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THE PRICE OF CO2 EMISSION ALLOWANCE INFLUENCE ON THE AMOUNT OF COAL PROFITABLE FOR EXCAVATION

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OVERVIEW

Increased competitiveness of electric energy markets forced by politicians and environmental regulations regarding CO2 emissions pricing through emission trading schemes have caused that the production of electricity from coal has become a very risky business. Situation is going to be worse in future due to after the year 2020 in Poland the whole decreasing limit of CO2 emission allowances will have to be purchased on auctions [6]. Development of methodology and tools, such as Monte Carlo simulation models, for risk estimation is a rational behaviour. One of important questions is how the expected increase of prices of CO2 emission allowance can influence the profitability of electric energy production from coal and the size of its resource or reserves – amount of coal profitable for excavation [2]. It is especially important for Poland where electricity production is based mainly on hard coal (60%) and lignite (35%). All these changes and uncertainty lead to the situation in which coal, the cheapest source of electric energy, have to compete with other alternative sources and profitability of investments has to be proved. Authors concentrate only on lignite. It creates additional difficulty due to lack of lignite market price and uncertainty characteristic for geology mining operations [5].

METHODS

A lignite mine and a power plant were treated separately as 2 different but mutually interdependent firms creating the bilateral monopoly and as the vertically integrated energy producer maximising joint profits [1]. Uncertainty connected with the discrete recognition of the coal deposit has been estimated by statistical analysis of 20 equally probably 3D coal quality and value models of the deposit generated by conditional simulations in the ConSim module of the Datamine Studio 3 program [3]. Due to lack of lignite market price all profitability analysis have been undertaken for different lignite price levels with application of open pit optimisation technique [1]. The Lerchs-Grossmann pit optimisation algorithm available in the NPV Scheduler program were used. For each of 20 coal deposit models 12 optimal ultimate pits have been generated for different lignite prices [3]. Uncertainty of economic parameters such as cost of mining and power generation, price of energy and cost of CO2 emission allowance purchase have been build into the Monte Carlo simulation spreadsheet model in @Risk v5.5 program by treating them as stochastic variables with selected probability distributions and applied correlations. Results from ConSim and Geological Risk Assessment processes were also added for integrated risk evaluation of profitability of electric energy production from lignite. In order to find out the influence of CO2 emission allowances prices on the size of lignite resource the four scenarios were calculated. In the base scenario the CO2 emission is allowed and there is no price of it. Next three scenarios for the future price levels of CO2 were based on Point Carbon's proposals: I (the price of CO2 emission allowance in the range 10-30 EUR, II (25-50 EUR) and III (35-65 EUR). It has been assumed that in Poland, due to heavy dependency of energy production from coal, about 90% of the price of CO2 emission allowance is straight away added to the

electric energy price. However other, lower levels of electric energy price increases also have been analysed.

RESULTS

Based on several Monte Carlo simulations (10k) a big set of output data has been generated containing several millions of potential future realisations.

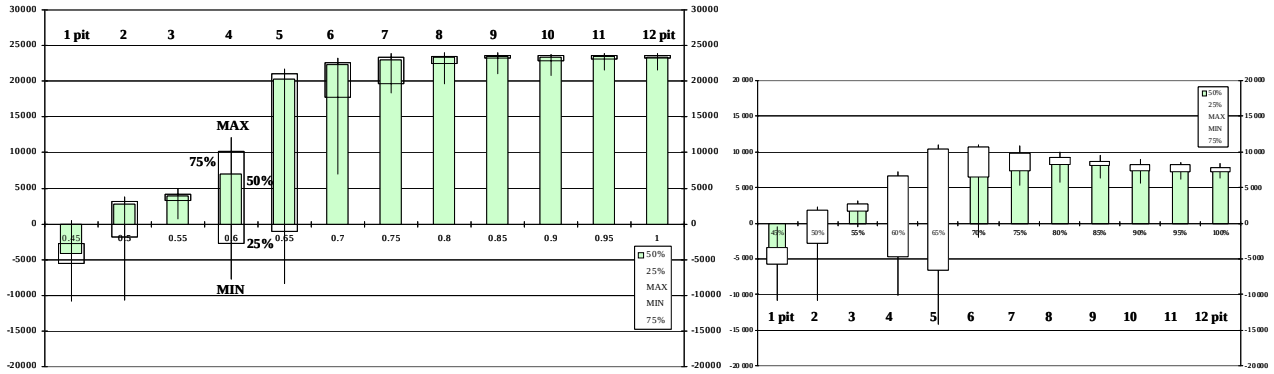

Fig. 1. Variation of joint profits for 20 versions of the simulated deposit and 12 optimal ultimate pits for two prices of CO2 emission allowances: 20 EUR (left side) and 50 EUR (right side)

CONCLUSIONS

The analysis of obtained data has allowed on taking out several essential conclusions regarding benefits of vertical integration, necessity of joint profit maximisation, risk reduction through integration. The most important outcome is the substantial decrease of coal reserves with the increase of prices of CO2 emission allowance. It can be seen on the Figure 1. For the higher CO2 price the optimal pit maximising joint profit is much smaller (No.6, left side) than for the lower price (pits No. 8-12). Also joint profits are much lower: about10 bln PLN versus 23 bln PLN.

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