 1

Basic Technologies for Producing Bioethanol

Raw material	Specific procedures	Common procedures	Material needed	Note
Sugar	Extracting sugar	Fermentation, distillation, rotating back higher distillates, separating the main product (alcohol) and by-product, prepacking		The cheapest
Carbohydrate Starch	Chopping plants, breaking down into sugar		Enzyme amiloglue-cosidase	
Cellulose	Chopping plants, breaking down into sugar		Enzyme cellulose	The most expensive
			Acid	Unfavourable by-product

Source: own compilation based on (2)

Development opportunities should be sought primarily in the production of enzyme cellulose as cheaply as possible and in the effective treatment (e.g. biogas production) or recycling of the vast amount of wastewater (13 l/l bioethanol) formed during the process.

UTILISATION OF BIOETHANOL AS MOTOR FUELS

There exist two main utilisations of bioethanol. When considering its utilisation as motor fuel, the main competing products are petrol, diesel oil and biodiesel as well as their mixtures in different ratios. Adding ether and izobuthilen to bioethanol, forms ethil-tercier-butileter (ETBE), which can compete on the market with metil-tercier-butileter (MTBE) as an octane-number increasing additive.

According to examinations to date a fuel mixture of 15-22% of bioethanol in gas does no harm even to conventional motors. Expected impacts obviously also depend on the type of car. Manufacturers of cars in the USA provide warrants for their products on the condition that they do not run on fuel mixtures of more than 10% bioethanol. Fuel mixtures of up to 25% bioethanol burn perfectly so they do not cause deposits or corrosion. These facts are all advantages of bioethanol compared to biodiesel.

The calorific value of biodiesel is 10-15% less than that of fossil fuels and for bioethanol is 35-40%. Due to the much higher hydrogen content of bioethanol compared with the other three fuels, it burns much more efficiently so it provides fuel consumption comparable to gas and a much more favourable pollution emission. These advantageous properties can be expected in particular when the fuel mixture contains not more than 22% bioethanol.

THE INTERNATIONAL BIO-FUELS MARKET

Increasing fuel costs make the issue of substituting fossil fuels with environmentally friendly energy sources a present day problem. Solutions for the energy-problems of tomorrow cannot to be found underground – according to most experts. According to the optimistic scenario of the International Energy Agency (IEA) by the year 2025 bioethanol itself may amount to some 10% of the fuel consumption of the world. Last year bioethanol production was 41 thousand million litres, mainly deriving from American corn and Brazilian sugarcane. About 50% of Brazilian sugarcane yield already becomes primary material for bioethanol production. Being an agricultural product, a heavy customs duty (20-50 Ft/l) is imposed on bioethanol all over the world in contrast to crude oil (3). Last year Brazil exported 2.3 thousand million litres to India, the USA and the Caribbean region. Brazilian bioethanol costs 100-120 Ft/l in Rotterdam including transport and duty, which is still 20-30 Ft cheaper than the cost of domestic production in Hungary.

The significance of this issue is indicated by the fact that the USA which is the biggest fuel consumer and the second biggest bio-fuel producer in the world made a fixed term contract on bioethanol on the Chicago commodity exchange (4) in the spring of 2005. The USA aims to double its bioethanol production by the year 2012 which means 30 thousand million l/year, substituting 500 thousand barrels of oil, which amounts to more than 5% of current fuel consumption. (5)

About 7% of the USA corn yield becomes primary material for bioethanol production. Bioethanol production is motivated first of all by environmental considerations, as the "Clean Air Action" introduced in 1995, obliged every town with polluted air to put "gasohol" – a 10% mixture of bioethanol and gas – on the market. Both consumption and production of bioethanol are subsidised in the USA: gasohol is sold at every significant gas station and the cost is subsidised at a rate of 36 Ft/l. An allowance of 4-8 thousand USD on personal income tax is given if purchasing vehicles running on alternative fuels and 50% (but at most 30 thousand USD) is allowed in case of establishing an alternative fuel station. Producers in the agricultural sector are subsidised with special "bioethanol species" – which amounts to nearly 5 million ha of sown area – and with corn prices increasing due to increasing demand. Besides the primary role of the state the cooperation of the plant breeding firms (Pioneer) and the great fuel traders (Texaco, Shell, Mobil) is also significant (6).

Expected trends in Hungarian fuel consumption are mainly influenced by the following factors:

- The European Commission's regulations – concerning vehicles and fuels in transportation – also apply to Hungary since our membership.
- Structural changes in the industry have not yet finished so the ratio of industrial branches demanding a lot of transportation may still decrease.
- The significance of export in our economy remains high so innovation aimed at energy-efficiency may gain great importance.
- Regional differences in the country are decreasing, relocation out into the suburbs of the bigger towns – suburbanisation – is going on, wages are getting closer to European levels, the significance of tourism is increasing, and the resulting changes in the average way of life are having a great impact on mobility and thereby on fuel consumption as well.

HUNGARIAN BIOETHANOL PRODUCTION

According to the GKM (Ministry of Economy and Transport) (2003) a 1% increase in GDP requires a 0.3% increase in energy consumption in Hungary. The same value in other European (OECD) member states is 0.2%, which means that our energy efficiency at national level is worse than that of economically advanced countries and it is all the more alarming because we depend mainly on imported energy sources.

The European Commission's regulations control the minimum ratio of biofuels partly indirectly through energetic, agricultural and air pollution regulations and partly directly through the 2003/30 EK Directive. Regulations currently in force in Hungary (Gov. Decree No. 2233/2004 (IX.22.), Gov. Decree No. 354/2004. (XII.22.) and Gov. Decree No.42/2005 (III.10.)) contain much less favourable values and consequently Hungary has already been warned by the EU (2). A debate on the May 17th 2005 suggestion of the Agricultural Committee of the Hungarian Parliament, about "Making dissemination of alternative fossil fuels more effective", is going on in Parliament. Accepting the suggestion would mean a compromise between the different regulations (Table 2).

Table 2

Target values for bio-fuel content ratio

Denomination	Amount	Present value	By 2005	By 2007	By 2010
EU-Directive	%	1-2	2	3.5	5.75
In force in Hungary		0	0.4-0.6	-	2
Planned in Hungary		0	-	2	4

*Source***:** (1)

On the basis of statistically forecast fuel consumption, the realisation of the various regulations summarised in Table 2 above would require rather different amounts of bio-fuel. The demand for bio-fuels in the near future is going to be influenced primarily by MOL as it has a monopoly in producing and marketing fuel mixtures. According to the tender process for bioethanol purchase, which was concluded in March 2005, the firm is going to buy 47 thousand tonnes of bioethanol in 2006, 67 thousand tons in 2007 and 75 thousand tons in the period 2008-2012. MOL intends to mix bioethanol into gas as an octane-number increasing additive. If we take into account the use of bioethanol as an additive in all domestic gas usage (compulsory ETBE use instead of MTBE), bioethanol demand would amount to 70-80 thousand tonnes per year.

The amount of biodiesel purchased is indirectly but significantly influenced by the capacity of alcohol production and the utilisation rate of the capacities of the Százhalombatta oil refinery plant, and of the distribution network. Increasing the rate of utilisation may result in decreasing the fixed costs of fossil fuels, which may make it reasonable for the firm to purchase bio-fuels even at a slightly higher price than that of fossil fuels.

Production capacity in Hungary primarily means the free capacity of operational alcohol factories, which is about 200 thousand hl/year. Retool fitting MOL's Pozsony refinery at the end of 2005 and the newly built bioethanol factory in Tiszaújváros in 2007 will increase production. The first phase of de-

velopment means 55 thousand tons of bioethanol production per year, the second phase with production in Pozsony means 50 thousand tons and the third phase with the new factory will probably add a further 62 thousand tons to the total production per year (4).

This means that altogether 167 thousand tons of bioethanol can be produced, mixed, transported and marketed by 2007 assuming utilisation of all MOL capacity, to which we can add 75 thousand tons of purchased bioethanol – most likely to be produced by the Hungarian alcohol factories – from 2008. The values mentioned above indicate that the EU and comprehensive Hungarian regulations will be mainly fulfilled by the state with the utilisation of bioethanol rather than biodiesel. Available domestic refining capacity could however, receive an additional 2.2 thousand tonnes of fuel and the free transport capacity, 2.9 thousand tonnes (1).

POSSIBLE PRIMARY MATERIAL BASE FOR HUNGARIAN PRODUCTION

Jerusalem artichoke, sugar broomcorn and corn seem to be providing most of the primary material for Hungarian bioethanol production. The utilisation of the first two plants however is prevented by production and processing-technological factors. Considering agricultural overproduction Hungarian bioethanol production is based on corn in the first instance and to a lesser degree on wheat.

Currently, arrangements are underway for the construction of four new bioethanol factories. In Mohács, Gönyü, Marcali and Kaba, Swedish investors – using ICM (Kansas, USA) technology – are going to build high-class bioethanol factories. The point of the technology is that while proccessing grain crops the factories are not only producing bioethanol but also feed and liquid CO_2, which are also utilised. The factories are planning to produce green-electric energy as well, which would be used mainly to supply the energy needs of the factories. According to the plans the factories are going to be in operation by 2008/2009. A long-term contract was prepared with the farmers to cover raw material needs for the next 10 years. Growing the required raw material (mainly corn and wheat) provides work for 10,000 people in the agriculture sector and the support industries. The factories will employ more than 300 workers, however the most important advantage is the fixed market for the cereals produced. 100,000 tonnes of ethanol should be produced in 2007, requiring about 300,000 tonnes of extra grain. This amount will hopefully rise in a few years to 600,000-800,000 tonnes of ethanol/year, which will require about 3 million tonnes of grain as raw material per year. According to the calculations by the year 2010 the total raw material need for corn and wheat will reach 4 million tonnes.

According to the most realistic estimate 550,000 tonnes of corn will be produced on about 90-100,000 ha, which is about one tenth of the sowing area of this plant. Based on a single variable regression analysis of a long series of data and ignoring the extremes, this may result in an increase of corn price by 500-600 Ft/t. However, production in the near future will be influenced by several other factors such as the followings:

- In our opinion expected surplus product must also be taken into consideration as a potential primary material even if production is theoretically more expensive.
- Real production cost can be decreased – especially in the case of potato – if delivery prices are lower than market prices and surplus is not wasted at the same time.

- Sugar beet cannot be economically exported and domestic demand is also decreasing due to the spreading of isosugar. It is expensive to produce bioethanol from sugar beet so it is not reasonable to use it as a primary material for production.
- Wheat and other cereals produce 50-100,000 tonnes of loss per year while corn production produces 40-70 tonnes of loss.

The sowing area of sugar broomcorn and Jerusalem artichoke is not significant but it would be reasonable to start by growing it on marginal areas, because producing alcohol from this plant is the most economic process. According to agricultural viewpoints a few thousand ha of sowing area can be taken into account for this purpose without any problem in case the surplus products are not enough.

REFERENCES

(1) Bai A. – Kormányos Sz. (2005): Bio-üzemanyag termelés és felhasználás szabályozásának és jogi feltételeinek elemzése. European Commission. 6th Framework Programme on Research, Technological Development and Demonstration Mobilis 513 562 Integrated Project. Mobility Initiatives for Local Integration and Sustainability. WP5 Clean and Energy Efficient Vehicles. Debrecen, 1-156. pp. – (2) László E. – Réczey I.-né (2000): Megújuló nyersanyagok nem élelmiszeripari felhasználása. Stádium Nyomda, Budapest, 51-70. pp. – (3) Réczey K. – Szengyel Zs. (2005): Növényi biomassza, mint nyersanyag és energiaforrás. VIII. Biomassza Konferencia, Sopron – (4) Biodiesel Board (Európai Biodízel Tanács): http://www.ebb-eu.org/ – (5) Négymillió tonna lesz a biodízel termelés az EU-ban. www.zoldtech.hu (2005.04.19) – (6) Kozár L. (1999): A gabona-bázison alapuló, energetikai felhasználású etanol-előállítás ökonómiai kérdései. A DATE Tudományos Közleményei. Kézirat. Debrecen, 4-5. pp.

ADDRESS:

Réczey Gábor
PhD hallgató
Nyugat-Magyarországi Egyetem
Mezőgazdaság- és Élelmiszertudományi Kar
Gazdaságtudományi Intézet Üzemtani Tanszék
9200 Mosonmagyaróvár, Vár 2.
Tel.: 96/566-737, Fax: 96/566-610
reczeyg@fvm.hu

Dr. Bai Attila
egyetemi docens
Debreceni Egyetem Agrártudományi Centrum
Agrárgazdasági és Vidékfejlesztési Kar
Vállalatgazdasági Tanszék
4032 Debrecen, Böszörményi út 138.
Tel.: 52/526-900, Fax: 52/526-916
abai@agr.unideb.hu