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# RISK ANALYSIS OF ELECTRIC ENERGY PRODUCTION FROM LIGNITE UPON THE BASIS OF MINING SCENARIOS BUNDLE GENERATED WITH THE USE OF GEO-RISK OPTIMISATION

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## INTRODUCTION

The value creation chain of optimal ultimate energy production from a lignite deposit contains several stages the lignite deposit evaluation and resources/reserves classification, optimal, ultimate pit design maximizing joint profits of a mine and a power station and finally generation of the optimal schedule of lignite exploitation that maximizes NPV of future cash flows from the sale of electric energy produced by the planned, lignite fuelled power station. Several techniques to assess future cash flow variability including conditional simulation of equally probably 3D lignite deposit models for generating a set of hybrid ultimate pits [1], Geo-Risk Assessment during optimal scheduling of lignite exploitation and Monte Carlo simulations of chosen economic conditions of future electric energy production and sale have been utilised [3].

## LIGNITE DEPOSIT EVALUATION

The first step of lignite reserves evaluation is creating a digital, three-dimensional deposit model (structural and quality) [2]. On a contrary to standard interpolation methods aimed on obtaining the best estimation of quality parameters the conditional simulation (the generalized Gaussian simulation) of a coal quality index (1) has been performed to build a set of equally probable quality block models.

$$QI = [\frac{Q_R}{Q_B} - \frac{A_R - A_B}{180} - \frac{S_R - S_B}{10}] \qquad (1)$$

where:

$Q_R$ i $Q_B$ – actual and reference (base) coal calorific value (kJ/kg)
$A_R$ i $A_B$ - actual and reference (base) ash content (%)
$S_R$ i $S_B$ - actual and reference (base) sulphur content (%)
Reference values: $Q_B$ ,$A_B$ , $S_B$ are averaged values (throughout the deposit)

The set of quality block models is the basis for building the set of economic models of a deposit –models which each block has been assigned with its mining cost and – in case of lignite blocks – calculated revenue from selling the contained lignite.

## GENERATING A SET OF HYBRID ULTIMATE PITS AND GEO-RISK ASSESSMENT DURING OPTIMAL SCHEDULING

The set of optimal ultimate pits upon the set of equally probable economic block models has been generated with the use of Lerchs-Grossmann algorithm. This Geo-Risk optimisation has been continued to produce a wide bundle of mining scenarios representing the optimal long – term schedules.

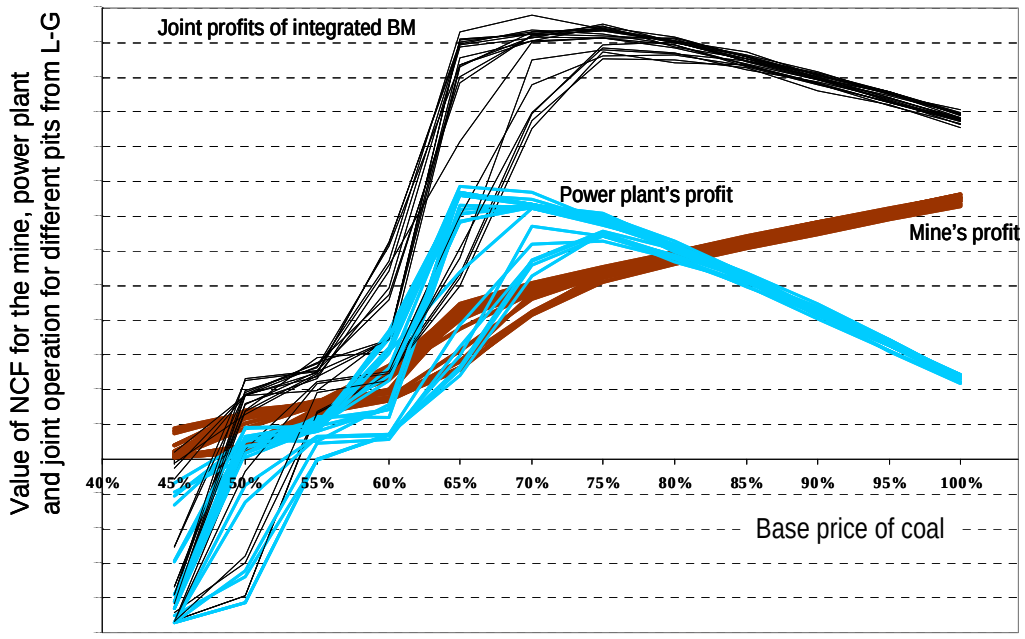


Fig. 1. Value of Cash Flows (NCF) from energy production- estimation of profits for the mine (brown), power plant (blue) & joint (black) operations obtained from Conditional Simulations [1]

## MONTE CARLO SIMULATIONS OF CHOSEN ECONOMIC CONDITIONS OF ELECTRIC ENERGY PRODUCTION

The special focus has been put to uncertainty connected with required amount and prices of allowances on CO2 emissions under ETS [4, 5].

The presented risk evaluation method has been applied to the case study of the planned Polish "Legnica" open pit lignite mine fuelling the green-field power station.

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