DOCTORAL (PhD) THESIS

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ECONOMIC EXAMINATION OF THE UTILITY OF THE
RENEWABLE SOURCES IN HUNGARY; WITH A SPECIAL
FOCUS ON THE EXPLOITATION OF BIOMASS AND
SOLAR ENERGY

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1   PRECEDENTS OF THE RESEARCH, SETTING UP THE OBJECTIVES

The huge environmental burden that has evolved due to the present energy utilization, requires the elaboration of alternative solutions.

Basically, this thesis would like to show the economic questions of the use of renewable sources, with the help of micro-economic means.

From the available possibilities depending on the Hungarian environmental endowments, the analysis focuses on the utilization of given elements of biomass and solar energy.

Certainly, the profitability of the company level is also affected by macro-economic facts, such as the national and European energy policy, support schemes, administrative regulations and international agreements on environmental protection. They are demonstrated only to an extent that is enough to clarify the referring elements of the main topic. As biomass is an agricultural product, there is a short section in the thesis which deals with the agricultural industry and studies, the changes in the agricultural productive sector that give the background of the utilization of biomass.

The micro-economic approach appears in the thesis both as a theoretical and a practical application. The theoretical bases are presented by a review of the models of the environmental economics, while the practical application is presented by a valuation of concrete projects.

The valuation of the efficiency of the renewable sources is given by a model of the efficiency of investments made with the application of computer technology, in which the different scenarios are emphasized as well. The technologies in this model appear as external features, as neither the candidate's professional experiences nor the conditions of the research

could make it possible to analyze them. Further more, despite the fact that the economic indicators of the demonstrated projects can be taken as a function of the applied technology, the thesis will not give technical explanations.

During the preceding research, the problem was raised how to harmonize the economy study of the different renewable power generation methods and how to compare the results. It affects both the financial methods and the features of the examined investments (size, time of the investment, household and industrial application). As a consequence, the individual analyses of the efficiency of investments, following the review of the technical literature, should be taken separately, restricted to the given project. The comparision can be realized by comparing the specific costs calculated according to the revealed model projects, the dynamic payback periods and the specific environmental values – which can be identified for example by the size of the saved emissions. A further comparision with Dániel Pálosi's research results of wind and water power can provide a further extension, since the methodology used by the two authors has been harmonized – as a result of the co-operative research work during the last few years.

Evaluating the projects, the emphasized aim was that in the background of the data there should be real applied technology and real market. Thus the results can prompt the investors who doubt the efficiency success of the „green power" generation, to make future oriented investments similar to those that are demonstrated here, following a thorough situation analysis. With all these, similarly to the alternative possibilities, they can contribute to the success and protection of the environmental values of a given region or country, while they keep the profit interests in view. Further more, in the case of the concrete projects the calculations can point out the necessary

degree of the public subsidy and the directions of the changes of the present subsidy level.

2   MATERIAL AND METHODS

Due to the novelty of the topic in Hungary there are no comprehensive economy studies among the Hungarian technical literatures about the use of the renewable sources. The majority of the technical literatures on the renewable sources mainly deal with the technological side of the topic. Taking foreign studies and analyses for a basis should be well considered, as the geographical features here are completely different, thus the use of the renewable sources will give a different economic result than abroad. A reliable examination can only be made by considering local features. According to these, in chapter "Results" economy studies of some home projects, realized during the research, will be presented.

The primary data were collected on lectures, conferences, workshops and interviews that dealt with this topic.

For making the economy study it is necessary to map the given technology. It was mainly realized with the help of the engineers of the institutions. During the classification of the collected data, the relevant ones for the making of the model should be chosen with a special care. Transforming them into economic data is realized by formation of the corresponding categories of expenses and returns.

Calculation of Cash Flow	*Tax Calculation*
Árbevétel (nominális)	**Returns (nominal)**
- Operating expenses	- Operating expenses
- Other expenses	- Other expenses
- Interest costs	- Interest costs
- Principal repayment	- Amortization
- Corporate tax	**Tex base**
FREE CASH FLOW	**Tax (16%)**

As the calculations are given by using nominal interest rates, all of the elements of the free cash flow must be adjusted by the inflation. For this I use the data used for inflationary indicating the future cash flow published by the Ministry of Finance. In order to make more accurate calculations, however, it is desirable to affix separate price indices to the different elements of returns and expenses. I will do so in the case of procurement price of rape seeds and the take-over price of energy (fuel) that gives the returns of the projects.

Each of the calculated monetary data will be given in Euro, making it more possible to give international comparisions. The EUR/HUF exchange rate is the average of the midrates in 2006 by the Hungarian National Bank, which is 264,27.

The calculations of the efficiency of investments are made in this thesis with the method called "Shareholder Value" in the scientific literature. This way the valuation of the project is given with consideration of the tax and from the owners' point of view.

The basis of the calculations is the decision rule of Net Present Value (NPV). It means the summation of the initial expenditures (-Io) and the present value of future cash flows. If the result is positive, the investment is worth realizing, since the sum of the present values calculated with considering the discount rate exceeds the expenses of the realization.

The discount rates used for the calculations are included in table 1.

1. Table: Financial ratios used for the calculations

(r_f és r_f': *http://www.mnb.hu/engine.aspx?page=mnbhu_statisztikak,*
r_m: *www..bet.hu → adatletöltés,*
*http://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=165.YC.B.U2.EUR.4F.G_N_A.SV_C_YM.SR_20Y,
**http://de.finance.yahoo.com/q/hp?s=%5EGDAXI)

year	2007	2008	2009	2010	2011	from 2012
r_f	7,4%	7,5%	7,6%	7,2%	7,3%	4,4%*
r_f'	7,4%	6,9%	6,5%	6,3%	6,1%	-
r_m	7,7%	18,3%	17,5%	16,9%	16,2%	12,2%**
discount rates	9,1%	26,0%	25,0%	23,6%	22,6%	13,5%

In the case of the German project I calculated with a 13,5% discount rate in every year of the planning period.

The profitability of the projects will be compared by the dynamic payback period.

In order to display them graphically in the thesis I worked out a diagram of the net present value plotted against time.

3 RESULTS

3.1 Valuation of bioenergetic projects

Beside generation of electricity by solar cells, two special cases of energetic utilization of the biomass will be presented in the thesis. One of them is the industrial production of biodiesel from rape, and the other one is the economy study of the incineration of the different solid biomass in thermal power plants.

The possibilities of utilization of the biomass in these two cases are much wider, of course, but the volume of the thesis and the research does not make it possible to show more methods of utilization.

Through the primary production, the backgrounds of the utilization of the biomass in the thesis are given by the agriculture and the forestry. Hence, it is unavoidable to place the micro-economic (operating level) examinations into a wider correlation system. That is, the questions referring to the total verticum of the utilization of the biomass should be answered. For instance, they can relate to the home and European support and tax policy relevant in the topic, the territory needs of the plants planted for energetic reasons, thus the factors that influence the security of the food-supply, the profitability of their production, the race condition formed by them, its effect on price, etc.

The financial calculations will be summarized by the presentation of the yearly calculated net present value of the investment plotted against years. In every case of production methods of electricity and fuel, beside the most presumable scenario according to the actual market situation (green curve) the profitability evolving from the ceteris paribus 20% decrease in the take-
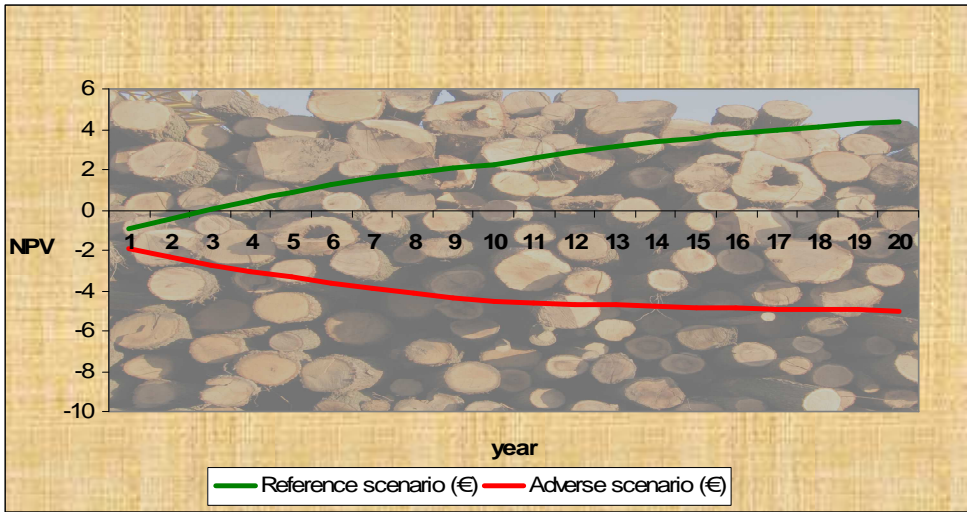
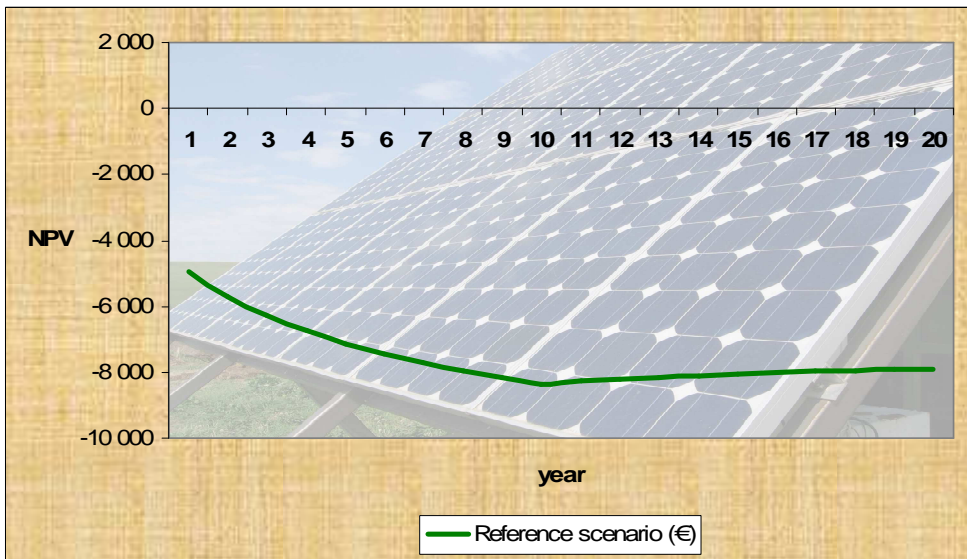over price of the product – with the exception of the solar cell project – will also be presented (red curve).
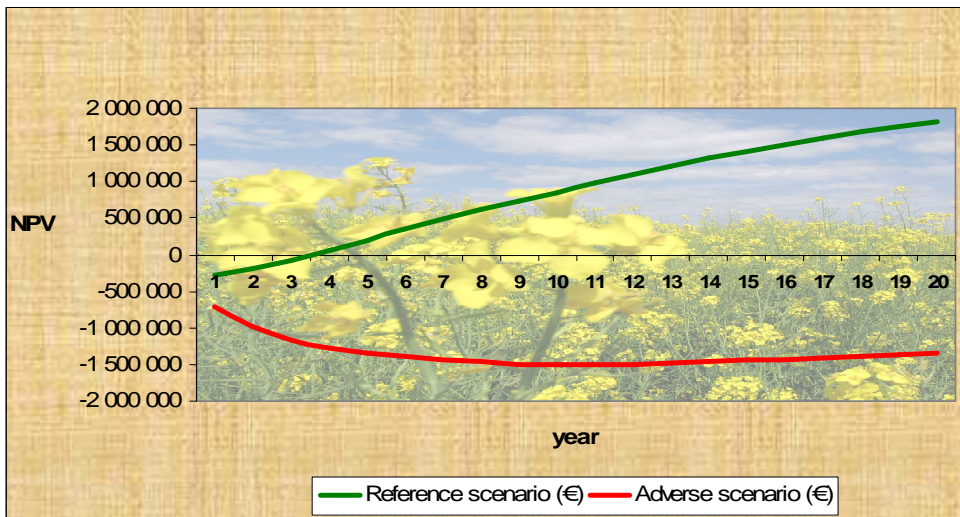
1. Figure: Return of the biodiesel project
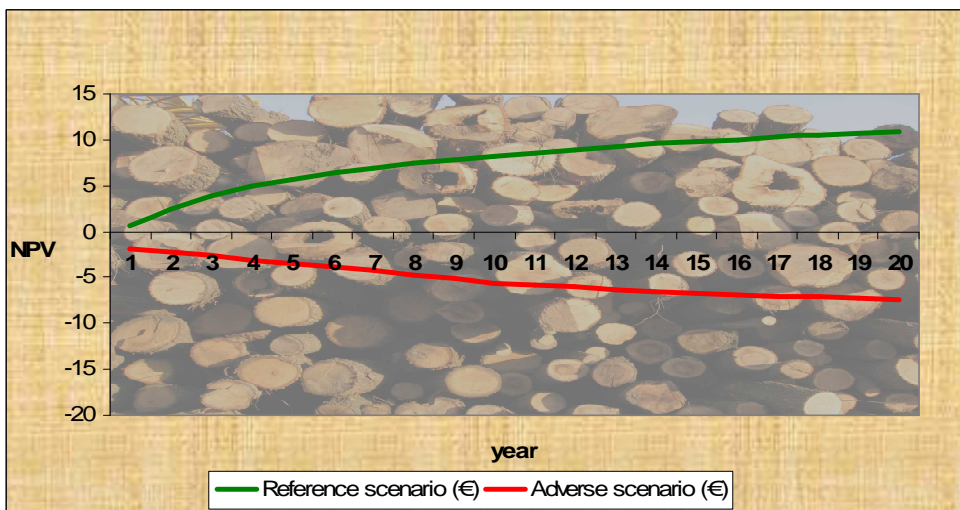
2. Figure: Return of the conversion of the Northern Transdanubian Thermal Power Station

3. Figure: Return of the Neustrelitz Thermal Power Station building

4. Figure: Return of the solar cell project

Each utilization method of biomass demonstrated in the thesis results in a return in 20 years (see diagrams 1-3). The production of biodiesel is highly reactive to the take-over price of the produced fuel, in case of a small decrease of which the project is not profitable. The situation is similar in the

case of biomass burning thermal power stations, where a 20% decrease in the take-over prices of electricity also largely worsens the profitability of the projects.

The generation of electricity by solar cells is not profitable. Only the development of technology could bring a breakthrough, which would make it possible to drastically reduce the expenses of the production of the device and to significantly increase the efficiency.

4   CONCLUSIONS

Increasing the number of the investment projects introduced in chapter "Results", the results referring to profitability would become more reliable.

The reliability of results can be enhanced not only by increasing the number of the projects but also by widening the modelled methods of power generation. The economic study of biogas production, pellet production from the plants of energy plantations, bioethanol production, hot water production with solar cells and the utilization of geometry could not be included within the frameworks of the thesis. The analysis of them could make it possible to propose an optimal solution for the division of the different possibilities of the home power generation after comparing them. Besides, it would also be possible to elaborate public subsidy constructions for the best of them by their mapped profitability.

Considering the circumscription of the topic, the thesis is a result of compromises, too, as, for example, the economical analysis of biodiesel production has been worked out by taking only the producing factory into consideration. If the analysis had taken the total verticum into consideration – from the agriculture to the macro-economic and social effects, more over, from a technical side, to the entire life cycle of the plants – important conclusions could be drawn about the rural development and the economic policy.

The thesis only touches upon the estimation of the home biomass potential, although it would be very important from the aspect of the utilization of the biomass. From what was mentioned above, it can be concluded that the topic raises not only economic issues, hence, the collaboration of agricultural engineers, mechanics and information specialists would be needed.

5   NEW SCIENTIFIC RESULTS

1. I concluded that the use of biomass as liquid fuel when utilizing rape, in contrast with the production of other industrial plants – plotted against the yield of the price of fossil energy and plant cultivation – appears both in time and space as a changing intensity, strengthening competitor. Because of the upgrading profitability prospects due to market rates and the subsidies, the manufacturers in the near future will prefer to grow traditional field plants with energetic aims. It can cause a temporary shortage of cereals and oil crops on the market in poor-crop years and food prices will also react with raising.

2. The raw material need of Hungarian biomass burning power plants is expedient to cover by traditional by-products of agriculture and forestry. However, because of their limited capacity – expediently, in the areas with worse productivity than the average – energy plant plantations should be set up and it is reasonable to utilize agricultural by-products with an energetic aim.

3. All of the methods of biomass utilization demonstrated in the thesis result in a return in 20 years. However, the biodiesel production and the profitability of a new biomass thermal power plant building is very dependent on the take-over price of the end product, and the projects – if only as a consequence of a small (5-10%) decline of the calculated prices – will become unprofitable. It worsens the profitability of the project only to a small extent in the case of the

transformation of a traditional thermal power plant into a biomass burning one. Hence, in the case of transformations of thermal power plants, it would be expedient to differentiate the obligatory take-over price of the electricity, since the incidental over-support of these projects could be avoided this way.

4. The demonstrated island-like solar-cell generation of electricity is unprofitable, and it could be improved only by a significant development of technology. In order that the presented project meets the levels of the alternative possibilities, the take-over price should reach € 75 cent value (approximately HUF 200 / kWh).

6   PROPOSALS

The global destruction of the biosphere of the Earth should be avoided, it is essential to turn the power generation and consumption, which is one of the sectors that is the most responsible for global environmental pollution, into a sustainable system. Considering power generation, it means the re-discovery of renewable sources.

The aims of the growth of the home renewable resource rate can be realized, however, more significant efforts must be made to reach this aim. Keeping the present public subsidies and in some cases increasing the non-refundable investment subsidies appear as financial sacrifices. The environmental education of new generations and suppressing the present prodigal behavior of the consumers should appear for sure as an indirect financial sacrifice.

It is important, however, to note that the need for subsidies of the projects for the exploitation of renewable sources is gradually decreasing with the relative increase of the price of the fossil energy sources. In the background of the present need for subsidies we can find that the use of renewable sources is more expensive – with the similar energy output - according to market rates. Thus in order to balance the overruns, the market profitability of the projects can only be reached by applying subsidies. Technological development can be another possibility of reduction the need for subsidies, as then the expenses of applying renewable sources would be lower.

It can be considered the most important achievement and economic applicability of the thesis that it can give a direction to the investors in a real planning process according to the mapped methods of power generation Furthermore the energy from renewable sources can be increased and, at the

same time, the environmental burden can be reduced, while the growth of the investments is highly beneficial for macro-economics.

7   PUBLICATIONS OF THE TOPIC OF THE THESIS

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Varga Zoltán - Pálosi Dániel (2007): Allokationsstörung durch Externalitäten. Acta Scientiarum Socialium, (24) under issue

Varga Zoltán - Pálosi Dániel (2007): Didaktische Prinzipien der Umweltbildung in Ungarn. Acta Scientiarum Socialium, (24) under issue

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Varga Zoltán - Pálosi Dániel (2007): „Zöldenergia" Magyarországon. A mikroökonómiai elmélettől a konkrét projektekig, I. Terület- és vidékfejlesztési konferencia, Kaposvár.

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