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Kaposvár University, Faculty of Economic Science, Kaposvár

ECONOMIC CALCULATION OF ALTERNATE ENERGY RESOURCES IN HOUSEHOLDS

Róbert BARNA[1], Vid HONFI[1], Marcell MOLNÁR[2]
[1]Kaposvár University, Faculty of Economic Science, H-7400 Kaposvár, Guba Sándor u. 40.
[2]Kaposvár University, Faculty of Animal Science, H-7400 Kaposvár, Guba Sándor u. 40.

ABSTRACT

In these days the importance of alternate energy resources is growing. There are more and more technologies available of size and at price suitable for households. In our paper the possibilities of solar energy, wind power, geothermal energy and biogas energy use are shown. In the study the instruments are chosen from the market and the installation costs and the produced power are calculated. On the basis of these, various economic calculations are made regarding the returns of the investment, for example: net present value, rate of return, payback period. The result shows that biogas is the one economic investment of them in this economic environment.
Keywords: Alternate Energy Resources, Households, Economical Calculation

INTRODUCTION

Nowadays the importance of alternate energy resources is growing. There are more and more technologies available of size and at price suitable for households. The use of fossil fuels should be reduced because of global warming. Large amounts of money are spent on research concerning the use of alternative energy. There are many new environment friendly technologies available for household use. In this article the economic calculation of different alternative energy resources was analyzed, which can be used in the households is studied.

MATERIALS AND METHODS

Such alternative energy generating equipment was chosen that may be implemented at 'household size'. The investment costs and possible savings were calculated on the basis of online available data or estimations. The investment "is realized" in a family house of 100 m^2, where 'originally' the hot water for central heating is supplied by gas furnace and the gas boilers provide hot water storage. A five-member family live in the house.

Simplifications were used, since we aim to compare various alternative energy sources and not to specify the economic indicators of a certain project. The yields were calculated at today's prices, the amount of annual energy savings was taken into consideration, and the projection's duration was 20 years. We calculated with the central bank rate in the investment. The calculations did not consider any proposals to be awarded.

Electricity fee: 41.24 HUF/kWh, the electricity charges for the night: 24.76 HUF/kWh, natural gas price of 3.19 HUF/MJ, or 109.13 HUF/m^3.

Net present value, payback period and internal rate of return calculations (*Chikán*, 2008) were performed with the data using Excel spreadsheet.

RESULTS AND DISCUSSION

First of all the parameters of different 'green' technologies were defined, these parameters are fitting to the house size.

Solar Collector
The solar collector is used for hot water production by fully utilizing the existing system. The investment is 3×2 m^2 surface of solar collector and an additional 250 liters of hot water tanks and pipe work, the installation price is 637 000 HUF, the annual savings are 41 382 HUF.

Solar Panel
The solar panels can produce electricity, which is stored in batteries. A piece of 1.6m^2 surface 220 Watt monocrystalline solar panel can save 440 kWh of electricity in case of 2000 hours sunshine per year. The investment will be 300 000 HUF, which represents 18 145 HUF annual savings.

Windmill
A windmill is chosen (voltage: 12 V, power: 400 W, average intensity current: 8.33 Amper) for current production which can be installed homemade. This is able to provide electricity for 13.5 hours per day, so we can save 492.6 kWh of energy in a year. The investment will be 250 000 HUF, which represents 20 312 HUF annual savings.

Biogas Reactor
There is currently no equipment available for domestic biogas production in the Hungarian market. A young Hungarian inventor's invention won first prize in the '2006 Future of young entrepreneurs' competition. The inventor did not disclose details of the device information, what these data are used.

The biogas production and power generation equipment costs 1.2 to 1.5 million HUF. This is able to produce – given 40 kg of organic material plus 100 liters of water per day – approximately 30 m^3 of biogas, which can be used for heating directly. The gas can be converted into electricity by a generator connected to the gas engine, while the cooling water is used for heating. In the calculations, natural gas used for heating is replaced, thus the technique saves annually 346 080 HUF. The 100 liters of water is ensured by the water use of the family (sewage), and even some organic waste also contributes to the operation. The saving from the used organic materials (corn silage) – calculated at a price of 10 HUF/kg – is 146 000 HUF.

Ground Source Heat Pump
The installation of heat pumps in existing buildings is quite expensive. In this example a ground source heat pump system is used to replace the gas heating system, at the same time by keeping the radiators. The estimated investment costs 3 million HUF. The cost of annual heat pumps for heating is 270 254 HUF, which replaces the gas cost of 346 080 HUF, so the annual saving is 75 826 HUF.

Economical Calculations
We can see the results of the calculations in *Table 1*. The three indicators gave similar results. The investment was economical only in one case, in which the net present value

is positive, the internal rate is higher than central bank rate, and the payback period is the shortest.

According to the net present value and internal rate the biogas is the only economically viable investment with parameters taken into account for counting. Unfortunately, this system cannot currently be available. It is also possible that when the product gets onto market other costs will be incurred.

Table 1

The results of the economic calculations

	Net Present Value (HUF)	Time of Return (year)	Internal Rate of Return
Solar Collector	-248 700	9.35	6.5%
Solar Panel	-127 945	9.80	6.1%
Windmill	-64 843	8.01	7.7%
Biogas Reactor	240 348	5.52	10.4%
Heat Pump	-2 129 491	16.41	1.6%

The windmill and the solar investment mean loss at today's prices, but the two combined cost of 550 000 HUF is more affordable to a household and does not involve a significant reconstruction of the building. Further on, a small increase in energy prices can also economize on the investment.

The price of solar collectors and a major construction of the building is not reasonable to use only for hot water production, however, it is likely that the installation of it for the existing floor heating is worth it.

The heat pump system installation causing the greatest reconstruction is the most expensive and the savings achieved at current prices are not enough. The indicators are better in case of floor- and wall heating systems requiring lower temperature water. The support system should encourage the installation of the new buildings.

CONCLUSIONS, RECOMMENDATIONS

It is welcome that environmentally friendly technology solutions are already available, which are affordable to households. Unfortunately, they themselves are not economical. Further applications to encourage the preferential credits for alternative energy are necessary to increase the number of households using alternative energy sources. Although in case of a single household the saving is not great, but 'many a little makes a mickle'.

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ONLINE SOURCES

(Between 2008 August and September)

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http://www.napra-kesz.hu/sajat_epites.html

Solar Panel
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Biogas Reactor
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Heat Pump
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Corresponding author:

Róbert BARNA
Kaposvár University
Faculty of Economic Science
Department of Information Technology
H-7401 Kaposvár P.O.Box 16.
Tel.: +36-82-505-954, Fax: 36-82-320-175
e-mail: barna.robert@ke.hu