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Abstract of PhD thesis: "Estimation and impact of surface cost on lignite mining project"

Research presented in this thesis combines multidisciplinary topics of mining, mining economics, geostatistics, geology, mine project optimisation and sustainable real estate management. Lignite reserves represent a subset of resources which could be mined economically with regard to realistic mining and economic conditions at the time of reporting. In order to identify lignite reserves at least the ultimate pit shell has to be designed. Main contribution of this research is to integrate joint optimisation of mine and power plant with regard to actual cadastral scheme that represents surface costs. Assuming that a digital, economic block model of a lignite deposit has been built (based on a quality model as well as economic parameters), and then it was processed with the use of open pit optimisation algorithm Lerchs and Grossmann. The total amount of electric energy that can be obtained from the lignite depends on the ultimate pit reserves as well as power station efficiency that prevents from product loss. Therefore, the 'coal-by-wire' approach has been applied to model the integrated power generation company consisting of a surface lignite mine and a power station that produces electric energy. Following this assumption, the economic block model of a lignite deposit contains the price of electric energy that is produced from the lignite. In thanks to formula used for lignite quality equivalent individual block of deposit was converted into deposit of energy. Costs of producing energy from coal in a power station are modelled as processing costs, necessary to obtain the product - electric energy. Additional costs of the energy market (carbon emission costs) are treated as selling costs of the final product. Lignite pit is usually mined with a surface mining technology which occupies vast area on the terrain. Surface costs are therefore vital while considering feasibility of any lignite mine. The step by step sensitivity analysis and simulation consists of many estimated levels of land acquisition costs, geostatistics, 3D deposit block modelling to Lerchs-Grossmann algorithm ultimate pits generation based on many key factors including electricity price considered as project product price, power station efficiency analysed in range of 37-50%, power station lignite processing unit cost, CO2 allowance costs, land buyout costs, mining unit cost and also lignite availability treated as lignite reserves kriging estimation error. With high fixed costs optimal surface costs and transition to higher efficiency power generation became very important issue to sustain high profitability of lignite based energy projects in a low carbon future. This analysis allowed to assess the impact of project parameters change on many results such as revenue (as the amount of energy sold multiplied by its price), net value of the project (as revenue minus total mining costs and costs of processing lignite in power plant), the lignite production costs, total surface costs and many more. In thanks to taking into account the surface costs presented methodology enables mining and energy company risk quantification in the early planning phase and also enables to develop appropriate negotiation strategy and real estate schedule buyout. Joint analyses constitute a contribution to investment decision-making and sustainable land use.