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# BIOMASS – A CHANCE FOR AGRICULTURE THROUGH DIVERSIFICATION OF ACTIVITIES ORIENTED TO THE PRODUCTION OF BIOENERGY

# BIOMASA – SZANSA DLA ROLNICTWA PRZEZ DYWERSYFIKACJĘ JEGO DZIAŁALNOŚCI W KIERUNKU PRODUKCJI ZIELONEJ ENERGII

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**Streszczenie.** Kryzys ekonomiczny nie dotyczy tylko sektora bankowego i finansowego, ale także przedsiębiorstw rolniczych. Kryzys staje się oczywisty – obserwuje się niższy popyt na surowce rolne, niższe są też ceny zbóż, mięsa i mleka. Czynniki te pośrednio wpływają na jakość życia na wsi. W tej sytuacji rolnicy muszą znaleźć nowe możliwości i dlatego ukierunkowują produkcję na wytwarzanie biomasy jako źródła energii. Produkcja biomasy to sposób, w jaki można zróżnicować rolniczą działalność gospodarczą. Podstawą tego rodzaju dywersyfikacji jest strategia energetyczna UE, znana jako 20x20x20, co oznacza 20-procentowy wzrostu udziału OŹE w całkowitym zużyciu energii, 20-procentowe zwiększenie efektywności obecnego zużycia energii i 20-procentowy spadek emisji gazów cieplarnianych. Badania naukowe wykonano dzięki wsparciu projektu badawczo-rozwojowego OPR Soro o kodzie 2009/2.2/02, pod tytułem „Nowe technologie dla produkcji energii i ochrony środowiska w oparciu o wykorzystanie biomasy”. Kod ITMS 26220220063.

**Key words:** biogas station, biomass, crisis, diversification, financial analysis.
**Słowa kluczowe:** analiza finansowa, biomasa, dywersyfikacja, kryzys, stacje biogazu.

## INTRODUCTION

The current issues of our time are not only economic and financial problems but also terrorism, the consequences of climate change, pandemics of infectious diseases and loss responsibility for our actions. In rural areas, it shows even more evident, which is associated with feelings of helplessness, resignation and confusion. This situation requires new thinking and proactive approach to solving problems. Agrarian sector in Slovakia is characterized by a high social employment especially in the regions of southern and eastern Slovakia, where the agriculture substituted social functions of the state. The sector has been employed by the tenderers as unskilled workers, rural women, respectively pensioners. Since 1993 we can monitor a permanent reduction of employees in agriculture, which was also reflected in the quality of rural life. Development of agricultural employment is shown in the following Table 1.

A good example is a proactive approach to the diversification of agricultural activities in some firms in Slovakia. One of them is PD Kapušany in Prešov. In collaboration with the Economics University in Bratislava successfully implemented biogas plant project, which seeks to make full use of crop and livestock production.

The project is composed of three main pillars:
– Construction of a biogas plant,
– Growing energy crops,
– Energy production from biomass.

Table 1. The number of employees in agriculture in the years 1993–2008

| Year | Permanent employed workers total | Permanently employed workers in agriculture | Permanently employed workers in animal production | Permanently employed leading technical and administration staff |
|---|---|---|---|---|
| 1993 | 173 711 | 15 120 | 49 748 | 28 235 |
| 1994 | 152 755 | 13 110 | 41 453 | 25 331 |
| 1995 | 142 911 | 11 845 | 41 894 | 23 786 |
| 1996 | 127 751 | 10 352 | 37 405 | 21 840 |
| 1997 | 119 084 | 8953 | 34 315 | 20 994 |
| 1998 | 103 578 | 7287 | 29 493 | 18 861 |
| 1999 | 88 994 | 5764 | 25 797 | 16 581 |
| 2000 | 77 332 | 5113 | 21 364 | 14 755 |
| 2001 | 72 067 | 11 312 | 20 414 | 13 805 |
| 2002 | 66 727 | 10 830 | 18 996 | 12 665 |
| 2003 | 58 892 | 9750 | 16 821 | 11 636 |
| 2004 | 49 938 | 8586 | 14 033 | 10 277 |
| 2005 | 48 362 | 8772 | 13 333 | 10 034 |
| 2006 | 44 630 | 8172 | 12 378 | 9342 |
| 2007 | 41 723 | 7757 | 11 586 | 8920 |
| 2008 | 38 370 | 7273 | 10 634 | 8266 |

## RES PROJECT FINANCING OPTIONS IN SLOVAKIA

The Slovak Republic supports investment in the RES in three forms:

– the general state aid,

– structural Funds 2007–2013,

– national programs and funds.

Investment aid may not exceed 60% of the legitimate investment costs. The amount of aid is possible to increase for medium-sized enterprises by a further 10%, of small businesses up to 20%.

National Strategic Reference Framework is a basic strategic document in the Slovak Republic for use European Union funds in the years 2007–2013 and also provides the priorities to be co-financed. The strategic objective is to increase in 2013, competitiveness and performance of regions and the Slovak economy and employment while respecting sustainable development coditions. In addition, there is still a national strategic plan for rural development.

National Strategic Framework provides the following operational programs:

1. Operational Programme Environment (hereinafter OPE), the OPE is financed jointly by the European Regional Development Fund and the Cohesion Fund, which includes separate axes for each of the funds and separate liability for each fund.

2. Operational Programme Competitiveness and Economic Growth (hereinafter OPCEC). The OPCEC is a basic document spelled out the direction and support the development of innovation, industry, tourism and other selected services using the growth potential of regions with a focus on global fulfillment – strategic objective of the Slovak Republic for the programming period 2007–2013, which is significantly increase the competitiveness and

efficiency of the Slovak economy and employment in respect of sustainable development till 2013. The OPCEC designated funds from the ERDF amounting to 772 million EUR.

The level of prices for electricity produced from renewable energy sources and electricity from highly efficient combined heat and power is governed by Decree No. 7 / 2009 of the Office for the regulation of network industries SR.

The price of electricity produced from renewable energy sources is determined as a fixed price in euro per 1 MWh as follows:

a) of the total hydropower installed capacity of power equipment manufacturer:
– 1 MW including 109.08 €/MWh;
– from MW to 5 MW including 97.98 €/MWh;
– over 5 MW 61.72 €/MWh;
b) of solar energy with a total installed capacity of power equipment manufacturer:
– 100 kW including 430.72 €/MWh;
– over 100 kW 425.12 €/MWh;
c) wind € 80.91 / MWh;
d) geothermal € 195.84 / MWh;
e) combustion:
– specifically grown biomass 113.10 €/MWh;
– other biomass waste 125.98 €/MWh;
f) co-incineration of biomass or waste with fossil fuels € 126.14 / MWh;
g) combustion:
– landfill gas or gas from sewage treatment 96.36 €/MWh;
– biogas produced by anaerobic fermentation technology with a total capacity of the facility till 1 MW including 148.72 €/MWh;
– biogas produced by anaerobic fermentation technology equipment with a total capacity over 1 MW 131.45 €/MWh;
– thermoclinical gasification in the gasification generator 159.85 €/MWh.

## SUPPORT FORMS FOR PRODUCERS OF RENEWABLE ENERGY IN THE EU AND SLOVAKIA

In addition to various support and incentive programs within the European Union exists other supporting financial instruments by individual governments. They can be divided into four main groups:

1. **Ransom tariffs / prices** – the system has worked mainly in countries such as Germany, Denmark and Spain, which are regarded as successful examples of how the promotion of bioenergy works. Producers are usually funded by the amount of purchase prices for the energy they produce from renewables which is reducing investments and business risk. This system is applied in 18 of the 27 EU countries. Higher purchasing price increases the cost of transformation companies which is reflected in energy prices to final consumers. In Germany, this increase was in 2008 converted to 10 EUR per month for household.

2. **The quota** – the quota set out the minimum amount of the share of energy produced from renewables in total energy. These allowances are charged either by energy producers, suppliers or consumers. This is often combined with „Tradable green certificates". These certificates are created by the producers of bioenergy, which are then offered for sale. On

the demand side are all participants in the energy market from the government, consumers, through distributors and retailers of energy. All these parties have a duty to a quota that can be filled through tradable certificates. This system is applied in seven countries (Italy, Belgium, Lithuania, Poland, Romania, Sweden and the UK).

3. **The financial incentives** – such measures are especially relief from various kinds of taxes for the production of $CO_2$ or energy tax. The disadvantage of this system is that it does not provide long-term supply security equipment for potential investors and thus increases the risk of investing in renewable energy technology.

4. **Public tender** – the system has been used in England, Ireland and France. Currently, France is the only country where this type of support is used. England changed it to a system of mandatory quotas in 2002 and Ireland in 2006 for a system of preferential purchase prices, which ensures preferential tariffs for 15 years. The advantage of tenders is increasing interest in investing in technology for the production of bioenergy.

To determine the characteristics of the vegetable source of biomass for power plant is necessary to consider the parameters affecting its quality:

– 1st dry matter content;
– 2nd pH;
– 3rd temperature;
– 4th persistent organic pollutants;
– 5th content of total nitrogen and its forms;
– 6th the content of sulfur and hydrogen sulfide;
– 7th the presence of heavy metals;
– 8th physical properties of the substrate;
– 9th toxic substances.

We need to consider these types of costs in the realization process of a biogas station investment:

– depreciation of buildings and technologies;
– insurance;
– own consumption of heat and power biogas plant + maintenance;
– analyses certificates – Laboratory analysis of the input substrate, analysis of biogas;
– substrate – used as input into the biogas plant;
– staff – needed for the operation of biogas plant and its management;
– water.

For the concrete implementation of a biogas station investment should be considered mainly as follows:

– suitable soil and climatic conditions for growing biomass for energy purposes intended;
– sufficient area of land suitable for cultivation of energy plants;
– sufficient energy potential of soils;
– conservation of biodiversity of crop production;
– proprietary – proper settlement of land used for construction of a biogas plant;
– ensuring sufficient funding for necessary investments;
– choosing the right performance of biogas plant which should be based on the potential of agricultural residues and biomass in the immediate vicinity;
– unlimited ability to supply raw materials for food industry;

– ensuring a stable supply of biomass from a distance of max. 100–150 km, to keep constant prices of biomass;

– sufficient storage space for biomass;

– in a biogas station consider the homogenizing vessel and separator in order to achieve an appropriate pretreatment of the substrate before applying to the fermentation tank;

– maintain a stable biological, chemical and thermal environment in the fermenter in order to achieve maximum yield with the highest biogas containing methane;

– ensure continuous operation of biogas plant by trained personnel, the middle and senior management of the biogas station should be also ensured;

– continuously evaluate the quality of the substrate and the environment in the fermenter;

– sufficient capacity of gasholder to ensure continuous supply of biogas to cogeneration units;

– regular service of the cogeneration unit.

## BIOGAS STATION IN KAPUŠANY IN PREŠOV

In 2009, the operation of a biogas station has been marked by outages for various reasons, resulting in lower revenue for the farm in terms of revenues from the sale of electricity. Overview of the results obtained is shown in the following Table 2.

Table 2. Information of the operation of biogas plant PD Kapušany

| | |
|---|---|
| 1. Technical specification of the biogas station | |
| Price of investment (€) | 995 818 |
| Building part | 398 327 |
| Engineering-technological part | 597 491 |
| Nominal hourly output of elektricity ($kWh_e$) | 180 |
| Nominal hourly output of heat ($kWh_h$) | 223 |
| 2. Operational data | |
| Date of commencement of operation | 01-01-2009 |
| Data of data measurement | 31-10-2009 |
| Max. possible working days | 300 |
| Max. possible working hours | 7200 |
| Number of hours worked by motor | 3218.27 |
| The percentage of time worked | 44.7 |
| Average hours worked per day | 10.73 |
| Max. kWh of electricity can be worked | 1 296 000 |
| Amount of produced elektricity (kWh) | 579 288 |
| Percentage produced ($kWh_e$) | 44.7 |
| KWh of electricity produced in a moto-hour | 80.46 |
| Max. kWh of heat can be worked | 1 605 600 |
| Heat kWh total (calculation) | 754 632 |
| Percentage produced ($kWh_h$) | 44.7 |
| Heat $kWh_h$ for a moto-hour (calculation) | 104.8 |
| Heat GJ total (calculation) | 2 716 675.2 |
| Heat GJ for a moto-hour (calculation) | 377.3 |

The following table shows the degree of diversification, which is based on the real situation that we have achieved over the annual operating of biogas station and also from the consideration of alternatives.

Table 3. The share of revenues from electricity sales in the income PD Kapušany

| Year | Production [thousands SKK] | Profit from operations [thousands SKK] | Profit for the period [thousands SKK] | Sales of electricity [thousands SKK] | The share of revenues from the production of electricity [% / degree of diversification] |
|---|---|---|---|---|---|
| 2006 | 53 954 | 2 285 | 24 | – | – |
| 2007 | 51 421 | 1 608 | 494 | – | – |
| 2008 | 55 905 | 1 066 | 170 | 627 | 1.12% |
| January – September 2009/ optimal performance of power cogeneration unit at a price of € 0.12324 / $kWh_e$ | 34 264 | –13 115 | –13 448 | 4545 | 13.26% |
| January – September 2009/ cogeneration unit with performance 500 $kWh_e$ | 34 264 | –13 115 | –13 448 | 16 129 | 47.07% |

## CONCLUSIONS

Since three of the four years of the accounts held in SKK, we recalculated the data from the 2009 rate of 30.126 SKK/Eur. As the table shows, in 2008, thanks to the very unreliable operation of the cogeneration unit, the volume of revenues from the sale of electricity to the overall production of the farm was only 1% share. In 2009, in the first 10 months the proportion has increased sales of electricity to nearly 7.5% even half-power of the cogeneration unit. However, if the cogeneration unit performance would reach about 95%, the revenues obtained from sales of energy, which would be produced at a price of € 0.12324 / kWhe, will reach a level higher than 13%. The farm would be able to cover up to 47.07% of its primary production in the case of 500 kW cogeneration unit.

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