

Economic analysis of the functioning of spin-cast pre-tensioned concrete electric power poles and ferroconcrete poles production plant using the Net Present Value Method

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This paper presents an analysis of the investment profitability of producing spin-cast pre-tensioned concrete electric power poles, used for the construction of overhead power lines of low and medium voltage. Decision-making criterion for an evaluation of profitability of investment in this case was the Net Present Value. Additionally, the study characterizes the current state of distribution networks of low and medium voltage in Poland and presents the need for modernization, which is planned for the coming years.

Introduction

Every single decision to begin with implementing an investment project should be preceded by precise analysis of cost-effectiveness. It is necessary to take into account, when estimating the profitability of long-term investments, the fact that the value of money changes over time. One of the dynamic decision-making criteria to allow such an assessment is the Net Present Value, in which the return on investment is affected by the value of income in subsequent years, the value of investments made in the year zero, as well as the discount rate.

The growing demand for electric power poles, which are supporting structures of overhead power lines of medium and low voltage, is dictated by the needs of substantial modernization of distribution networks in Poland. The following estimation, based on data from the Polish Society of Power Transmission and Distribution, shows that upgrading of the distribution network for low voltage in 2005 included 236 930 km and for medium voltage 60 056 km. In addition, there is a need to build 1,500 new transformer stations and related lines of medium and low voltage in order to join the new electricity customers. Taking into account the above presented needs, it is estimated that the necessary investments to improve the distribution networks in Poland amount to 6 263 340 000 EUR [1].

Description of the investment project

The investment plan involves starting the production of spin-cast pre-tensioned concrete electric power poles (Fig. 1) and ferroconcrete poles with total annual output of 26,500 pieces. Production will take place in two adjacent production halls. Besides the two halls, three additional buildings will be located on the plot, in which there will be the laboratory, administration and the steel yard for the spin-cast pre-tensioned concrete electric power poles. Moreover, nearby the plant buildings there will be a concrete mixing station with areas for the storage of aggregates. The total area of land on which the plant will be located is 30000 m². The plot will have a connection to the sewerage network, water and electricity.

The plot together with its two production halls, the other three buildings and storage areas for finished poles will be fully owned by the investor.

The required investment to start production thus includes, in addition to the construction of two halls and buildings, the purchase of: building plot, spin-cast pre-tensioned concrete electric power poles production line, ferroconcrete poles production line and the necessary equipment to the laboratory. It is assumed that all construction works, installation of all equipment in the plant, trial start and the necessary staff training will take eight months. Full production is assumed to start in September 2010. Most of the equipment installed in the



Fig. 1. Spin-cast pre-tensioned concrete electric power pole [3].

spin-cast pre-tensioned concrete electric poles production line was manufactured in China. Selection of such a solution was dictated by the considerable difference in the purchase price compared to other manufacturers. The total cost of both production lines includes a complete installation and commissioning of the production lines, supply to the place of incorporation and the necessary replacement parts for a period of three years from the start of production.

The production plant will be located in Middle-Eastern Poland, about fifty-five kilometers from Warsaw. All the necessary components for the manufacture of power poles, such as sand, aggregate and cement will be purchased at the price prevailing in this area of the country.

Model of financing the investment

The investment will be financed with an investment loan, which will be used to purchase a building plot, finance the construction of production halls and other

buildings, two production lines and equipment to the laboratory. The total cost of purchase of the mentioned devices is shown in Table 1.

Table 1. Cost of equipment needed to start production.

No.	Description	Price [PLN]
1	Building plot 30000 m ²	7 500 000
2	Two production halls with buildings	4 000 000
3	Spin-cast pre-tensioned concrete electric power poles production line	4 240 600
4	Ferroconcrete poles production line	2 200 000
5	Laboratory equipment	358 820
TOTAL		18 299 420

A great part of the equipment of the laboratory and spin-cast pre-tensioned power poles line will be purchased for U.S. dollars. Total cost of purchasing this line and the laboratory equipment has been converted from U.S. dollar, whose exchange rate against the Polish zloty (PLN) in the period from January 2009 to August 2009 amounted to an average of 3.2620. The average rate was calculated based on data published by the Polish National Bank.

Table 2. Tranches of the investment loan in a period of 10 years.

No.	Install [PLN]	Interest [PLN]	Capital [PLN]
1	2 811 404.99	1 393 826.18	1 417 578.81
2	2 811 404.99	1 288 324.07	1 523 080.92
3	2 811 404.99	1 174 970.03	1 636 434.96
4	2 811 404.99	1 053 179.69	1 758 225.30
5	2 811 404.99	922 325.27	1 889 079.72
6	2 811 404.99	781 732.07	2 029 672.92
7	2 811 404.99	630 675.34	2 180 729.65
8	2 811 404.99	468 376.36	2 343 028.63
9	2 811 404.99	293 998.38	2 517 406.61
10	2 811 404.99	106 642.48	2 704 762.51
TOTAL	28 114 049.87	8 114 049.87	20 000 000.00

Table 3. Prices and the participation of the various types of poles in manufacture and sales.

Type and length of pole	Participation in production and sales [%]	Share in production and sales [pcs.]	Gross unit price [PLN]	Gross total price [PLN]
E 6,7	10	1 500	1 115,20	1 672 800
E 7,5	15	2 250	1 304,00	2 934 000
E 8,2	15	2 250	1 369,50	3 081 375
E 10,5	20	3 000	1 632,90	4 898 700
E 12	20	3 000	1 923,60	5 770 800
E 13,5	10	1 500	2 203,20	3 304 800
E 15	10	1 500	2 798,20	4 197 300
ŻN 9	30	3 450	374,40	1 291 680
ŻN 10	40	4 600	427,00	1 964 200
ŻN 12	30	3 450	500,20	1 725 690
TOTAL		26 500	TOTAL	30 841 345

Table 4. Summary of revenues, expenses and cumulative cash flows of the investment project [PLN].

Description	2010 Year „0”	2011 Year „1”	2012 Year „2”	2013 Year „3”	2014 Year „4”	2015 Year „5”	2016 Year „6”	2017 Year „7”	2018 Year „8”	2019 Year „9”
I. REVENUES	30 280 448.33	30 841 345.00	30 841 345.00	31 458 171.90	31 458 171.90	31 766 585.40	31 766 585.40	32 719 582.60	32 719 582.60	33 990 246.40
1. Electric power poles sale	10 280 448.33	30 841 345.00	30 841 345.00	31 458 171.90	31 458 171.90	31 766 585.40	31 766 585.40	32 719 582.60	32 719 582.60	33 990 246.40
2. Bank loan	20 000 000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
II. COSTS	27 126 186.63	21 019 818.20	21 264 420.33	21 594 962.90	21 745 211.35	22 424 940.08	22 920 110.18	24 051 753.52	24 684 881.13	25 741 289.33
1. Purchase of a building plot	7 500 000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Construction of the production halls and other buildings	4 000 000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Purchase of the electric power poles production lines	6 440 600.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Laboratory	358 820.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Installment loans	2 811 405.00	2 811 405.00	2 811 405.00	2 811 405.00	2 811 405.00	2 811 405.00	2 811 405.00	2 811 405.00	2 811 405.00	2 811 405.00
6. Property tax	66 600.00	66 600.00	66 600.00	66 600.00	66 600.00	66 600.00	66 600.00	66 600.00	66 600.00	66 600.00
7. Land tax	21 300.00	21 300.00	21 300.00	21 300.00	21 300.00	21 300.00	21 300.00	21 300.00	21 300.00	21 300.00
8. Concrete production cost and purchase of reinforcing steel	3 367 560.00	10 405 760.00	10 613 875.20	10 613 875.20	10 717 932.80	11 039 469.90	11 481 047.80	12 055 761.50	12 357 155.00	13 109 705.10
9. Salaries	1 728 000.00	5 184 000.00	5 184 000.00	5 443 200.00	5 443 200.00	5 715 360.00	5 715 360.00	6 172 588.90	6 419 492.50	6 612 076.80
10. Cost of steam production	139 974.80	419 924.40	432 522.13	445 497.80	454 407.75	468 039.98	482 081.18	496 543.62	511 439.93	526 783.13
11. Cost of electricity consumption	460 752.83	1 417 307.00	1 441 196.20	1 465 563.10	1 502 844.00	1 541 243.40	1 580 794.40	1 621 532.70	1 691 466.90	1 764 897.50
12. Water consumption and sewage disposal	4 507.30	13 521.80	13 521.80	13 521.80	13 521.80	13 521.80	13 521.80	13 521.80	13 521.80	13 521.80
13. Cost of materials and repairs	200 000.00	600 000.00	600 000.00	630 000.00	630 000.00	660 000.00	660 000.00	700 000.00	700 000.00	720 000.00
14. Running cost of administration and fixed costs	26 666.70	80 000.00	80 000.00	84 000.00	84 000.00	88 000.00	88 000.00	92 500.00	92 500.00	95 000.00
III. GROSS PROFIT/LOSS	3 154 261.70	9 821 526.80	9 576 924.67	9 863 209.00	9 712 960.55	9 341 645.32	8 846 475.22	8 667 829.08	8 034 701.47	8 248 957.07
IV. INCOME TAX	599 309.72	1 866 090.09	1 819 615.69	1 874 009.71	1 845 462.50	1 774 912.61	1 680 830.29	1 646 887.53	1 526 593.28	1 567 301.84
V. CASH FLOWS NCF	2 554 951.98	7 955 436.71	7 757 308.98	7 989 199.29	7 867 498.05	7 566 732.71	7 165 644.93	7 020 941.55	6 508 108.19	6 681 655.23
VI. DISCOUNT RATE dt	1.00	0.93	0.87	0.82	0.76	0.71	0.67	0.62	0.58	0.54
VII. REVISED CASH FLOW dt*NCF	2 554 951.98	7 435 151.15	6 775 233.67	6 521 583.38	6 002 114.26	5 395 080.42	4 774 469.22	4 372 642.40	3 787 718.97	3 634 152.28
VIII. CUMULATIVE CASH FLOWS	2 554 951.98	9 990 103.12	16 765 336.79	23 286 920.17	29 289 034.43	34 684 114.85	39 458 584.07	43 831 226.47	47 618 945.43	51 253 097.71

The total amount of debt owed by the investor is 20 000 000 PLN. Loan bears interest at 7.2% level. It has been assumed that the repayment of the investment loan will be followed by a period of 10 years in the system of fixed installments. The tranches are presented in Table 2.

Financial analysis of the investment

Revenues

Revenues from sales of spin-cast pre-tensioned concrete electric power poles and ferroconcrete poles are presented in Table 3. The table also includes the percentage of each type of pole in the production and sales. Gross prices are average values derived from companies offering production and sales of electric power poles in 2008 and 2009.

Additionally, disposable income will provide a loan of 20 000 000 PLN given to the investor by the bank.

Costs

Expenditures related to the functioning of the plant include: the concrete production cost, purchase of reinforcing steel, property and land tax, the cost of consumed electricity and water, the cost of steam production, the cost of sewage, the employee remuneration, installment loan, the cost of materials and any repairs, the costs of necessary administrative and fixed costs. The amount of expenditures is presented in Table 4.

NPV analysis of the investment

The assumed income tax, which pays the company, will amount to 19%. The discount rate over 10 years will shape the average rate of 7%. The value of the discount rate was calculated using the formula:

$$d_t = \frac{1}{(1+r)^t} \quad (1)$$

where: r — the discount rate,
 t — subsequent years of the examined period.

Detailed financial analysis of the entire project together with the cumulative cash flow is presented in Table 4.

Summary

On the basis of financial analysis and the value of cumulative cash flows, the investment can be considered profitable. It manages to revenue in each year, together with the year zero and the years in which there is a need to repay the loan. However, before embarking on

a project described, the investor should take into account the fact that the data are only for illustration. The whole project financial analysis does not include a risk analysis, which is very substantial from the standpoint of an investor. Generated revenue and profit are the values calculated assuming total sales of all manufactured items. In each case initial investment should be preceded by a market research for the product. Not without significance is the site of the manufacturing plant and the prevailing land prices in the relevant region of the country. Gaining market position and attract a sufficient number of consumers causes that in the initial period profits from the sale may actually be lower than anticipated. Sales of products at 70% compared to the one estimated in the project results in a loss in the 5-th year of business. An additional risk occurs in production lines and all the machinery to equip the laboratory. A large number of the machinery is imported from China and purchased for U.S. dollars. Significant currency fluctuations observed in the past 2 years can cause that the price of equipment in extreme cases varies even twice a year. Furthermore, it is notable that the purchase price of the spin-cast pre-tensioned power poles production line was very favorable. European producers' offers can be as little as 3 to 4 times more expensive, which is also dependent on the degree of automation line. Prior to the investment we should also take a look at the risks associated with an increase in electricity prices and other media.

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