Effectiveness of investment to renewable energy sources in Slovakia

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In present time renewable energy sources and their effectiveness is subject of number of discussion in domestic, as well as foreign studies and expert publications. Using of energy from RES has its big perspective to the future, but energy from RES is still rather financially demanded, comparing with conventional energy sources. We searched effectiveness of investment to the chosen RES through evaluation of net present value and payback period, where we resulted from data about project with chosen RES, such as costs, revenue, cash flow. We came to conclusion that RES has its possible using possibility due to the acceptable effectiveness, regarding living environment.

Key words: *renewable energy sources, investment effectiveness, net present value, payback period*

Introduction

Renewable energy sources (RES) are considered as sources of future. But yet in present time RES achieve more and more importance. Such sources bring real alternative of conventional sources, which stocks are limited and gradually spending. RES have minimal influence to the climax and there is possibility to decrease number of emissions of damaging elements. In spite of number of conveniences, RES development is still rather slow and limited. There are existing presuppositions that RES installing and their development is exceedingly not effective and costly, since we have available rather cheaper conventional sources. But problem of RES development is economical system, acting according principle „cheaper production, faster achievement of high profit." RES development, their financial and environmental return last for some period, it means results cannot be expected immediately. Therefore it is necessary to invest to RES with aim to achieve broader space and time for Technologies and innovation improving. Consequently it will lead to higher effectiveness of energy transmitting as well as shorter payback period.

Present state of business with RES in EU and Slovakia

European Union as a whole is dependent on import of primary energy sources – around 50 %. Accepted liabilities in area o fair protection present other influence to the energetic strategy of EU; therefore this strategy is concentrating mainly in area of energy to the RES using and energetic effectiveness, with not negligible potential in the individual member states. More years' program of activities in area of energetic had become main tools for achievement of indicative goal for energy production from RES (Intelligent energy – Europe, etc.). Member state in EU had agreed in 2009 on increasing of energy production from RES. Its goal till 2020 is to achieve 20 % rate of RES. In 2011 its rate was estimated at the level 13,4 % that presented growth about 0,9 %. Europe is investing considerably in **renewable energies** for a sustainable future, with both Iberian countries (Portugal and Spain) promoting significantly new hydropower, wind, and solar plants. (Jerez, et.al, 2013)

In Slovakia, electrical energy is provided mainly by nuclear and heat power stations, with the remainder being produced in hydroelectric power stations. In this sector renewable energy sources (RES) still represent a minimal share in Slovakia. Nonetheless, the years 2009 and 2010 specifically represented a turning point in legislation promoting RES, with the introduction of both a guaranteed repurchase period for buying electricity produced using the various RES and a 'fixed' price. This resulted in greater investor interest in the building of energy sources for the production of heat and electricity including those derived from biomass.

As for other countries, co-assessment of the natural and renewable energy resources in US is a must for renewable energy industry growth without dramatic environmental detrimental effects. (Subhadra, 2013) Fostering development of a renewable energy industry is critical to ensuring energy security and sustained economic development. The United States recently lost its status as global leader in new financial investment in renewable energy, while investment in renewable energy has increased in the developing world. (Chacon, 2013).

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And for example Taiwan is highly vulnerable in **energy** security, but geographic conditions for the development of solar **energy** applications have created a considerable advantage. However, the total installed solar **energy** capacity is far less than might be expected. (Liu, et.al, 2013).

Material and methods

Decisions whether to invest to RES are made according number of economic indicators. These indicators evaluate the yield (return) of the resources invested. Several methods are used in the theory and practice of investment evaluation with aim to increase efficiency of investment projects. For evaluation of investment to RES we have chosen payback period (time required for a return on investment and net present value (NPV).

Payback period – the time required for a return on investment (T_p). The simple payback period is defined as the time required recovering the total cost of investment in a project through future revenue. This means the period of time it takes for the investor to earn back the resources invested in the project. Determining the period of recovery is not complicated and is based on project cash flow, consisting of income and expenditure made over the life of the project (Fotr, Souček, 2007).

$$T_p = IC/ CF$$

where IC = invested cost ,
CF = annual cash flow from project.

The determined payback period of the project is then compared with the normalised value chosen by the company (generally according to past experiences and other investment opportunities). This period differs according to the sector in which the company operates. If the payback period is lower than the normalized value, then the project should be approved. The shorter the period of return, the more advantageous the project is.

The main advantage of this method is that it is simple and easy to understand the calculations; however, the shortcomings of this indicator include the following primarily:

- it ignores project income received once the period of recovery is over,
- it emphasizes very rapid financial returns of the project
- it does not consider time, i.e. the different time values of money obtained or invested at different times.

This shortcoming can be avoided if a true payback period is used, as given below.

Net present value (NPV) – net present value is the sum of discounted cash flow during the lifetime of the investment, i.e. throughout the period of construction and operation. Cash flow is expressed as the difference between income and expenditure in the individual years of the project life cycle. (Jílek, 2009)

NPV generally lead to the same results when selecting the type of investment. The basic problem in using them in practice does not concern calculation techniques, but the validity of the input data, primarily the data on expected cash flow from the investment.

Evaluating investment projects with the help of expected income and expenditure assessments is popular primarily because it takes the time factor into consideration in calculations. It also takes into consideration the period following which financial expenditure on investment during construction becomes deadweight and the period when revenue is made. Thus, it provides a much more precise total overview of the efficiency of individual projects. (Pirč, Grinčová 2008)

$$NPV = \sum_{t=1}^{n} CF.\frac{1}{(1+r)^t} - IC$$

where CF_t – cash flow from project in year t (changes to cash flow following project implementation),
r – discount rate (hurdle rate, alternative cost of capital, real interest rate),
t – evaluated period (1-n years),
n – life cycle of the project,
IC – investment costs.

Net present value is used relatively frequently in real life, mainly since:

- it takes the life of the investment (project) into consideration,
- it accounts for the time value of money (discounting process).

Given these advantages, this method represents important criteria for undertaking decisions on whether to approve or reject a project. The business should implement all projects that have a positive net present value and reject those with a negative net present value. The higher the NPV, the more economically advantageous the project is. One advantage of NPV is its additive value. This means that net present values of projects can be added together and thus the total revenue gained through realizing different investment projects can be quantified. One of the disadvantages of these criteria relates to the difficulties involved in determining the discount rate and that NPV as an absolute index does not express an exact measure of project profitability. For these reasons, the internal rate of revenue method is sometimes preferred. (Smejkal et al. 2003)

Input data of project of BFS and PVP

Following tables 1-4 include capacity, cost, revenue and incomes of the projects, separately for both investment projects during period 11 year.

Tab. 1. Capacity of project BFS and PVP.

Project performance	BFS	PVP
Middle value of electric capacity [kWhe]	330	100
Number of hours per year	8 000	8 000
Electric energy [kWhe.year^{-1}]	2 640 000	105 000
Heat energy [kWht.year^{-1}]	1 040 000	-

Projects consider BFS with installed capacity 300kW, while due to the legislative policy of Slovakia in area of RES support there is not allowed PVP with installed capacity higher then 100 kWp, therefore there would be considered only given installed capacity of PVP. In spite of similar number of operation hours we can see BFS with installed capacity 300 kW produces 25-times higher volume of electric energy per year, comparing with 100 kWp in PVP. BFS can be used also for production of heat energy; in PVP case it is not possible.

Tab. 2. Cost for BFS and PVP projects.

Costs [EUR]	%	BFS	PVP
Input substrate	2	1 128 648	-
Electric energy consumption	2,5	41 171	-
Project start		5 000	2 300
Repairing, service, maintenance	2	86 337	8 299
Service of cogeneration unit	2	481 881	-
Personal costs	4	157 521	-
Manipulation with biomass	4	48 593	-
Depreciation		1 030 084	-
Interest	0	0	0
Insurance		78 045	16 597
Advisory activity	2,5	77 760	9 959
Overhead, additives, etc.	2,5	10 767	-
TOGETHER		3 145 806	37 155

As for the cost we can state cost during planned period 11 years are considerable lower for PVP, since there is not rising expense, connected with securing of input raw material, or personal costs (for example wages of employees – service of PVP is provided by external company). In PVP there is an also removed expense, connected with consumption of electric energy, since PVP is able to produce energy by itself. Both projects consider also financing form own sources, there is no expense by the way of interest in any project.

Tab. 1. Revenues from BFS and PVP projects.

[EUR/yea]r	BFS	PVP
Revenue from electricity sale	392 621	12 507
Revenues from heat sale	24 024	-
Revenues from digestive sale	68 068	-
TOGETHER	484 713	12 507

Meanwhile BFS can calculate also annual revenues from sale of electricity, heat and digestive, PVP provides only possibility to sale electric energy. Project BFS should produce total annual revenues higher then revenues from PVP – mainly about 472 206 EUR .

Tab. 4. Incomes from BFS and PVP projects.

Incomes [EUR]	%	BFS	PVP
Sales from electricity sales	2,5	4 901 269	273 850
Sale (saving during 11 years)	2	828 300	-
Using of heat energy	2,5	299 903	-
TOGETHER		6 029 471	273 850

Assumed incomes of BFS during 11 years are considerable higher then planned incomes from PVP and they present their sales from electric energy sale, savings from sale during 11 years and using of heat energy. As for BFS incomes present 6 029 471 EUR and for PVP only 273 850 EUR.

Results of evaluation of investment to RES

Evaluation of economical effectiveness is inseparable part of any investment project. Investor is interesting about way how investment would be evaluated, and at the same time how long it would take to receive invested money again. We will compare investment effectiveness to the biofuel station (BFS) and photovoltaic power plant (PVP). It is calculated according economical results and cash flow from the investment projects. Table 5 and 6 show comparing of economical results and cash flow from BFS and PVP projects.

Tab. 5. Economical results of BFS and PVP projects.

Economical result	BFS	PVP
Costs together	3 145 806	37 155
Incomes together	6 029 471	273 850
Profit	2 883 665	236 695
Income tax (19%)	547 896	87 796
Profit after taxes	2 335 769	148 899

Values of economical result and cash flow in the individual projects are mentioned in following tables as positive values for both investments, BFS project has more positive assumed economical result, comparing with PVP.

Tab. 6. Cash flow of BFS and PVP projects

Item [EUR]	BFS	PVP
Depreciation	1 030 084	-
Profit (loss)	2 883 000	383 389
Income tax (19%)	547 896	87 796
Cash flow	3 365 853	295 593

Following table 7 and 8 illustrates results from investment effectiveness analysis. As for the static method we will compare payback period of invested money to BFS and PVP project and net present value (NPV) of the individual projects.

Tab. 7. Payback period comparing.

Payback period of invested money	
BFS	PVP
7 years and 214 days	5 year and 73 days

Financial means, invested to the PVP project are returning to investor two years sooner then invested to BFS project.

Tab. 8. Comparing of NPV.

NPV [EUR]	
BFS	PVP
745 514,4271	226 646,5652

NPV value for both projects is positive, which means investor is able to create cash flow in necessary level for covering of its invested expenses. Investment to both projects is acceptable.

Higher mentioned evaluation of investment effectiveness to BFS and PVP projects proves that it would be more profitable for investor to invest money to BFS project due to the following: in BFS there is possible to use electric energy, as well as heat energy, but in PVP it is not possible. The only one advantage of PVP project presents its lower invested costs. But BFS project has also other advantages, for example incomes from electric and heat energy sale, incomes from digestive sale, higher revenues and profit. Neither lower payback period of PVP project is decisive for investment. From the view of NPV investment to BFS is expressly more convenient.

Conclusion

Analysis of investment activity of chosen subjects had been goal of the contribution, as well as evaluation of investment effectiveness in area of RES in Slovakia.

According data and their analysis we can state that due to the natural conditions and legislative support mainly biomass and solar energy have its perspective future development.

Higher mentioned evaluation of investment effectiveness to concrete projects – BFS and PVP proves that it is more convenient to invest to BFS, mainly due to the possibility to use electric energy, as well as heat energy and it brings higher NPV.

Suggestion to increase business with RES proves necessity to make gradual accepting of measurements, supporting business with RES in Slovakia and to remove barriers in this area, political, economical, administrative or legislative ones.

References

Fotr J., Souček I.: Podnikatelský záměr a investiční rozhodování. *Grada Publishing, Praha, 2007, ISBN 80-247-0939-2.*

Horbaj, P., Tauš, P.: Súčasný stav energetiky v Slovenskej republike. *In Energetika. ISSN 0375-8842, 2008, vol. 58, no. 4, s. 123-126.*

Chacon L.B.: Long term contracting the way to renewable energy investment. *Lessons from Brazil applied to the US. Emory Law Journal. 2013, Vol. 62 Issue 6, p1563-1612. 50p. ISSN: 0094-4076*

Janíček, F. a kol.: Obnoviteľné zdroje energie: Technológie pre udržateľnú budúcnosť. *Pezinok: Renesans, 2007. 176 s. ISBN 978-80-969777-0-3.*

Jerez S., Trigo M., Vicente S.M., Pozo V.D., Lorente P.R., Lorenzo L.J, Santos A.F, Montávez J.P.: The Impact of the North Atlantic Oscillation on Renewable Energy Resources in Southwestern Europe. Journal of Applied Meteorology & Climatology. *Oct.2013, Vol. 52 Issue 10, p2204-2225. 22p. ISSN: 1558-8424*

Jílek, J.: *Finanční trhy a investování. 1. vyd. Praha: Grada, 2009. 648 s. ISBN 978-80-247-1653-4*.

Kudelas, D., Rybár, R., Cehlár, M.: Energia vetra: prírodné, technické a ekonomické podmienky jej využitia. *Košice: Edičné stredisko Fakulty BERG, TU v Košiciach, 2009. 216 s. ISBN 978-80-553-0169-3*.

Liu, S.Y., Perng, Y.H., Ho Y.F.: The effect of renewable energy application on Taiwan buildings: What are the challenges and strategies for solar energy exploitation? *Renewable & Sustainable Energy Reviews. Dec2013, Vol. 28, p92-106. ISSN: 1364-0321*

Pirč, V., Grinčová A.: Finančná matematika, *Katedra matematiky FEI TU v Košiciach, 2008, ISBN 978-80-8073-986-7.*

Smejkal, V., Rais K.: Řízení rizik, *Grada Publishing, spol. s r.o., Praha 2003, ISBN 80-247-0198-7*.

Subhadra B.: Natural Resources, Renewable energy sources, GHG – emission and Demographic profiles in US: A broad analysis for developing sustainable low carbon energy sector. *Energy Science & Technology. 5/31/2013, Vol. 5 Issue 2, p36-49. 14p*.

Volner, Š.: Zdroje energií pre EÚ a SR v 21. storočí. *1. vydanie. Bratislava: Iris, 2010. 174 s. ISBN 978-80-89256-56-3.*