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CHOSEN ASPECTS OF FINANCIAL EFFECTIVENESS OF INVESTMENT IN BIOFUELS FROM OILSEED RAPE IN POLAND

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Abstract: Poland as an integrated EU member is obliged to standardize Polish law to EU regulations. Such obligation creates favorable conditions for the development of renewable energy sources. Therefore Poland has to implement international obligations in order to protect the air and to reduce the emission of carbon dioxide. The article focuses on the production of biofuels from oil plants (oilseed rape). The preparation of the production is associated with the calculation of the profitability of investment. Such calculation would be the main premise whether the project is financially efficient or not. The main thesis of the article focuses on such aspects of profitability calculations, which would be helpful for investors to make a right economic choice.

Keywords: biofuels, investment, NPV method

1. INTRODUCTION

Private and public investors set different goals towards investment projects. The criteria they are driven by while taking investment decisions are different [1]. The biofuels sector is a specific one since there appear investment objectives of the national economy and the objectives of entrepreneurs orientated towards the profit. The subject of the private sector included in the research is, most of all, directed to generating financial surplus from the business activity it runs. However, investment projects in the field of biofuels are not only the profit for entrepreneurs – investors [2]. These are also social aspects, orientated towards increasing the number of jobs in Poland, ecological aspects connected with reduction of CO₂ emission and, which is really important, reduction of Poland's energy dependence on countries exporting petroleum. In the paper an attempt has been made to examine the effectiveness of the economic investment made by a small private entrepreneur. While possessing basic data referring to biofuels production there has been conducted the analysis on the economic effectiveness of investment projects connected with their manufacturing. At the early stage of the analysis the expenditures essential for starting the investment have been estimated, the cost of biofuels production have been assessed and also revenue from the sale and the assessment of the economic effectiveness of the project has been carried out, depending on the source of origin of rapeseed, with the use of discount methods. The analysis of the economic effectiveness is related to the decisions concerning single projects. Its essence consists in examining the project with respect to investment profitability and showing whether it could be an interesting and effective form of capital investment for new investors wishing to start investments connected with biofuels [3].

2. THE ANALYSIS OF THE ECONOMIC EFFECTIVENESS. CASE STUDY

The entity being the subject of the analysis has been running its business activity in the sector of biofuels in Poland for a few years now. It has been examined with respect to the economic effectiveness of the investment connected with using national oilseeds, and more precisely, using the rapeseed for biofuels production. The analyzed enterprise is a small one, classified for the purposes of the paper according to the determinant which is an annual amount of rapeseed processed for biofuels [4]. The enterprise processes rapeseed in the amount of 900 ton per year. One of the assumptions adopted in the paper is the possibility of producing biofuels from the in-house raw material which the rapeseed is or from the purchased one [5]. The enterprise X is an agricultural producer [6], which means that it runs an agricultural holding where plants for the purpose of agricultural raw materials are grown. The rape is such a plant for biofuels production. This entrepreneur does not purchase the rapeseed since they produce it themselves in a sufficient quantity, though, for the purposes of the market there has been conducted preliminary calculation of purchase costs of the rapeseed for energy needs. On the basis of the information obtained from Wielkopolska Izba Rolnicza (Chamber of Agriculture of Wielkopolska) the costs of cultivation of 1 hectare of rapeseed was assessed on 13.02.2013 and it amounted to 5198 PLN. The conducted research indicates that 4 kg of seed is required for 1 hectare of land. The conducted calculation of the costs of rapeseed cultivation shows that the expenses borne by the agricultural producer for rapeseed production are reimbursed with the crop slightly above 3 ton from one hectare while assuming the minimum selling prize of 1997 PLN per one ton [7].

For the purposes of the analysis it has been assumed that the start date of the investment project is 2013 and the forecast period is 10 years. The additional analysis has been based on the net value excluding value added tax and excise duty in the calculation. On account of the length of the regarded period of the analysis the phenomenon of inflation has been taken into consideration. The size of the economic categories in the following years of the forecast has been assessed according to predictable current prices. The indicators of price growth rates of goods and services (3.7% a year) [8] have been used as the basis for calculations on the level of changes of economic categories, which appear in the financial projections. It has been assumed that the source of financing will be the owner's equity and borrowed capital coming from the bank loan for financing fixed assets. On the basis of the research conducted in the entities producing rapeseed, it has been assumed that from 1 hectare of the arable land it is possible to obtain high yield of rapeseed amounting to 3.5 ton.

Each new investment project is connected with bearing expenses in the beginning period while taking into consideration delayed future effects [9]. Spending capital is, most of all, related to the investment in tangible assets of the company to begin production. Expenditure on items of property, plant or equipment borne while undertaking the project connected with biofuels production has been assessed as amounting to 370 700 PLN. This value is made up with the expenditure on machinery and equipment for oil and biofuels production amounting to 112000 PLN and 104000 PLN, purchase costs of means of transport (105000 PLN) and costs of construction of the building along with the warehouse for rapeseed storage (49700 PLN). The assessment of the purchase costs of the above mentioned tangible assets assumes the purchase of new machinery and equipment and the prices have been adopted on the basis of the information obtained from their producers. For the purposes of the paper it has been assumed that the enterprise does not bear the expenses related to the land purchase since while beginning the investment connected with biofuels production it has already possessed its own land. With biofuels production the first main process is crushing rapeseed in which a by-product is rapeseed expeller which, unprocessed, may be used as feed additive. The analyzed enterprise uses one-step oil pressing, which is pressing on one press machine whose purchase cost is relatively low and amounts to 112 thousand PLN. It has been assumed that the enterprise obtains 35% of oil from each processed ton of rapeseed which

undergoes further processes for the purpose of obtaining biofuel. The remaining 65% is the expeller sold as feed additive for farm animals.

One of the assumptions adopted in the paper is the possibility of biofuels production from the owner's own raw material which the rapeseed is or from the purchased one. For the purposes of the paper the total operational costs connected with the processing of 900 ton of rapeseed for biofuel have been assessed and they amount to 1707.93 thousand PLN in the variant with the owner's own rapeseed and 2 168.68 in the variant with the purchased rapeseed. These costs consist of production costs or rapeseed purchase costs (1336 thousand PLN – the owner's own 900 ton of rapeseed or 1797 thousand PLN – the purchased rapeseed), purchase of two additional materials for biofuels production: potassium hydroxide (75.60 thousand PLN) and methanol (94.19 thousand PLN). Further costs are as follows: depreciation (43 thousand PLN), energy (23 thousand PLN), outsourcing (6 thousand PLN) and remuneration (115.2 thousand PLN). Expenditures on rapeseed as a main raw material for biofuels production are the highest from among the total operational costs borne while processing them into biofuel. Table 1 presents the cost of gaining rapeseed by the analyzed enterprise including two variants of financing, the owner's own financing and the borrowed one.

Table 1 – Expenditure on gaining rapeseed

Specification	1 ton [PLN]	3.5 ton [PLN]	900 ton [PLN]
Rapeseed from own farmland	1 485	5 198	1 336 557
Purchased rapeseed [10]	1 997	6 990	1 797 300

Source: Author's own research

The starting point in the calculations, concerning the effectiveness of investment in biofuels production, is the value of rapeseed own production or the costs connected with its purchase. There has been assumed the seed harvest of 3.5 ton from 1 hectare of farmland. On the basis of the calculations of rapeseed cultivation costs the value of own production has been assumed as 5198 PLN / 3.5 t, which means that the production of 1 ton of rapeseed amounts to the value of 1485 PLN, whereas the purchase cost of the same amount of seed is higher by 512 PLN and amounts to 1997 PLN/t. As it turns out, as early as at the stage of calculating net profit, the variant with the purchased rapeseed is unprofitable for the investor since it generates net loss.

Further materials for biofuels production are methanol and potassium hydroxide which must be stored before the investment is started. Their usage per 1 ton of rapeseed has been adopted on the basis of the data obtained from the analyzed enterprises producing fuels. Their unit price has been assumed on the basis of the average prices in 2012. Potassium hydroxide whose unit cost per 1 kg amounts to 15 PLN is added in the amount of 5.6 liter per 1 ton of the processed rapeseed. This gives the value of 75.6 thousand PLN for the project processing of 900 ton of rapeseed. The third ingredient essential for biofuels production is methanol. The unit cost of gaining it is much lower than the cost of KOH (2.3 PLN assumed as the average market price in 2012), however, the amount necessary for processing 1 ton of rapeseed for biofuel is more than eight times larger and it amounts to 45.5 liter per 1 ton of seed. When calculated per actual amount of the processed rapeseed it gives much higher values. For the analyzed enterprise processing of 900 ton of rapeseed, the methanol added takes the value of 94.19 thousand PLN.

In the research into the economic effectiveness of the investment projects in the sector of renewable energy sources an important aspect is the analysis of the annual sales volume, and then its projection in the future for the period of 10 years. The main product in processing rapeseed is rapeseed oil used for biofuel production. It is important to indicate that during the process of processing rapeseed into oil there also appears another product (by-product), so called rapeseed oilcake as expeller which generates additional financial benefits (the income from sale). On the basis of the research conducted in the analyzed enterprise there has been assumed 35% yield of oil from rapeseed, which at a further stage is processed into biofuel. The remaining part is the

expeller (rapeseed oilcake). Table 2 shows the annual amount of rapeseed which undergoes processing into rapeseed oil and it presents the amount of the obtained biofuel and expeller.

Table 2 – Production volume of biofuel and expeller

Investment project	Annual processing of rapeseed		Amount of biofuel (liter)	Amount of expeller (ton)
	ton	kg		
	900	900 000	340 200	585

Source: Author's own research

The calculations indicate biofuel production from the assumed amount of the main material equaling to 340 200 liter and 585 ton of the expeller as an additional product. The calculations included in Table 2 constitute the basis for establishing the annual revenue from the sales of both products, which is presented in Table 3. These calculations refer both to the variant with own rapeseed and to the one with the purchased rapeseed.

Table 3 – Annual revenue from the sales of biofuels and expeller

Sales	Unit price [PLN]	IU	Investment project
			900 ton rapeseed
			Sale value [thousand PLN]
Biofuel	4.00	PLN/l	1 360.80
Expeller	1 172.00	PLN/t	685.62
Sales in total		PLN	2 046.42

Source: Author's own research

Selling price of 1 liter of biofuel has been adopted as the average selling price offered by the producers in 2012 and it amounts to 4 PLN/l, whereas the price of the expeller (rapeseed oilcake) - 1172 PLN per 1 ton, on the basis of the data published by the Ministry of Agriculture, also as the average price in 2012. The annual revenue from the sales of biofuels amount to almost one million four hundred thousand PLN, and without bearing additional production costs the investment brings further 685 thousand PLN, which in total brings more than 2 million of revenue from the sales.

The calculated annual sale value in Table 5 is the basis for the forecast of the sales figures in 2013-2022. The forecast includes all the economic categories according to the current prices while using the assumed inflation rate amounting to 3.7% a year. The basis of the assessment of the value of sales of biofuels and expeller in 2013-2022 was the assumption on using full production capacity.

To be taken, a decision on realization of a given investment project in the field of energetic is assessed with respect to the economic effectiveness with the use of the appropriate selection criteria. There is a set of methods and measures enabling the choice of the best economic decisions from among different solutions. One of them is net present value NPV. The analysis of NPV allows for initial assessment of profitability of the investment projects on the market of wind energy. While calculating this indicator, there has been indicated relative profitability of the undertaken investment projects connected with the production of energy from biomass, showing changes of the time value of money [11].

Net present value makes it possible to establish the current value of all the revenue and expenditure connected with the analyzed projects based on biofuels production. One of more important issues while calculating NPV for the analyzed projects in the field of biofuels is assessing their future cash flow [12,13]. They consist of net investments for setting up projects, future receipts connected with exploitation activity and generated by the analyzed projects and residual value, which is net cash value when the period of forecast is over.

In the paper there has been applied the classic method [14] of calculating the NPV indicator while considering operating and investment flow and the effect of tax shield is taken into consideration in a discount rate calculated as the weighted average cost of capital. It has been adopted that net investments in items of property, plant and equipment are borne in year 0 at the stage of setting up the project before biofuels production is begun. However, all the remaining expenses connected with only working capital and revenue from exploitation constitute net cash flow borne in further years of project functioning[15]. In the paper there has been assumed the calculation period which

is equal to the period of the forecast (10 years), though, to calculate NPV there has been adopted the variant assuming that after this time the projects will still be functioning and making profit. The value of net benefits from the analyzed investment projects in the field of biofuels, which will be generated after the forecast period, are reflected in the form of the value of residual income [16]. The profitability of the project has been determined by net present value of the benefits in the agreed forecast period and the value of net benefits acknowledged as existing after the forecast period. The residual value, which is the project value after the forecast period of cash flow, according to the literature, may be assessed by means of a few methods. These methods, most of all, depend on the prospect of their further functioning after the forecast period:

- a) putting the enterprise into liquidation and realization of assets;
- b) selling the enterprise as the organized entity;
- c) the continuation of the project.

The last of the above mentioned points can be calculated by means of the income capitalization method or the market multiples method. For the purposes of the article there has been assumed the continuation of the investment projects by the analyzed enterprise. Therefore, the residual value has been described in the paper as the value of continuation [17] ecast period, will be constant and equal to the calculated cash flow from the last year of the forecast.

The income capitalization method allows to evaluate the residual value on the basis of the theory of a perpetual bond and consequently, it has been calculated on the basis of the last forecasted net cash flow and discount rate for the last period of the forecast. The residual value has been calculated on the basis of the following formula [18] and presented in Table 4.

$$\text{Residual value} = \frac{\text{Cash flow in the last period of the forecast}}{\text{Discount rate for the last period of the forecast}}$$

Table 4 – Residual value

Project	Cash flow in the last year of the forecast	Discount rate for the last period of the forecast	Residual value
Variant with own rapeseed	410.81	14.47%	2 839.07
Variant with the purchased rapeseed	-153.19	1447%	-1 058.67

Source: Author's own research

For the investment project using own rapeseed, cash flow from the last year of the forecast are positive, which results in positive residual value. In the variant with the purchased rapeseed, cash flow in the last period of the forecast are negative, which is the result of negative net profit forecast. This brings about that the residual value in this variant takes negative values. On account of the fact that the project connected with biofuels production from the purchased rapeseed is unprofitable and it does not bring net profit, the calculations referring to NPV have not been shown since the investment is ineffective. The negative financial result was caused by the cost of the rapeseed purchase, the result of which was the advantage of the operating costs (2 168.68 thousand PLN) over the revenue from the sales of finished products (2 046.42 thousand PLN). Unfortunately, the enterprise does not possess the remaining operating income, which brought about net loss. In further calculations connected with net present value there is presented only the variant of the investment in biofuels using own rapeseed.

Net investments for the analyzed enterprise have been assumed as borne in year 0 in the amount of actually borne irrespective of whether these are only the investor's own funds or also the funds coming from the bank loan. The investments in the fixed assets amount to 370.7 thousand PLN.

Cash flow in exploitation activity have been established as the financial result after the payment of income tax, increased by depreciation and the change in net working capital [19], which is presented as follows [20]:

1. Net profit
2. (+) Depreciation

3. (=) Operating cash flow
4. (+) Changes in net working capital, i.e.:
 - 4a. (+) Reducing the running costs
 - 4b. (-) Increase in current assets
 - 4c. (+) Increase in current liabilities
 - 4d. (-) Reducing current liabilities
5. (=) Net cash flow

Not taking into consideration the interest on loans causes that it fully reduces flow generated by the analyzed investment projects. The data for the assessment of net cash flow are included in Table 5.

Table 5 – The data for the assessment of cash flow

Specification	Years										
	0	1	2	3	4	5	6	7	8	9	10
Investments	-370.70										
Net profit		263.25	273.78	286.68	303.29	320.33	337.80	353.73	366.82	380.39	394.46
Depreciation		43.84	43.84	43.84	43.84	43.84	22.84	22.84	22.84	22.84	22.84
Change in inventories		-526.18	-10.52	-10.73	-10.95	-11.17	-11.39	-11.62	-11.85	-12.09	-12.33
Change in receivables		-8511	-1.70	-1.74	-1.77	-1.81	-1.84	-1.88	-1.92	-1.96	-1.99
Change in current liabilities (without loans)		33427	6.69	6.82	6.96	7.09	7.24	7.38	7.53	7.68	7.83
Net cash flow – in total	-370.70	30.08	312.08	324.87	341.37	358.29	354.64	370.45	383.42	396.87	410.81

Source: Author's own research

After the assessment of the value of net cash flow in the whole life cycle of the undertaken investment projects in the field of biofuels, they have been discounted with the use of the calculated discount rates for each period separately. In the paper there has been assessed discount rate essential for calculations as weighed average cost of capital (WACC). The undertaken investment project is financed from both own and borrowed capital, which allows for the calculation of the discount rate in this way. The involved capital is characterized by a different profile, structure and the related costs of its usage. In this case the basis of establishing of the level of discount rate is weighed average cost of capital (WACC) and weighed average rate of return on capital connected with it, which has been calculated on the basis of the following formula [21]:

$$r_{WACC} = r_w \frac{K_w}{K_c} + r_o \frac{K_o}{K_c} (1-T) \quad (1)$$

where: r_{WACC} – discount rate, weighed average cost of capital, r_w – cost of equity (required rate of return), r_o – cost of borrowed capital, cost of debt, K_w – equity, K_o – borrowed capital, K_c – total capital ($K_w + K_o$), T – income tax rate.

Weighed average cost of capital depends on a share of equity and borrowed capital in financing of the investment project and the costs of its individual constituents. The starting point in the conducted analysis is to establish the costs of the capital coming from different sources and the structure of the involved capital [22, 23].

On the basis of the rate of return of 52-week treasury bills of 4.47% (in 2012) and the expected risk premium the cost of equity has been assessed on the level of 14.47%. The cost of borrowed capital [24], in turn, for the analyzed enterprise has been assessed on the level of 4.48% on the basis of nominal interest rate on subsidized loans (5.53% per year), used for financing of similar investment projects in the RES and on the basis of income tax rate of 19%,

Discount rate has been calculated on the basis of weighed average cost of capital (WACC), and the way of calculation is presented in Table 6. Table 6 shows the estimated discount rate for the analyzed investment project. Every year the involvement of borrowed capital diminishes due to repayment of long-term loan and share of equity increases. On the basis of the assessed cash flow from the investment in biofuels and discount rate, net present value has been calculated as the difference between the amount of discounted net cash flow achieved in the period of project

exploitation and all the expenditure borne only in one year, i.e. $t = 0$. The calculations are presented in Table 7.

Table 6 – Calculating WACC

Years	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
No. of the year of the forecast	1	2	3	4	5	6	7	8	9	10
A share of the equity in project financing	35.99%	55.16%	72.04%	86.45%	97.62%	100.00%	100.00%	100.00%	100.00%	100.00%
A share of debt in project financing	64.01%	44.84%	27.96%	13.55%	2.38%	0.00%	0.00%	0.00%	0.00%	0.00%
Cost of equity	14.47%	14.47%	14.47%	14.47%	14.47%	14.47%	14.47%	14.47%	14.47%	14.47%
Cost of borrowed capital	4.48%	4.48%	4.48%	4.48%	4.48%	4.48%	4.48%	4.48%	4.48%	4.48%
WACC	8.08%	9.99%	11.68%	13.12%	14.23%	14.47%	14.47%	14.47%	14.47%	14.47%

Source: Author's own research

Table 7 – Calculating NPV

Specification	Years										
	0	1	2	3	4	5	6	7	8	9	10
Net cash flow	-370.70	30.08	312.08	324.87	341.37	358.29	354.64	370.45	383.42	396.87	3 249.88
Discount rate		8.08%	9.99%	11.68%	13.12%	14.23%	14.47%	14.47%	14.47%	14.47%	14.47%
Discount factor		0.9253	0.8412	0.7533	0.6659	0.5830	0.5093	0.4449	0.3887	0.3395	0.2966
Discounted cash flow	-370.70	27.83	262.53	244.72	227.33	208.87	180.61	164.81	149.02	134.75	963.94
NPV											2 193.72

Source: Author's own research

The project connected with biofuels production on the basis of rapeseed is characterized by positive net present value, which means that its realization is profitable for the enterprise. The condition in favor of the acceptance of the project: $NPV \geq 0$ is satisfied. When comparing the investment of the amount of 370.7 thousand PLN in biofuels production by the analyzed entity to a hypothetical investment of the same amount only on the capital market (e.g. as bank deposits), it has been concluded that the project on the market of renewable energy sources gains higher economic benefits. The calculated value of NPV amounts to 2 193.72 thousand PLN, which means that the investment of the amount of 370.7 thousand PLN in the project in the field of biofuels generates by 193.72 thousand PLN more than in the exemplary bank deposit.

3. CONCLUSIONS

The investment project analyzed in the paper is undertaken in the renewable energy sector in Poland. The discussed model entity is an example that the investment projects connected with gaining energy from biomass can be effective and profitable for their owners and bring development and increase in value for the enterprise. Unfortunately, with high prices of rapeseed in Poland, biofuels production using it is not always profitable. It is profitable only when the investor is at the same time an agricultural entrepreneur and possesses their own rapeseed cultivation. Otherwise, the cost of purchasing seeds exceeds revenue from the sale of biofuels manufactured on their basis, which has been presented in the paper. Therefore, investments in biofuels production are not taken by many investors in Poland. The incentive could be the State aid, which, unfortunately, is often difficult to obtain.

The NPV method shown in the paper is not the only method of assessment of the effectiveness and apart from that, future entrepreneurs should also take into consideration the period of return on investment, internal rate of return IRR and the NPVR indicator used while comparing the projects which differ from each other.

The analysis performed indicates that the investments connected with biofuels production may constitute an interesting area of future research and analyses.

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