



SZENT ISTVÁN UNIVERSITY
GÖDÖLLŐ

**COMPLEX EVALUATION
OF
THE FIRST GENERATION BIOFUELS MARKET**

PhD Theses

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1. Preludes of work – the topicality of the subject

The solution of problems caused by climate change belongs to the greatest challenges of the 21th Century. Climate change is investigated for decades as a phenomenon, and researchers are continuously searching its causes. Scientists had founded that climate can be affected by many factors, but the most marked factor is the human activity, which is responsible for global warming in the last 50 years. Climate change – caused by humanity – was primarily due to the increasing quantity of greenhouse gases and tiny particles of aerosols released into the atmosphere, secondly it was occurred for changes in land use.

One of the opportunities for reducing greenhouse gases released into the atmosphere is to develop and apply renewable energies in practice. Renewable energy sources are energy sources, which are continuously available through natural processes, or can be reproduced without significant human intervention in a few years. Using renewable forms of energy is consistent with the nowadays often emphasized principles of sustainable development, theirs application does not destroy the environment and not prevent the development of human potential. Against the traditional, fossil energy the application of renewable energy sources contributes to the general protection of the environment, considering that it does not cause irreversible and harmful effects, like greenhouse effect, or water and air pollution.

Consequently environmental protection – which is the part of the complex system of different resources (energy, water, agriculture) – can not be defined in itself, because the efficiency of using other resources influences greatly the condition of environment.

Despite this, environmental protection has its own particular sustainable elements, which includes climate, air quality, and protection of water, as well as sustainability of soil's fertility and biodiversity.

Based on these can clearly stated, that the only way for handling future problems is encouraging the use of renewable energy sources, which ensures reduction of global emissions, as well as increasing energy efficiency.

2. Objectives of dissertation

The introduction and use of renewable energy are not just a matter of research and potential, because it is the integral part of socio-economic environment, therefore its application meets with different checks. In Hungary, there is no question about the *raison d'être* of biofuels within the renewable forms of energy in the future. The sector's growth and development possibilities are supported by the environmental and economic potential of producing and using biofuels, as well as statutory obligations arising from EU membership. At the same time many conflicting views formed in connection with producing and using biofuels in the last few years in Hungary, which justify a paradigm shift.

I am looking for answers mainly to these questions in my essay, with the investigation of the basic material needs of first generation biofuels, the profitability of investments, as well as the economic impacts of distribution.

Many factors need to be analyzed during formulating objectives of dissertation, the following must be emphasised:

1. The society of 21st Century dependence on oil, the growing demand for energy and the environmental pollution arising from above encourages prudent using of energy and other sources, as well as creating balance between economic actors and instruments. Therefore economic, social and environmental contexts may be defined.
2. Inside the potential renewable energy sources should pay special attention for biofuels from biomass:
 - for possible effects of the first generation biofuels on food safety,
 - for analyzing effects of the first generation biofuels on energy consumption and energy market,
 - for exploring environmental significance of the first generation biofuels,
 - for mapping the local economic benefits of biofuel production, and define competitiveness,
 - for measuring international tendencies of biofuel production, including analysis of the main producing countries' production volume.
3. Along the sub-areas above can be placed the current and future role of Hungarian biofuel industry, can be stated whether the sector can meet the criteria of production and competitiveness.
4. Appropriate conclusions can draw and proposals can be formulated how can develop the Hungarian biofuels industry, on the analysis of the situation and in the light of expectations concerning the obligation required by 2009/28 EC Directive, undertaken by Hungary overall 10 percent blends up.

Considering these factors were determined the research area of the dissertation and its direction is appointed by answering the following points:

- replacing of fossil energy, *raison d'être* of biofuels,
- contexts of food, energy and environment safety: intensifying competition for soil,
- Hungary as biofuel high-power without endangering food safety,
- questions of Europe 2020 Strategy and sustainability.

According to the above I search particular answers for the following 4 hypotheses:

- H1. Is that statement supported that basic material of the first generation biofuels in Hungary can abundantly cover those quantity of basic material, which is necessary to fulfil the obligation required by 2009/28 EC Directive, undertaken by Hungary about overall 10 percent – but 16 percent for bio-ethanol and 6 percent for biodiesel – blends up, without growing food prices?
- H2. What kind of effects do fiscal regulations have on more extensive adoption of domestic bio-ethanol blends up?
- H3. May it be to meet the compulsory 16 percent blends up requirement for bio-ethanol with the capacity of domestic fuel processing in the view of current profitability of bio-ethanol production?
- H4. Is successfully applicable a west-European typed promoting, stimulating system for using biofuels in Hungary?

Theme and methods

The scientific base of my research have been founded on sources included by Hungarian and international bibliography. The review and organization of the significant foreign and Hungarian bibliography had contributed substantially to give answers on questions in connection with the objectives of the dissertation. Through working up bibliography became possible not only has the comprehensive knowledge of international biofuel marketed, but the wide-ranging exploration of Hungarian problems and potentialities.

According to significant subjects must be highlighted the works of the following authors:

- Theoretical relations concerning sustainability were analyzed by Mrs. Farkas, Fogarassy-Neubauer, Kiss, Láng, Adams, Holdren and Mailler.
- Questions about possible renewable energy sources are disused by Mrs. Farkas, Popp-Potori (ed.), Vida.
- Works from Bai, Fogarassy, Popp-Potori (ed.), Popp-Somogyi-Bíró, Somogyi, Collins, Helbling-Roche, Szulczyk contributed to the international research of biofuel industry.
- In the frame of the complex research related to biofuels I tried to work up basic data of the following Hungarian and international institutions: Research Institute of Agricultural Economics, Hungarian Central Statistical Office, Hungarian Bio-ethanol Association, Union of Biomass Product Line, as well as Eurostat, FAO, US Department for Agriculture, European Union of Ethanol Producers, European Producers Union of Renewable Ethanol, European Bio-ethanol Fuel Association, European Biodiesel Board.

Besides the essential literature sources in connection with my dissertation periodicals, studies and professional discussions dealing narrower or wider with this topic had provided further information. Must be highlighted from the international ones the *F.O.Licht*, *Environmental Impact Assessment Review*, *Natural Resources Research*, *AgraFacts*, and the „*Európai Tükör*”, „*Gazdálkodás*”, „*Statisztikai Tükör*”, „*Tudomány*” called periodicals, as domestic sources.

Documents published by European Commission, European Parliament, and OECD meant further primary sources, as well as all information acquired on professional conferences and scientific meetings.

Methods

By making time series with the process of collected data, as well as analyzing documents I tried to reveal important factors influencing or doing no effects on changes. My applied research

concentrates on practical questions, in order to offer practical solutions for participants of current and future biofuel market.

I paid special attention for those economic, environmental and social aspects associated with the spread of biofuels, which had been examined in an international outlook as well. During the revealing domestic possibilities and the assessment of the situation I have also taken into consideration the global analysis made pending my research. Thus the changes of Hungarian biofuel market, the faith in foreign fund and the unpredictable regulatory environment of bioenergy market can be the base of a research itself. In my dissertation this topic will be examined summarized and synthesized because of space limitations.

I have analyzed the relationships among the effects of biofuels on different markets relied on economic and scientific secondary data based on detailed collection of data. In order to achieving targets of EU 2020 Strategy the blends up of biofuels to fossil fuels differences in EU member states in the point of biodiesel and bio-ethanol, thus the questions in the objectives of my research I intend to answer primarily in relation to Hungary.

I made a comparative analysis between prices of the bio blend of fuel and the gasoline, with detailed introduction of effects related to changes in legislation (excise tax, VAT). During analyzing the return capacity of biofuel industry I used the method of net present value (NPV) and added present value (APV) calculations. The calculation is primarily a model: modelling that is there any added value of the created, in money measurable effects generated by a decision for establishing a Hungarian bio-ethanol plant as a project, and it is not regarded any way as investment-economic calculation of a concrete, newly making, to-be-installed company. I have searched for concrete answer, when and how much is this business project, an investment like this value-added, namely – converted to current value – is the expected income generated in the future higher than the hoped income on capital market with the same investment and a similar undertaken risk. As in every modelling there are many extrapolation possibilities. I have chosen the linear approach, which made possible to build up clear and exact calculations allowing function relationships as basis, and which has the least risk in this case. My calculations are based on the legislation in force in November, 2011. The potential changes of NPV due to legislation changes I have modelling by sensitivity analysis method. As the fourth scientific findings described analysis I have used empirical methods, as well as I have modelled the application of promotion possibility by estimates based calculations.

My significant professional experiences and knowledge – gained as the colleague of Ministry of Agriculture and Rural Development (1998-2007), and the Municipality of Budapest from 2007 – were transplanted into my dissertation on empirical way. Knowledge arising from participating in international and domestic conferences, own professional presentations, as well as experiences from the conducted in-depth interviews during the preparations and realization of the research are built into the dissertation.

3. Results

1. The demand for natural sources is growing fast, and goes beyond what Earth can sustain long-term, therefore the main threat of ecosystems are increasing.

Pollutants are primarily due to human activity into the atmosphere. This causes that the temperature of natural greenhouse internal air increases. This natural greenhouse effect has been accelerated because of burning of fossil fuels and deforestation, which induces global warming, namely climate change. On the grounds of climate change there are ecosystem changes to threaten our civilization, thus it is our duty to deal with the short, medium and long-term consequences. The 21st Century, marked by the concept of sustainability, built on social awareness, which tries to make balance among series of man-made improvements and environmental protection through consciousness.

Sustainability is not the perfect solution to all of our problems, because regions of the world respond differently to climate change through the variant geographical, social and economic factors; the various systems are vulnerable in different scale and to avoid this, the ability to adapt is diverse as well.

2. One of the problems affecting today's is the growing population and the necessarily rising energy demand of the world, and to respond to this pressure

Nowadays the significant part, about 85 percent of energy production and energy consumption builds on fossil fuels. Therefore the adverse effects on the environment, the role of environmental pollutants is undisputed. Beside the growing energy demand and the arising environmental pollution, regional differences of energy types and the three-dimensional structure of energy production and energy consumption mean further problems.

Due to the growing population of Earth and industrialization of developing countries the energy demand of the world is increasing intensively. In accordance to the fundamental law of supply and demand it brings the increase in energy prices as well. On this base it is sure to continuously rise the price of petroleum in the future, which results the increasing price of gas and nitrogen fertilizer.

Considering that the dependence of oil is a strategic question, thus it directed the attention of political decision-makers for alternative and renewable energy opportunities. Beyond economic benefits it is proved that greenhouse gas emissions can be reduced by using renewable energy besides energy dependence.

3. It is a fundamental interest and also a duty to increase the use of renewable energy sources in favour of the future of environment and population

Key findings formulated in the frame of analysing renewable or green energy can be summarized as follows:

- Their common feature is always being available, or can be renewed without intervention, thus they can contribute to the diversification of energy production.
- Renewable energy sources largely depend on local facilities, their use reduces the amount of applied fossil fuels, but the utilization of renewable energy solutions have several drawbacks today, like electricity storage issues.

- The world's wind energy potential can be able to fulfil itself the reduction of carbon dioxide emissions to the level required in 2020, if electricity production and storage issues can be resolved. The first wind farm for using wind energy has been build in 2000, the amount of energy produced by the other 172 tower installed until 2010 is still very low, which may caused by domestic terrain.
- The solar energy can be also capable to ensure the energy needs of humanity, if we have the necessary and efficient technology. Hungary has currently no nameable production of electricity from solar energy. In quantitative terms solar energy production makes up 2,4 percent of all renewable energy.
- Geothermal energy can be utilized worldwide for producing electricity beside direct heat transfer. However it can be produced only in those geothermal areas, which are in the volcanic zone. From this point of view Hungary has special significance, because geothermal fields are located in 70 percent of its territory. At the same time it is inefficient in Hungary today because of the direct costs of bring it to the surface or the additional costs of production.
- Now biomass is the only renewable energy source in Hungary, which can be used to obtain directly or with the necessary transformation continuously renewable energy sources and its application can be replaced fossil fuels, as well as can be reduced the emission of carbon dioxide. It can be stated, that biofuels produced from renewable resources can be directly applied to the transport, and its application can substantially reduce the use of fossil fuels in Hungary.

4. Food prices are largely depending on the current price of petroleum, and not on the quantity of biofuels.

First generation biofuels are attacked primarily from a food-safety point of view, because it is currently produced in industrial scale only from plants which can be used as food. It is proven that the developed food price shock is caused by extreme natural events (drought, flood) and the rise of petroleum (consequently the fertilizer) prices, and not the expansion of the first-generation biofuels. Despite this the second-generation biofuel production will be a major breakthrough, namely the spread of biofuel production technology based on agriculture and forestry by-product and waste.

The world's dilemma is the competition of raw material for food among food, feed, biofuels and environment industry. As the cultivable land size is limited, biofuels compete with other industries for raw material. Accordingly the average price of raw material should increase, in favour of encouraging the growth of supply. The improvement of outputs can be a solution on unit areas.

5. Beside in many countries applied obligatory blending, the production of biofuels is improving by several forms of support.

Biofuels should be worthy analysed in a broader context, from an economic point of view. On this basis, from economic and social aspects the following statements can be determined:

- World depends largely on petroleum, but the stocks are finite, thus the substitution of fossil fuels would be entirely justified to solve.
- Amount of fossil energy used in transport can significantly reduce by the application of biofuels.
- Analysing the economic side, the biofuel suitable for substitution is able to decrease the cost of oil importing countries.

- Jobs can be created parallel; power plants can be installed for bioenergy purposes on marginal or fallow fields.

Production of biofuels in Europe is not competitive with the Brazilian sugar cane-based bio-ethanol. Thus European production and consumption is trying to make an alternative attract with several support, like output and input supports reducing the costs of biomass production; supports for decreasing costs related to infrastructure; output supports and tax benefits reducing costs of biofuel production; tax benefits reducing costs of biofuels or distribution.

6. Mainly the use of fossil fuels and the change of land use are responsible for the human greenhouse gas emissions. The use of biofuels can reduce greenhouse gas emissions, if its greenhouse causing direct and indirect gas emissions is less than those fossil fuels, which they changed.

Biofuels can help to moderate the rate of global warming and to arrest it, as the plants of its raw material can store the present CO₂ in the atmosphere in bound form. On this basis the following conclusions can be formulated:

- The carbon dioxide emission (GHG emissions of CO₂ equivalents) compared to diesel can be reduced on each travelled kilometer by 57 percent with pure diesel (B100) produced by plant raw material, and 88 percent with pure diesel produced by used cooking oil.
- Diesel with 10 percent blending biodiesel (B10) results 6-9 percent reduction of emission compared to the fossil obverse.
- In the case of gasoline with 85 percent blending bio-ethanol (E85) reduces carbon dioxide emissions with 70 percent on each travelled kilometer compared to gasoline.
- When using gasoline with 5 percent blending bio-ethanol this value is approximately 3 percent.

7. Only 8 percent from global cereal production had been used to ethanol production for biofuels in 2010. Considering the utilization of by-products for feed (replacement of feed by wet and dried distillers grains with soluble (DDGS)) the net use of corn for ethanol industry had taken 5 percent of global production.

About 85 percent of global ethanol production is used as biofuel, liquor and industrial alcohol is made from the remaining parts. The 85 billion liters of ethanol produced in 2010 for fuel had made 2-3 percent of world's gasoline consumption (volume-equivalent). Raw material of ethanol production for fuel adds up to 60 percent of corn, 35 percent of sugar cane, 5 percent of molasses, wheat and other raw materials. The largest producer of bio-ethanol for fuel in 2010 was the United States of America with 50 billion liters, where trying to promote the growth of production and consumption primarily by tax incentives. The growing corn needs of ethanol producers can be satisfied by increasing production. The growth of regional productivity increases emissions in the case of unchanged production area as well. The larger quantity of corn can be also produced by increasing sown area. It can take place at the expense of soybean, or involving areas being less suitable for corn production (farmers have already increased the sown area of corn by the reduction of soybean areas). At the same time the perspective of biodiesel production causes the increasing demand of soya, thus we will be witnesses to complex cross-effects in the development of production structure.

The second largest bio-ethanol producer is Brazil. It is the major producer and exporter of sugar, as well as represents the 20 percent of global sugar production and the 40-50 percent of sugar world trade. It means that Brazilian production and consumption trends have decisive effects on world market situation of the sector. Slightly more than half of sugar cane production has already used for

ethanol production. Despite the significant domestic use Brazil rates as major exporter (it exports 3-3,5 billion liters of bio-ethanol per year).

With a remarkable fallback the third largest producer in 2010 was European Union with 4,3 billion liters. Over the total value of 5 billion EUR has been established capacities for bio-ethanol in the EU until 2009, and actually there are further capacities to build with the value of 3 billion EUR. It is estimated that 15-18 billion liters of bio-ethanol will be required in the European Union until 2020, and is not excluded, that it will be covered by import. Import is also needed in order to the growing raw material needs required to the growth of biofuel production do not distort the supply side, thus do not increase the prices of agricultural products on the market.

8. Utilization issues of by-products generated in bio-ethanol production can not be only and solely reduce to the level of animal breeding and feeding. Possibilities for utilization should be analysed in a wider segment with its technical and ecological dimensions.

The primary by-product of the dry-milling ethanol production is basically the grain-swill. Considering that its dry-matter-content is very low, it can be efficiently sold or used as feed only in plants, which are closed to ruminant livestock farms. The other possibility of utilization method without drying is the processing of the mentioned grain-swill with low dry-matter-content in biogas plant. According to the current practice, by the application of the process using drying, the production of DDGS, namely fodder with 90 percent dry-matter-content has been more spread worldwide. Market of DDGS produced as by-product of bio-ethanol is the most significant in the USA. CGM (Corn Gluten Meal) and CGF (Corn Gluten Feed) the by-products of bio-ethanol produced by wet-milling process are more valuable and marketable feed and food ingredients. It can be stated, that using by-products of biofuels reduces the specific production costs of biofuel, and also reasonable to claim that feed utilization of by-products of biofuel production can significantly reduce the environmental impact.

9. The further liberalization of world trade can cause appreciable changes on the biofuels market of the EU, but it does not affect equally the two main biofuels. Considering that arresting the import of oilseeds and vegetable oils is not an objective for the EU, the impact of liberalization is favourable in this case. This fact is illustrated by the low duty for raw materials of biodiesel (or rather zero in case of oilseeds). The EU import of these products is expected to grow, as internal production of raw materials of the EU is not enough to meet the requirements settled in directives in connection with blending rates.

Biodiesel production and consumption is concentrated mainly to Europe and less to the USA today. EU is the largest producer of biodiesel, it has given 55 percent of world production with 8,9 million tonnes in 2010. The USA shares with 1,1; Argentina with 1,9 and Brazil with 2,1 million tonnes from biodiesel production. The 16,5 million tonnes biodiesel produced in 2010 added up 1 percent of the world's diesel consumption, to which was used 11-12 percent of global vegetable oil production. The growing demand for biodiesel in the EU can not be satisfied by oil plants produced in the EU, thus it is needed to import about 4-5 million tonnes of vegetable oil, or oilseeds equivalent with this. Probably the import of these products will increase because of growing demand on the one hand, and meeting the blending rates determined in directives on the other hand. The capacity of all biodiesel producers in the EU approaches 21 million tonnes; however the utilization is around 40-50 percent, as consumption is still far below from capacities. Based on trends biodiesel production of the Community will expected to rise in the medium term to 18,5 million tonnes, while its sharing from global emission will sink 40 percent below. According to

climatic conditions the primary material of biodiesel in Europe is the rape. The main raw material of biodiesel production in the USA and in South-America will be soybean oil as well in the future, giving that no problem, as USA, Brazil and Argentina are world's main exporters of soybean. European markets are targeted by their growing biodiesel export.

10. European Union uses comprehensive measures to support biofuels in Europe, as well as to protect them against foreign rivals. This is one of the greatest manifestations of „green protectionism“. Green protectionism is not only an environmental policy in itself, but it involves such as not environmental objectives, which are discriminatory and have paradoxically trade-restrictive effects on environmental policy as well.

The European Committee has created its renewed sustainable development strategy with the objectives of economic development and reducing the occurrence of environmental damage. On one hand issues of biofuels are accessible from the aspect of agriculture, because ethanol plants based on corn are important outlets or purchasing market as they solve the substitution of former EU legislation (e.g. intervention), however they determined the basic price of corn. On the other hand it can be analyzed from environmental aspect, due to renewable nature and the ability to reduce greenhouse gas emissions of biofuels.

The most important EU directives related to biofuels are the following:

- 2003/30 EC Directive on the promotion of the use of biofuels or other renewable fuels for transport; so in this sense the rate of biofuels using in transport sector has been fixed on 5,75 percent until 2010.
- 2003/96 EC Directive on restructuring the Community framework for the taxation of energy products and electricity allows that products, including renewable components – like bio-ethanol – can be whole or in part tax-free. EU methods to inspire the spread of biofuels: tax benefits, tax differentiation, support of producers and distribution requirement.
- 2009/28 EC Directive on the promotion of the use of energy from renewable sources (RED) formulates concrete measures for biofuels production and utilization, as well as establishes required target for the rate of renewable energy sources used in transport. Sustainability criteria had been also enacted as the part of the Directive.
- 2009/30 EC Directive on the quality specification of fuels.

11. It can be stated that EU-27 rely on more energy import by the reduction of primarily energy production, so the dependence of energy import is growing. Import and diversification of available energy sources will become increasingly important in order to ensure the uninterrupted energy supply.

The growing energy dependence of EU is caused by the decrease of primarily energy production of EU; it relies on import mainly for petroleum. Hungary's dependence of import was 62,5 percent in 2009, slightly above the average of EU-27 member states. The 80 percent of oil demand and the 87,19 percent of natural gas consumption of domestic use were imported in 2009. The electricity demand of Hungary is primarily satisfied by natural gas and nuclear energy. The share of all renewable energy to all domestic energy sources were 5,3 percent during the year, which had been derived almost two-thirds from biomass. During energy consumption analysis it is worth to observe the differences between EU average and domestic data.

Energy consumption (including all sectors) of EU had reduced by 0,6 percent between 2000 and 2009, but energy use of transport and service industry had jumped by 7,7 and 22,3 percent, which occurred in spite of different measures promoting and inspiring national and EU-wide energy efficiency. From the total use of energy has been represented 33 percent by transport, 24,1 percent by industry and 25,4 percent of households. In the period under review the rate of energy consumption had been grown by 2 percent in Hungary, and the 46,2 percent saltatory increase of energy consumption in transport must be emphasized. It is nearly sevenfold of EU average's growth rate, which reason may be the increasing number of cars put in circulation.

1. table: Total energy consumption of EU and Hungary in sectoral statement

Unit: million toe

	Total energy consumption		Industry		Transport		Households		Services	
	2000	2009	2000	2009	2000	2009	2000	2009	2000	2009
EU-27	1120,1	1113,6	329,3	269,4	341,4	367,6	292,5	295,2	115,1	140,7
Hungary	16,08	16,41	3,51	2,67	3,27	4,78	5,58	5,52	3,02	2,98

Source: own compilation based on EUROSTAT

12. It can be stated that first generation biodiesel and bio-ethanol produced by traditional technology from agricultural raw material will likely dominate renewable energy used in transport, which provides further developing possibilities mainly for cropping countries.

It is almost certain that the evolution of energy efficiency and structure in transport are going to have impacts on energy and biomass based fuel demand. Transport issues may be particularly important from a Hungarian point of view, which are confirmed on one hand by indicators about number of vehicles, and on the other hand by options for developing public transport. Statistical data shows that total passenger mileage in Hungary in 2009 divided into two main parts: its 37,9 percent for public transport and only 62,1 percent for cars in, which made Hungary especially well-positioned in the point of public transport relation. Although Hungary should face with many problems related to public transport, even so it has an outstanding performance in Europe. Obviously the preservation and modernisation of this system has a fundamental significance from an environmental and energy management point of view, whose solution can be the organic treatment of public transport fleets, thereby the cost-effective implementation of alternative fuels and propulsion methods (pure ethanol, gas, electric drive, etc.)

13. Our obligation for the uniquely high 16 percent bio-ethanol blending in Europe means that severe steps should be taken in wider dissemination of high bio-ethanol content (E85) fuels. The lack of processing capacity can cause here serious problems, so the fulfilment of this engagement is still in question. The 6 percent blending obligation for biodiesel can be complied after the processing capacity of the currently under construction plant in Foktő and the necessary esterification capacity will be built.

Hungary has been determined quantities and types of biofuels and other renewable energy sources will be used until 2020 in the National Action Plan (NAP), which means that the assumed value of renewable energy till 2020 in total energy consumption is 13 percent. Hungarian National Action Plan makes its total gross energy consumption probable around 19 644 ktoe in 2020, which transport energy demand is around 5 349 ktoe. Under the Directive 10 percent – means 535 ktoe – of fuel consumption expected in 2020 has to be replaced by renewable energy. The required amount of bio-ethanol is 475 thousand tonnes, and around 230 thousand tonnes of biodiesel is expected. The total amount of bio-ethanol will be produced by first generation technology, while 205

thousand tonnes of biodiesel will be made by first generation technology and 25 thousand tonnes by using waste. The amount of bio-ethanol in the Action Plan is about 16 percent in percentage of energy, while biodiesel is equivalent to only 6 percent blending.

14. Basic material needs of our bio-ethanol obligation is abundant covered by the volume of grain export, but the lack of processing capacity proposes serious problems in connection with meeting national commitments.

The base of domestic ethanol production can be primarily corn, and secondly wheat. In my dissertation I focused on corn taking into consideration basic material needs of domestic, existing and soon started corn-based bio-ethanol plant. The amount of cereal production was between 13-16 million tonnes in recent years. In the point of corn Hungary has more exceeded the 200 percent self-supplying level in outstanding years. Despite of our high corn production the EU-27 became a net importer in some years, and the disposal of domestic surplus on internal market caused also difficulties, as well as not to mention the export possibilities. Corn surpluses – arising on one hand from the lack of export, and on the other hand from the decrease in the number of animals – may derive, if Hungarian ethanol market could put on the additional part of it. To the 16 percent requirement of bio-ethanol set forth in Hungarian Action Plan, the 475 thousand tonnes per year of bio-ethanol production needs 1,5 million tonnes of corn. Processing capacities are already working (Hungrana in Szabadegyháza with the emissions up to 135 thousand tonnes per year), and construction is in progress (Pannonia Ethanol in Dunaföldvár with the emissions up to 160 thousand tonnes per year). Based on the schedule fixed in the Action Plan, these two plants can satisfy domestic demands of bio-ethanol up to 2018. Additional 170-180 thousand tonnes of bio-ethanol production capacities will be needed to fulfil the appointed target rate, which can be a certain outlet of further 555 thousand tonnes of corn basic material. Considering the volume of average 3,6 million tonnes of exported corn per year in the period of 2005-2010 can be stated that this amount also covers the raw material needs of bio-ethanol production. I found that further, about 180 thousand tonnes of bio-ethanol production capacity is needed to meet the 16 percent bio-ethanol blending requirement in 2020. If the plant in Dunaföldvár do not add further capacity, and other investors will not want to establish bio-ethanol plants, the missing amount of bio-ethanol must be imported despite of the necessary raw material can be satisfied by domestic production.

15. Calculating with 40 percent oil content, approximately 470 thousand tonnes of rapeseed and sunflower seeds can provide the 205 thousand tonnes of first generation biodiesel about 6 percent blending rate taken till 2020 in the Action Plan. Hungary is able to fulfil the 6 percent blending commitment without building other processing capacities in order to meet the requirements.

European and domestic raw materials of first generation biodiesel production are rape and sunflower from own production of agricultural raw materials. Demand of Hungarian vegetable oil industry is about 600 thousand tonnes of sunflowers seed per year. The remaining more than 400 thousand tonnes of surplus is exported. Since consumers generally prefer to use sunflower oil such as rape oil in Europe, so the stable and conductible demand is expected to persist in the future, therefore sunflower seeds can be used for biodiesel production at a lower level.

The harvested area of rapeseeds had been increased from 116 thousand to 259 thousand ha between 2000 and 2010. Analysing the growth trend for the future about 550 thousand tonnes of harvested rapeseeds can be expected per year. Thus the primary raw material of biodiesel may be the rape.

Only one biodiesel production plan was working with producing 125 thousand tonnes of biodiesel in 2010. Starting from the plant capacity can be stated that further about 105 thousand tonnes biodiesel production, as well as 95 thousand tonnes vegetable oil production and mill capacity are necessary to fulfil the 6 percent biodiesel blending commitment to 2020.

The start of the newly built vegetable oil industrial mill plant in Foktő can bring substantive changes in the domestic vegetable oil production: the complete set of oilseeds produced in Hungary can be processed at home by the creation of this plant. After esterification the required 105 thousand tonnes of biodiesel can be produced from this. It means that our capacity of biodiesel production with the plant in Foktő will be sufficient for the 6 percent biodiesel blending till 2020 as set out in Action Plan.

2. table: Biofuel potential of Hungary derived from foreign trade data

Basic material	Production	Net exports	Biofuels quantity produced from net export volume		
	2005-2010 average	2005-2010 average	thousand tons	million liters	Ktoe
	thousand tons	thousand tons			
Corn	7 446	3 612	1 084	1 366	668
Wheat	4 513	2 006	602	758	379
<i>Total bio-ethanol</i>			<i>1 686</i>	<i>2 124</i>	<i>1 037</i>
Rape	568	531	212	242	189
Sunflower	1 169	552	221	250	198
<i>Total bio-diesel</i>			<i>433</i>	<i>492</i>	<i>387</i>
<i>In total</i>					1 424

Source: own calculations based on data from Hungarian Central Statistical Office and Research Institute of Agricultural Economics, 2011.

16. An intensifying competition for food and energy plant has been started by the run up of biofuel industry, which winners will be clearly the producers. The forestalling of produced food surplus can also be guaranteed by bio-ethanol plants working with first generation technology. Therefore biofuel industry has a key role in national economy.

Significant and multisectoral restructuring can be experienced by the development of domestic biofuel industry in the near future.

- Some traditional sale and distribution channels of corn will be ceased; the role of major grain storages probably will decrease in regions, where local corn supply is bought up by bio-ethanol industry.
- Significant changes are expected in logistics, the profitability of bio-ethanol production is appreciably depends on transportation and other logistical costs of increasing quantities of bio-ethanol and its by-products, as well as to its processing necessary raw materials, therefore the continuous demand of local bio-ethanol producers make possible the optimal use of transport capacities.
- The domestic bio-ethanol plant means certain outlet for domestic corn producers, thus the outlet will be grown by launching further bio-ethanol plants.

- The resulted stable market means stable or more stable producer prices.
- As result of a predictable and continuous demand, this will inspire producers to achieve higher crop yield.
- In addition producer's efficiency will improve, by which the unit cost can decrease, and it means also an exploitable competitive advantage for them on feed market.
- The run up of biofuel industry can significantly contribute to the preservation of rural jobs.

17. The social awareness for environment is not sufficiently developed in Hungary today. The change of excise tax is able to discredit thousands of small- and medium-sized enterprises, as well as involves about 30 thousand jobs. At the same time the increased tax burden makes difficult to achieve the 10 percent renewable rate, targeted by the EU until 2020, because the thrift of using biofuels has become questionable from consumer's point of view.

The homeland of E85, as fuel is Brazil. It was spread in Europe between 2005 and 2006. Production, utilization and regulation of biofuels are in its infancy in Hungary, as having regard that the first relevant legislation was born only in 2005. Like in other EU member states excise tax and VAT rules have impacts on prices and spreading of biofuels. Under the national standard E85 should included bio-ethanol at least 70 percent. According to the Energy Taxation Directive (2003/96 EC), in favour of promoting sale, the bio-ethanol part of E85 had exempted from excise tax from 1st January 2007 to 31st July 2011, until the new Excise Act came into force. As a result the use of E85 was growing rapidly from 2007.

3. table: Comparison of item prices of E85 and gasoline 95 octane on 13 July 2011.

	E85	gasoline 95 octane
Excise tax / 1000 liter	18 000	120 000
Wholesale price / 1000 liter	202 500	286 780
Retail margin / 1000 liter	16 200	22 942
25% VAT / 1000 liter	54 645	77 431
Consumer price / 1000 liter	273 375	387 153
Consumer price / liter	273,4	387,1

Source: own calculations based on data from Hungarian Petroleum Association, 2011.

Agip has been released E85 at first in Hungary. 400 stations have already sold it in 2011. Due to excise tax exemption E85 had an average 100-110 HUF/liter price advantage compared with gasoline. At the same time, because of the specifically lower calorific value of E85 the E85-fueled car consumes about 20 percent more on 100 kilometers, thus 10-15 percent cost saving was realistically available. Instead of the current tax exemption for bio-component the amendment – enters into force in August 2011 – demands nearly 50 HUF/liter extra price on users by VAT. This can have unforeseen, significant social, economic and environmental consequences.

4. table: Comparison of item prices of E85 and gasoline 95 octane on 7 December 2011.

	E85	gasoline 95 octane
Excise tax / 1000 liter	52 000	120 000
Wholesale price / 1000 liter	236 500	301 980
Retail margin / 1000 liter	18 920	24 158
25% VAT / 1000 liter	63 855	81 534
Consumer price / 1000 liter	319 275	407 672
Consumer price / liter	319,3	407,7

Source: own calculations, 2011.

The Parliament had accepted next year's tax laws in November 2011, which means that the excise tax of bio-ethanol per liter will be increased by further 30 HUF from the 40 HUF introduced in Summer. The 70 HUF tax content (almost 90 HUF including VAT) will result a drastic reduction of domestic bio-ethanol demand. This runs counter with the target undertaken by the country in the Action Plan until 2020. The raise of current 25 percent VAT rate to 27 percent is also contributing to growing prices of fuels.

5. table: Comparison of item prices of E85 and gasoline 95 octane from 1 January 2012.

	E85	gasoline 95 octane
Excise tax / 1000 liter	77 500	120 000
Wholesale price / 1000 liter	262 000	301 980
Retail margin / 1000 liter	20 960	24 158
27% VAT / 1000 liter	76 399	88 057
Consumer price / 1000 liter	359 359	414 195
Consumer price / liter	359,4	414,2

Source: own calculations, 2011.

4. New and novel scientific results

E1. The raw material demand of domestic bio-ethanol production has no direct impacts on food prices.

In case of corn and wheat using for bio-ethanol production there is no doubt in our country about the development and developmental opportunity, given the fact that we produce more corn and wheat than we use for food, feed and industrial purposes. For this reason remains are exported or can be exported as raw material. As Hungary do not product bio-ethanol from wheat, the accumulated amount of it in the recent year led to a decrease in price of wheat. In contrast, the minimal increased price of corn can explain by bio-ethanol production, despite the only domestic bio-ethanol plant buy in just about 400-500 thousand tonnes of corn a year, so 25-30 percent of the produced surplus.

This means that the major raw material base makes economically possible the production of biofuels, without threatening the food and environmental safety of the country. Based on these I consider it in domestic relations also proven my hypothesis that the spread of biofuels does not directly influence food prices in Hungary, because we are self-supplying in raw materials (grain, oilseeds), moreover we have a significant export potential as well.

E2. The new excise tax policy for the content of E85 bio-component introduced in two steps in 2011, as well as the new VAT rate come into force in 2012 go against the criteria of affordability.

In order to fulfil the 16 percent bio-ethanol blending obligation established in National Action Plan significant steps need to do for promoting the dissemination of E85 as widely as possible, as well as for its continuously increasing sale.

E3. Ethanol plant investments shall be analyzed with particular attention, considering the 16 percent ethanol blending obligation can not be met besides the plenty of raw material but the lack of processing capacity.

The necessary amount of raw material for the required, average 10 percent (16 percent for bio-ethanol, and 6 percent for biodiesel) blending – undertaken in NAP until 2020 – is available; however increasing the processing capacities is a remarkable problem in Hungary. If it will not be solved, Hungary needs to import biofuel from other member states and/or from third countries.

I have analysed Hungarian biofuel- production capacities, which led to the conclusion that further capacity expansion is needed in order to complete the average 10 percent blending obligation. Since the bottleneck is the expansion of bio-ethanol processing capacities, therefore I have modelled the economy of establishing a newly built bio-ethanol plant by operating profit and loss account, and the method of net present value (NPV) calculation. By the result of my model I can supported my initial assumption that the Hungarian 10 percent obligation can be completed by biofuel processing (net import is not necessary), however the enlargement of bio-ethanol processing capacities is not only regional but also national interest. Accordingly it is necessary to support investments (tax breaks, local/regional grants) and/or convert the legal environment investor-friendly and easier besides the favourable economic environment.

E4. The use of biofuels must be rise in order to fulfil the commitments to 2020. Considering the fact that Hungary has undertaken a really high, 16 percent blending obligation for

bio-ethanol, it needs to do serious steps in order to widely spread the high ethanol content and/or E85 fuels. This essentially requires the awareness training and sensibility of the society.

I tried to model a Swedish parking subsidy incentive system in the most polluted city of the country, in Budapest. As a result of the model I need to point out that a West-European (e.g. Sweden) type of incentive system for the use of biofuels can not be work in current circumstances. The reason for this is the lack of data on traffic engineering, the budgetary and other conflicts of interest arising from the two-tier local government system, as well as the undeveloped, improper operation or the lack of the control system for the right to take advantages (any benefit, e.g. handicapped parking), which could provide a basis for a discount to encourage the use of biofuels.

5. Conclusions and recommendations

The substitution of fossil fuels and the raison d'être of biofuels

In the near future there are absolutely neither conceptual, nor practical possibilities to completely discard from fossil fuels. It can not be fully replaced fossil fuels by renewable energy sources in the foreseeable future, only gradually substitute them. The important question is whether we can strike a balance between fossil and renewable energy, thus reduce the further pollution of the Earth. It is elemental to research renewable energy, and mainly – within this – reducing energy demand of transport sector. It is therefore appropriate to start replacing fossil fuels such technology, in which the required raw material are available, we have mature technology to process them, and their usability does not require significant financial investments on behalf of consumers. First generation biofuels meet these criteria. At the same time, on one hand from food-safety, on the other hand from environmental-safety and thirdly from economic aspects of view they are not adequate substitutes for fossil fuels. Instead of the non-food material the aim is to develop modern, second or third generation biofuels.

Biofuels: intensifying competition for soil

The world's population is continuously growing, and will reach 9 billion people on Earth in 2050. Trend in food also changes: more and more meat and milk, as well as meat and dairy products are consumed, thus especially the demand of grain and oilseeds will grow. To accommodate this demand world food production must be increased by 70 percent, which is a 1,1 percent rate of growth per year between 2000-2050. This involves further food price growth. At the same time food prices will be also affected by oil price and inflation rate besides the increase of demand in the future. The rate of crops used for world's biofuel production in relation to all grain and oilseed production is relatively low, and it has small effects on the balance of global cereal stocks. Despite this many experts says that the expansion of biofuels is the reason for increasing food prices, although it is the consequence of ever-rising food consumption of the earth's growing population, as well as changing diet. In my opinion the increasing number of hungry and malnourished people is not due to the growing demand for raw material of biofuels, or the resulting food shortages, but rather it is because more and more poor people are not able to buy food. It is not about the physical lack of food, but the distribution, the problem of food access is it, which means a question related to household income.

Economic issues of Hungarian biofuel production

I have emphasized many times in my dissertation that raw material for using 10 percent biofuels are available in Hungary. The main problem is strait processing capacity. Noteworthy that why is still there a restraint from the downstream side in a prospering industry. Analyzing the causes of the lack of capacities arguments can be the lack of encouraging legal environment and appropriate supporting structures, as well as the low key or negative willingness to lend of banks. In my opinion that is why the investment attractiveness of the industry is not clear from an economical point of view. Increasing the required blending rate may mean inspiration, because the determined amount of bio-component must be blended to conventional fuels regardless on the fluctuation of oil prices. After all the promotion of biofuel production needs the further maintaining of EU defensive duty and national tax benefit of sale (e.g. excise duty benefit). There should be revised economic incentives for the development of industry in Hungary, which can provide predictable legal framework, investment grants, and possibly temporary tax breaks for investors.

The EU 2020 Strategy and its sustainability issues

EU 2020 Strategy gave new impetus to the development of engine within climate protection, moreover to the conceptual restructuring of transport. It is time for a paradigm shift on EU and membership level, new and more modern approach is needed instead of the old cause-effect relationships. For example: according consumers bread is expensive because the high cost of wheat. However the detailed cost analysis reveals that food prices are impacted first of all by energy costs. Namely the cost of bread is more dependent on the price of energy (petroleum), than the price of wheat (the rate of wheat is smaller than the energy in the cost structure of production). It also follows and it can be seen that bread price is not primarily determined by bio-ethanol production. Consequently effective methods must be gone on climate protection. Hungary is able to complete the requirement of average 10 percent biofuels by processing domestic raw material. It contributes to get one step ahead to the whole Community in the implementation of EU 2020 objectives.

Proposals

There is no question about the renewable energy potential of Hungary. The raw material supply of biofuels is insured, but the further enlargement of processing capacities is necessary. If this problem is not treated in time, than our EU obligation will not be realized by processing domestic raw material – produced in Hungary –, but importing the lack of biofuels, I mean the import of a higher added-value than raw material and the export of jobs. Appropriate economic environment has to be established in order to attract investors:

- Increasing important domestic and EU support to investments which inspire the production of renewable energy (Environment and Energy Operative Programme).
- The reduction of administrative and fiscal charges which increase investment costs and the production of renewable energy.
- The high support of natural gas is delaying its replacement by renewable energy, therefore is reasonable to abolish the support of fossil energy (but this is controversial with the governmental intent which propagates the wider use of bio energy).
- Similarly to EU member states, at least temporarily and adapted to local conditions is needed the support of biofuels production.
- Reduce administrative burdens by simplifying the almost baffling and complex legal system (licensing, decision competencies and estimate).
- The support of using renewable (heat energy) energy.
- The long-term concept, which based on political consensus and is accepted by the society, is missing.
- It is necessary to inform the society about the objectives and their expectable effects of the country and the European Union.

6. Biography

Andrea Somogyi graduated in Károlyi Mihály Spanish-Hungarian Bilingual Grammar School in Budapest, in 1993. She completed her education on the Faculty of Food Science in Corvinus University, and became food manager in 1998. During this time she had spent a year in Complutense University in Madrid, as a scholar. From September 1998 to December 1999 she had attended a post graduate training on the Faculty of Economics in Nantes University as a scholar of the French Republic, her mandatory semi-year practice was spent in Manchester, at ALM group, as a Central and Eastern Europe rapporteur.

After her university studies she positioned herself on the Department of European Integration in the Ministry of Agriculture and Rural Development. This department was responsible for the organization and implementation of Hungarian agricultural accession negotiations, and for the establishment of professional minds. She had accumulated a number of professional knowledge and experiences as a negotiation secretary. She had a lot of presentation on international conferences and exhibitions about the situation of Hungarian agriculture and the possible challenges of the joining. On her further career in the Ministry she becomes a top-level negotiating advisor and then the head of EU Coordination Department. The national organization of meetings of the Special Committee on Agriculture in Brussels was a significant task for her. On many occasions, in several European countries had she opportunity to acquire experiences, including France, Italy, Austria, Belgium and UK. Resulting of her manager status she had represented the interest of Hungarian agriculture on many professional conferences and workshops, and due to her language skills she kept her presentations on the language of the host country.

She was transferred to the Municipality of Budapest in 2007, where her main task was the set up of the Office of European Union Affairs from a legal, administrative and human resources point of view, and due to this office Budapest could apply for co-founded sources in Brussels. As the head of the Office of EU Affairs she was responsible not only for the preparation of EU projects, but for the international (EU) bilateral relationships of the Capital as well. Several international events, as the implementation of „European Mobility Week” in Budapest, which became an environmental issue, are associated her name. Thanks to her work Budapest has signed that EU agreement among majors, under which they have undertaken to increase the use of renewable energy by 20 percent, and to reduce the CO₂ emissions by 20 percent in their cities until 2020.

She has high level exam in English, French and Spain languages, as well as intermediate exam in Russian language. She also speaks Italian, Portuguese and Dutch. She undertook educational activity in the Interpreter Training Institute of Eötvös Loránd University between 2003 and 2010 as a lecturer, where she taught the issue of Common Agriculture Policy and EU decision-making mechanism. She was a member of examination committees, conference organizing committees, and professional juries in many cases, as well as she provided several times for diploma tutoring and critical activities.

In her publications there are an English-language book, a Hungarian book chapter, special articles in 3 Hungarian, 3 foreign-language scientific periodicals, as well as 3 Hungarian, 3 foreign-language other periodicals, 3 foreign-language and 2 other international presentation on scientific conferences.

7. List of publications

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