

THESES OF DOCTORAL (PhD) DISSERTATION

GÁBOR RÉCZEY

MOSONMAGYARÓVÁR

2007

University of West Hungary
Faculty of Agricultural and Food Sciences
Institute of Economic Sciences

„Doctoral School of Precision Methods of Plant Production”

Theses of dissertation (Ph.D.)

**THE POSSIBILITY OF THE UTILISATION OF BIOMASS FOR
ENERGY AND ITS EFFECT ON RURAL DEVELOPMENT IN THE
FRAMEWORK OF THE SUPPORT SYSTEM OF THE EUROPEAN
UNION**

Written by:
Gábor Réczey MSc
agricultural engineer

Scientific consultant:
Lajos Salamon, Dr. habil.
Head of Department, professor

Mosonmagyaróvár
2007.

1. INTRODUCTION

Our ancestors heated with fire ten-thousand years ago using fire to prepare their food. Until the end of the 19th century, there was a balance between the rhythm of development and the quantity of energy used. The production and utilisation of energy was decentralised as cottages, villages and towns formed single units. The condition of development was the increase of energy utilisation that is the work that had been carried out by human beings and animals were exchanged to machines. Therefore more and more raw material (wood, coal and crude oil) was needed. From the end of the 19th century on, crude oil has been present in the global raw material market, its discovery gave a raw material to mankind that has had its exponential effect on the development and so it lost its connection with realistic prices of crude oil in the 20th century.

Biomass is the organic material produced by the flora, fauna and the micro-organisms. The utilisation of biomass for energy has a long history.

Nowdays, biomass ensures the primary source of energy for the half of mankind and it makes up to 14 per cent of the world's utilisation of energy (Zeng et al., 2007). According to the calculations of the World Energy Council, the worldwide utilisation of biomass will amount to 7-27 per cent between 2025 and 2050. In 2002, Steele called the attention to the fact that there is a large difference between the developed and the developing countries as regards the utilisation of biomass. While it makes up to merely 3-4 per cent of all the energy produced in the developed countries (IEA, 1996), this amount is almost 20 per cent in developing countries like India or Brazil. The energy utilisation based on non-commercial biomass gained by the burning of primarily agricultural waste and animal fecal can make up to 90 per cent. **The European Union (EU) covers currently 4 per cent of its energy need from biomass** (EGSZB, 2006). Based on the fact above, the renewable strategy of the EU aims to increase the share of biomass as regards the utilisation of energy up to 12 per cent until 2010. At the same time, the share of green power is to be increased from 14 per cent to 21 per cent.

The utilisation of biomass resulting from agriculture and family holdings dates back to the discovery of plant production, due to animal husbandry the range of materials to be utilised was widened. Farms try to utilise the majority of residual products and agricultural wastes, however, it is mainly fossil energy that provides the fuel needed to operate machines. The utilisation of residual

products depends more or less on the ingredients and energy content of raw material. One way of utilisation is *direct burning*, first of all plant materials with low moisture content and high caloric value are the materials to be utilised in this way. Plant materials dried and chopped are to be utilised as the raw material for *biobriquet*, or *pellet*. Any kind of organic material mixed in the appropriate ratio is able to be used for the production of *biogas*. *Biodiesel* can be processed from seeds and wastes with oil content, while *bioethanol* is a propellant to be processed from plants with carbohydrate content. The different processes provide alternatives for those making a living from agriculture while having also macro-economic benefits and positive effect on the environment. Moreover, taking into consideration the environmental capabilities, the greatest growth can be achieved by the utilisation of biomass (Réczey and Bai, 2005).

The utilisation of biomass as **one of the key factors** of land use and **rural development** has an increasing role in the European Union besides its above mentioned effects on national economy. As the toolkit for the production as well as the utilisation of biomass is provided by rural environment through agriculture, one of the priorities of the rural development policy of the European Union is supporting the production of energy from agriculture and so the sustenance of the original state of land and the maintenance of employment thereby developing the quality of life.

The present dissertation aims to cast a light on **the effects of biomass on the rural development** besides the energetic use of it. Generally, it can be said that maintaining the jobs based on agricultural activities plays a crucial role in the employment of the rural population, as without permanent jobs, rural communities cannot be sustained even with social aids.

Having recognised this fact, the European Union spends **46 per cent of its budget for 2007-2013** on supporting agriculture and thereby rural development. Although there are more and more attacks against such distribution of the common budget, it is clear that, in the long run, the EU tries to create competitiveness between the member states of the Union and the leading world-powers by **connecting the questions of agriculture, energy and rural development**.

2. MATERIAL AND METHOD

In order to introduce the connections between the utilisation of biomass and rural development it is necessary to introduce the two economic fields in details, their effects on each other thereby disclosing their cause-and-effect relations. First of all, I surveyed the utilisation of biomass based on national and international data, I also used the data collected by myself. The dissertation aims to introduce the wide range of utilisation from the selection of possible raw materials through the technology used. It is also essential **to know the legislation in force** in order to have a clear picture of the topic, therefore I listed the pieces of legislation summarised in an annex (Annex II.) at the end of my thesis. I collected the data from **primary and secondary sources** that is the databases of the Ministry of Agriculture and Rural Development, the Single Monitoring and Information System (SMIS) using also the relevant sources of the HCSO (Hungarian Central Statistical Office), the Hungarian Energy Office and the European Union. The **analysis of the connections** behind the wider and wider utilisation of biomass for energy provides the own survey and the results of the dissertation. **I used the following methods when surveying the topic of such empirical kind:**

Analysis and comparison of literature

I surveyed through the national and international literature available in details in order to get to know the field. By comparing and colliding the arguments pro and contra I tried to cast a light on the complexity of the topic chosen.

Analysis of documents

Beyond the introduction of the relevant literature I put an emphasis on the introduction of the original documents, acts and regulations that provide direct information. I gained much help from the database of the Department of Agriculture and Rural Development of MARD, where I managed to know and use the up-to-date data and the proposals of regulations.

Comparative studies

Using the data of the Single Monitoring and Information System (SMIS – primary data) I made a comparative survey to introduce the support system through the applications of the Agricultural and Rural Development Operational Programme (ARDOP).

SWOT-analysis

I revealed the advantages, disadvantages, the possibilities and the dangers of the energetic utilisation of biomass with the method known. I searched for the **economic, political and social causes of the stimulation of utilisation**, as getting to know these paves the way to the justification of utilisation.

Analysis of problems

I surveyed the difficulties of the utilisation of biomass and obstacles of the national introduction of bioethanol by using a problem-tree, **which serves as the basis** for the **conclusions** drawn at the end of the dissertation. The method introduces the groups of problems that are to be studied and evaluated in a detached way yet built on one another in a representative way.

Methods with interviews - Indepth interview

During my research, I put a special emphasis on the opinion of the experts of the topic, the researches and the experts influencing the agricultural policy, especially when analysing the support system of the EU. I managed to receive such information during the indepth interviews that cast the light on the **connections**, as the *novelty of the topic chosen is provided* by the connection of partial areas which reveals the interdependence of the system.

3. THE SURVEYS AND THE RESULTS

The condition of the economic development of Hungary and one of the means of the political stability of the European Union is **the diversification of agriculture**. One of the conditions to this is the transformation of agricultural production developed after the World War II having emphasis on food-production. The basis for that can be provided by the reformation of energy policy, which also means social rearrangement having in view the priorities of rural development as well as environmental aspects. Having investigated the hypotheses set in the beginning of the dissertation I concluded the following:

The energetic use of biomass is first of all *not an aim* but *a tool* to enable society to **reach its aims**, its **strategies of rural development and environment** and the **reduction of its dependence on energy**. The introduction of biomass into the Hungarian energy market can be successful in the case all the people involved in the process – starting from raw material production until the end-users – are interested in the production as well as in the utilisation. It is the task of the state to create the regulations and the strategies to that. There shall be created an economic background where long-term subsidiary benefits are realised opposed to the short-term quick returning investments.

On the basis of the literary claims introduced, it can be claimed that vegetable biomass in its solid, gaseous or liquid form, is **capable to partly substitute for fossil energy**. The question is its *efficiency* and the *costs* of this process.

It is also to be claimed that the biomass potential of Hungary exceeds the quantity utilised so far, this way the energetic utilisation can be increased without having harmful effects on food-production. It is also important to put an emphasis on the fact that we mean an over-production of food in the European Union as opposite to developing countries which can be derived from the original objective of CAP, that is the creating food safety in the whole continent. Nowadays, this safety means rather *food quality safety*. „Good farming practice”, „cross-compliance” and meeting the environmental provisions have come into the foreground.

However, biomass is not able to substitute totally fossil energy under the current technologies. Although its utilisation reduces to some extent the need for „traditional” energy, under the technologies known, the same efficiency cannot be reached.

There are two options **to overcome the over-production**. On the one hand, traditionally produced agricultural products (cereals, corns, etc.) can be utilised as raw materials; on the other hand new utilisation of agricultural land available is also an option (for example afforestation). At the same time, the establishment of traditional production areas of good quality with fast growing energy plants cannot be the aim. The provisions relating to environment protection, organic production and water management that help the biodiversity of agricultural areas have also to be taken into account.

The condition of the energy balance is the exact knowledge of the input and output energy quantity. In the case of such an open system as the production and utilisation of primary biomass, the **input value** to be calculated to the energy balance can be only estimated in many cases. It is no doubt that the **comparison with useful energy is also needed in the case of biomass**, but this cannot be regarded as a starting point **when investigating efficiency and necessity**.

The Net Energy Value (NEV) is available to survey basically closed energetic systems. The energy balance is the difference of the quantity of energy input and and the energy produced, which makes a clear position for decision. To get to know the connections of an open energetic system, a method that neglects the complexity of the system and the energy of nature cannot be used. The energetic use of biomass contains numerous elements (specific output, heat of the plant produced, transport costs, the utilisation technology chosen, etc.) during the setting of which variables depending on areas or weather are to be taken into account.

The general statements approved from these cannot be regarded scientific. Although the energy balance calculated for the method chosen shall be taken into account to some extent, it cannot be regarded as a basis for decision in the question whether it is capable to substitute for fossil energy source.

The factors that are to be taken into consideration as regards biomass are difficult or even impossible to be quantified. The creation of the energy balance in the case of biomass can be surveyed from the point of view creating a self-sustaining system with the technologies and raw materials available. This means, from an economic point of view, that the process has to be viable without support, and from an energetic point of view it means that through the process **renewable energy** is gained transforming the input energy.

The role of supports can be viewed from two sides. On the one hand, the goods will have a better position on the market, producers that would not be viable without the supports can access the market. On the other hand, it can reduce the distort of competition deriving from environmental differences, as it provides a **kind of protection** against goods of better quality produced by more costs. Taken into account that there are stricter provisions as regards production in the European Union than in the developing countries (isolation distance, keeping organic passages, utilisation of GMOs, etc.), the European producers can fall into a competitiveness gap. The competition would be balanced if the expectations of the consumers were globally fixed.

There can be supports implemented in a competitive market economy but real clear distinctions are to be used in order **not to distort** competition and **equal opportunities**. The intervention into competition is possible under strict criteria, in case it realises social aims that cannot be **quantified in economic results** (for example objectives of health, land and environment). The **retaining of workforce in the rural areas** or the **reduction of energy dependence** are such objectives.

The European Union has to make a decision in a transitional period. On the one hand, World Trade Organisation is expecting the elimination of export subsidies and other direct subsidies aiming at production, on the other hand, the 27 member states do not share the same opinion as regards the questions of CAP. Countries that are more sensitive to the budget of the EU such as Great Britain, Denmark and Sweden, turn down all proposals that intend to support agriculture hence the energetic utilisation of biomass. It is also essential for those willing to enforce a clear market economy that there shall not be a greater burden posed on

to the countries paying the budget for the operation of the Communities after the elimination of supports and thereby transforming the budget.

It is clear that Europe wishes to preserve the layout of the regions and the traditional values. This **community objective** will result in long negotiations with the WTO and compromises in the other fields of economy. The territorial disparities influence the competitiveness of the European Union in the long run. The decision-makers have to face the fact that the consumers expect to reach agricultural products cheaper – biomass as well. This makes necessary the elimination of protective duties and the opening of markets.

The **intervention of the state is essential** to reach these social and economic objectives, on the other hand, long term social objectives demand that the economy shall be calculable due to the diversification of energy supply. The condition for that is the *compensation* among production prices, the *support* for entering the market and the *motivation* of the utilisation.

It is *essential* to transform the present support system of biomass in Europe. We have to prepare for the challenges of a liberalized market and the expectations of high quality. The direct support system depending on production that omits economic needs and market expectations cannot be followed. Supports have to meet the needs of the society in a way that they take into account the effects of *elimination of supports* in all fields of economy.

There can be some „*green label*” support schemes that do not mean direct competitive disadvantage to producers outside Europe and do not create economic advantage for producers of agricultural energy (energy-farmers) against operators of other sectors.

These are the supports for *research-development and for education, supports for environmental investments and infrastructure development, and for marketing purposes or entering the market or for best projects as well as reduced interest rates, support loans and tax relief.*

When setting the aid intensity of the support, the expectable long term macroeconomic increase of value shall be taken into consideration in a way that

it shall be able cover for the possible surplus costs. It is also important to define the proper term of supports as oversupporting can harm self-sustaining.

Prorosal for setting up Biomass Working Groups

There are numerous studies on utilisation of renewable energies to be expected that handle the utilisation of biomass as a priority. These shall be the „Renewable energy itinerary” – the *Gierek report*, the *Saryusz-Wolsky report* on the common European energy policy and the *Lipietz report* on commerce and climate change. Based on these, it is necessary to define the long term energy strategy that focuses on environmental aims and the aims of rural development and energy policy. The realisation can be achieved by constructing a *programme* that **dissolves the contradictions derived from the short term economic interests**. One of the possibilities for that is the quantification of internal and external costs of energy prices and their taking into account when compared to the prices of fossil energy.

The Biomass Economic Research Group (headed by Prof. Ferenc Ligetvári Dr. habil., DSc, SZIE-MKK) made up of researchers of the Research Centre for Social Studies of the Hungarian Academy of Sciences and the Szent István University tries to reveal the complete system of social context of the topic.

Based on the above, it is necessary to develop **an action plan** – set to the national circumstances - in accordance with the Biomass Action Plan of the European Union, the action plan shall define direct tasks to the ministries involved.

In my opinion **six working groups** shall be established, the common work of which would provide the national biomass energy programme. The task of these would be to manage the negotiations among ministries that is the detailed investigation of the area, the completion of evaluations and finally the preparation of concrete proposals. The participants would be decision-makers, researchers and representatives of civil organisations.

The task of the **first group** – the **Biofuel Working Group** – is focusing on biofuel.

–first of all, the elaboration of the introduction of bioethanol and biodiesel in Hungary, taking into consideration the national possibilities and the mixing target to be reached by 2020 set by the European Union.

The economic calculations show that it is not useful to put the production of ethanol solely on one raw material as the price of that raw material that makes up 60 per cent of the final product wavers between extremities depending on world prices and average yields.

The Biogas Working Group (the second group) would be responsible for spreading the utilisation of biogas and deponia. The aim is the best possible utilisation from economic point of view of agricultural waste and the residual products of production of bioethanol for both house and farming production.

I propose **the Solid Working Group for the third group**. This kind of energetic utilisation is the oldest in Hungary. As the market share of natural gas as energetic utilisation is rather large, results are to be expected in areas where traditional heating with wood is still present and where a great number of consumers can be linked by district heating.

The fourth working group should survey the **utilisation of biocomponents** in order to reduce the utilisation of environmentally harmful artificial materials. The raw materials for these are agricultural products providing a new source of income for the producers. The working group would give further pieces of advice to reduce environmentally harmful activities.

The fifth important area is refinement. The development lies in the efficient utilisation of the „whole” plant like the refinement of crude oil. The aim is the most efficient utilisation of the residual products that are treated in many cases as waste.

The **sixth group** would be made up of experts of production development who would be responsible for setting the optimal conditions of a production area, the technology for water supply and nourishment that is to define the precision methods of production of potential biomass.

The greatest challenge is **to change the social attitude to agriculture**. Agriculture is not to be regarded as a merely raw material producing sector in which only the producers are concerned. The utilisation of biomass not only provides new economic possibilities but it has a key role in terms of rural development. It serves as one of the pillars of sustainable agriculture that changes the two-poled agriculture (food and fodder production).

4. NEW AND NOVEL SCIENTIFIC STATEMENTS

The new and novel scientific statements are summarised in the following points:

1. I proved that **energy production as the third pillar has a great role in** utilisation of Hungarian agricultural land and the tools available besides plant production and animal husbandry. It creates the possibility to continue plant production without constraint fallowing and without the increase of food over-production.
2. I come to the conclusion that the grater utilisation of biomass **can contribute to the reduction of energy dependence, but it is not able to provide energy self-sustainment and it cannot satisfy the growing need of energy and it cannot serve as substitute for fossil energy.**
3. **I investigated and proved that NEV (Net Energy Value),** the method describing energy processes of closed systems **is not able to define** alone the **energy content of biomass** as other basic factors influencing the energy balance in both input and output sides cannot be neglected. Other **positive externalities** (retaining rural work force, healthy environment, sound landscape) that **provide the real value** of the utilisation of biomass have not imputed. A broad method from *the point of view of sustainment* is needed, a method that takes into consideration that **renewed energy is produced.**
4. The dissertation cast the light on the **close connection** between the **energetic use of biomass and rural development.** I concluded that the diversification of agruculture realises all the agricultural priorities that provide the fulfilment of the meeting the high standards of the European Union: retainment of public goods and the reduction of regional differences.
5. My research proved that the energetic use of biomass is **not yet competitive without support,** there is a need to elatorate on **a long term biomass strategy** in order to enable agriculture to become self sultaining in the future based partly on energy production. The dissertation proposes six platforms to this end, which are introduced in chapter 3.

5. LIST OF PUBLICATIONS PUBLISHED AND UNDER PUBLISHING

Conference presentations:

1. Réczey G. (2003.) Renewable fuel of the XXI. century. Environmental technologies, renewable resources for sustainable development, Belgrade
2. Réczey G. – Hegyi J. (2003.) Átalakuló mezőgazdasági termelés – a bioetanol mint a XXI. sz. egyik üzemanyaga. AVA Nemzetközi Konferencia Debrecen
3. Réczey G. (2003.) Bioüzemanyagok: Energetika, agrárpolitika vagy környezetvédelem? XLV. Georgikon Napok, Keszthely
4. Réczey G. (2004.) A bioetanol üzemanyagként történő felhasználásának hazai és nemzetközi tapasztalatai. IX. Nemzetközi Agrárökonómiai Tudományos Napok, Gyöngyös
5. Réczey G. (2004.) A bioetanol mint megújuló üzemanyag Magyarországon történő bevezetésének lehetőségei, Országos Tudományos Napok, Mosonmagyaróvár
6. Réczey G. Bai A. Biomass utilization in the rural areas. (2004.) WEU Konferencia, Mosonmagyaróvár
7. Réczey G. (2004.) Biomass utilisation – Possibilitites in Central Europe. Prága
- Réczey G. (2004.) Biomass utilisation – situation and possibilities in Hungary. 10th Workshop on Energy and Environment, Gödöllő
- Réczey G. (2005.) A bioetanol üzemanyagként történő felhasználásának ökonómiai háttere Magyarországon. AVA2 Debrecen
- Réczey G. (2005.) A mezőgazdaságtól az energiagazdász- A bioüzemanyagok jelene és jövője Magyarországon. XLVI. Georgikon Napok Keszthely
11. Réczey G. Bai A. Background of the bioethanol production and utilisation as fuel in Hungary. (2005.) I. Gazdálkodás Konferencia, Mosonmagyaróvár
12. Réczey K. Réczey G. (2006.) A magyarországi bioetanol potenciál. X. Nemzetközi Agrárökonómiai Tudományos Napok, Gyöngyös
13. Réczey G. (2006) Economical background of the biomass utilisation in Hungary. WEU 2, Mosonmagyaróvár

Poster presentations:

14. Réczey G. (2003.) Potential raw materials for bioethanol production in Hungary. Bio-energy, enlarged perspectives Budapest
15. Réczey G. (2003.) Background of the fuel ethanol utilization in Hungary. Ghent
16. Réczey G. (2004.) A biomassza felhasználásának lehetőségei a családi gazdaságokban. OTN, Mosonmagyaróvár
17. Réczey G. Bai, A. (2004.) Egy megújuló üzemanyag (bioetanol) jelene és jövője Magyarországon, WEU, Mosonmagyaróvár

Publications:

18. Réczey G. Bai A. Salamon L. Biomass utilization - Possibilities in Central Europe. Hungarian Agricultural Research. 2005. 14. 1. 9-12.p.
19. Réczey G. Bai A. Salamon L. Biomass: Energy form the fields. Acta Ovariensis, 2006. 47. évf.
20. Réczey I. Réczey G. Mi a biomassza? A biomassza mint nyersanyag és energiaforrás. Bioenergia, 2006. I.évf.2.sz. p. 8-11
21. Réczey G. Bai A. bioetanol előállítása és motoritikus felhasználása Magyarországon. 2006. Gazdálkodás 17. különszám
22. Réczey G. Problémák és kihívások a szilárd növényi biomassza felhasználásának területén, Bioenergia, 2007. II. évf. 3. szám
23. Réczey, G. A biomassza felhasználásának hosszú távú lehetőségei az Európai Unió támogatási rendszerének tükrében, Bioenergia, 2007. II. évf. 5. szám (in press)