Resources Policy xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Resources Policy

journal homepage: www.elsevier.com/locate/resourpol

Coking coal mining investment: Boosting European Union's raw materials initiative

Marta Matyjaszek[a], Krzysztof Wodarski[b], Alicja Krzemień[c,*], Carmen Escanciano García-Miranda[d], Ana Suárez Sánchez[d]

[a] Doctorate Program on Economics and Enterprise, University of Oviedo, Independencia 13, 33004 Oviedo, Spain
[b] Faculty of Organization and Management, Silesian University of Technology, Roosevelt 26, 41-800 Zabrze, Poland
[c] Department of Risk Assessment in Industry, Central Mining Institute, Plac Gwarków 1, 40-166 Katowice, Poland
[d] School of Mining, Energy and Materials Engineering, University of Oviedo, Independencia 13, 33004 Oviedo, Spain

ARTICLE INFO

Keywords:
Coking coal
Critical raw material
Mining project
Price forecasting
Feasibility study
Raw materials initiative

ABSTRACT

In 2014, the list of Critical Raw Materials for the European Union included for the first time an energy fossil resource: coking coal. Its presence was due to its high economic importance, being the second raw material in the list immediately after tungsten, although with a low supply risk as Australia and USA were the main exporters of coking coal to the European Union in recent years. However, on the 2017 list, coking coal is considered a borderline case. Although it narrowly misses the economic importance threshold, for the sake of caution, coking coal is kept on the list and thus included in the table. However, it will be phased out from the next list should it fail to meet the criteria in full.

Successive depletion of coking coal deposits generates the need to develop new mines in order to maintain the production level of coal mining companies for the years to come. The process of building new mines is high capital-intensive, with long terms needed for the different investment steps. That is why providing a tool for the coal mining companies that will allow quick discrimination between feasible and unfeasible projects, in order to reduce time consuming analysis together with their costs, while shortening mine development cycles is a critical issue.

Trying to boost the European Union's Raw Material Initiative by complementing its efforts from an economic perspective, this paper provides an exhaustive analysis of present day coking coal mining investment. To achieve this goal, it analyses in first place the trends and evolution of coking coal prices in order to contrast the forecasts used by the different projects. Secondly, it will study five ready-to-go coking coal projects around the world: the Lublin underground project in Poland; Kodiak underground project in the USA; Amaam opencast project in Russia; Makhado opencast project in South Africa; and Crown Mountain opencast project in Canada.

Conclusions of this research clearly state that it is possible to establish a relationship between capital expense and clean coal production in opencast projects and that the predicted yield and the transport costs are critical parameters in order to assess the operating costs of a coking coal mining investment project. Finally, the financial outcomes claimed by the projects are compromised due to the lack of adequate price forecasting and to the use of fictitious discount rates for calculating the Net Present Value.

1. Introduction

Coking coal, also known as metallurgical coal, is a hard coal mainly used to create coke, one of the key irreplaceable inputs in iron ore in blast furnaces for the production of steel. The coking coal market is linked with the iron ore market since both of them are complementary inputs for pig iron production and the current situation on the world market of coking coal and coke is determined by the size of the demand and dynamics of steel production growth (Hecking and Panke, 2015).

Coke is produced by heating coking coals in a coke oven in a reduced atmosphere (deficient of oxygen). As the temperature of the coal increases, it becomes plastic, fusing together before resolidifying into coke particles. This is known as the caking process. The quality of the resultant coke is determined by the qualities of the coking coals used, as well as the coke plant operating conditions (Aspire Mining Limited, 2012).

* Corresponding author.
E-mail addresses: marta.matyjaszek@polsl.pl (M. Matyjaszek), krzysztof.wodarski@polsl.pl (K. Wodarski), akrzemien@gig.eu (A. Krzemień), cescan@uniovi.es (C. Escanciano García-Miranda), suarezana@uniovi.es (A. Suárez Sánchez).

https://doi.org/10.1016/j.resourpol.2018.01.012
Received 11 December 2017; Received in revised form 24 January 2018; Accepted 24 January 2018

The properties that distinguish coking coal from other coals, such as energy or steam coal, are the ones that allow the formation of good coke through a coking process. These properties, such as caking, volatile content (which indicates the yield of coke and establish the basis for coal trade), hardness, free swelling index, coke strength after reaction, etc., affect the value of the coking coal as they define different grades of it: from the best grade of "hard", through "semi-hard " and to "semi-soft" (Ozga-Blaschke, 2004).

Nevertheless, this classification is not a precise definition: other classifications also include “premium hard”, “medium”, and “soft” grades, something that has a lot to do with marketing strategies. For example, Argus Media Ltd, a global energy and commodity news and price reporting agency, reports premium hard and hard coking coal prices distinguishing between low, medium and high-volatile (Argus Media Ltd, 2017).

High quality coking coals are in great demand by steel producers, who need these coals to make high quality coke to maximise the productivity of their blast furnace operations. Steel producers use blends of coking coal with different grades to make coke, with about half being of the grade known as “hard” coking coal, although the larger the blast furnace, the better quality coke required which drives the ascension of the blending ratio of strongly-caking coal.

According to Euracoal (2016), global coking coal production in 2015 was 900 Mt. Nowadays the world's largest exporter of coking coal is Australia, with a total of 190 Mt during 2016 (Euracoal, 2017), being also one of the largest producers of this raw material in the world. However the biggest producer and consumer of coking coal is still China (International Energy Agency, 2015).

Nearly 50% of the export capacity of metallurgical coal is controlled by the ‘Big-Four’ multinationals: Anglo-American, BHP-Bilton, Rio Tinto and Xstrata. The metallurgical coal is produced by the Big-Four mainly in Australia, competing against some producers in Canada, the USA and Russia (Trüby, 2013).

In Europe there are not many coking coal resources, so the European Union is a big importer with a total amount of imports in 2016 of 34.7 Mt (Euracoal, 2017). In 2015 coking coal production in the EU was around 16.6 Mt, taking place only in Poland (circa 12 Mt), the Czech Republic (circa 4.6 Mt), and also a small amount in Germany which will finish coal mining exploitation in 2018 (Blaschke and Ozga-Blaschke, 2015).

The coal basin distributed between Poland and the Czech Republic is one of the largest in Europe and the most important. Currently, almost 30% of the deposits have already been mined (Vaněk, Bora, Maruszewska, and Kašparková, 2017). In Poland, Jastrzebska Spolka Weglowa S.A., the biggest European coking coal producer is changing its structure introducing a higher share of hard coking coal exploitation. The company extracted 11.2 Mt of coking coal in 2015, accounting for 67.5% of all EU production (Mysiak and Jarno, 2016). Addressing Easter Europe, Coal Energy S.A., a Ukrainian company, and Raspadskaya OJSC, a Russian company, also produce coking coal (Nawrocki and Jonek-Kowalska, 2016).

The European Commission adopted in 2008 the Raw Materials Initiative (European Commission, 2008) based on research about critical needs for economy growth and supply: the affordability of non-energy fossil resources, the geographic structure of their production, the rise of demand until 2030, or the level of dependence of the importer countries. It was important to establish a knowledge base about specific risks for different raw materials (Bardt and Karapinar, 2011), as a deficit caused by those exposed to disruption or supply interruption may lead to serious consequences within the European economy (Witkowska-Kita and Biel, 2015; Lutyńska and Lutyński, 2016; Grilli et al., 2017).

The Raw Materials Initiative consists of three pillars: ensuring the sustainable supply of raw materials from global and European markets, ensuring fair access to the resources, and helping with recycling and boosting the efficiency of resources (European Commission, 2014a).

A first list of 14 critical raw materials was identified in 2010 (European Commission, 2010), and in 2014 it was extended to a total of 21 critical raw materials, including for the first time an energy fossil resource: coking coal. Its presence in the list was due to its extremely high economic importance, being second most important immediately after tungsten, although with a low supply risk (European Commission, 2014b) as Australia and USA were the main exporters of coking coal to the European Union in 2012 (European Commission, 2014a).

Moreover, the supply of critical raw materials is directly connected to the substitutability index, which shows how difficult it can be to substitute each material. The range of this index is 0–1, where 0 means that it is easy to replace and 1 means that it is hard to replace. Coking coal has an index of 0.92 (European Commission, 2017).

However, coking coal is considered, on the 2017 list of Critical Raw Materials for the EU, to be a borderline case. Although it narrowly misses the economic importance threshold, for the sake of caution, coking coal is kept on the list and thus included in the table. However, it will be phased out from the next list should it fail to meet the criteria in full (European Commission, 2017).

The EuroGeoSurvey's Mineral Resources Expert Group released, in December 2015, the third vesion of the Critical Raw Material Map of Europe. It was an updated version of the one produced during the ProMine EU funded research project that was created in order to stimulate the EU's extractive industry, storing information about mineral deposits in Europe, including their location, owner, type, reserves and resources or economic aspects. The Critical Raw Material Map of Europe showed the European mineral deposits from the ProMine Mineral Deposit database that contain critical commodities, according to the list of EU's critical raw materials (Bertrand et al., 2016).

In this map only a few coking coal deposits were shown: on the border between Poland and the Czech Republic, on the border between Poland and Ukraine, and in the east of Ukraine. The rest of the coal deposits were not specified as coking coal or they referred to different kinds of coal (Bertrand et al., 2016).

When addressing the reporting standards of exploration results, mineral resources and reserves, there is an aspect that differentiates coal and coking coal from the other minerals. The PERC Reporting Standard (2017) in Europe, as well as the other international standards, like the JORC Code (2012) in Australasia, address matters that relate specifically to the public reporting of coal exploration results, coal resources and coal reserves.

According to the PERC Reporting Standard (2017), when reporting coal reserves, the difference between reserves that consider mining losses and dilution (also known as run-of-mine or recoverable reserves) and saleable product, which includes mining and processing losses (also known as marketable reserves) representing beneficiated or otherwise enhanced coal, should be clarified. When marketable coal reserves are publicly reported the equivalent proved and/or probable reserves should be shown, and the predicted yield that leads to achieve the saleable product must be stated. According to these definitions, all reserves include mining losses and dilution, and in situ coal is a mineral resource.

Moreover, information about coal quality should be reported for all resource and reserve categories, using appropriate parameters and including the basis on which they are derived. The quality of coal should use parameters relevant to its specific application: moisture basis, volatile matter, ash, sulphur, calorific value, coking properties, bulk density, etc. Marketable reserves should also be classified into relevant types of coal product.

This paper will analyse in the first place the trends and evolution of coking coal prices and, secondly, it will study five ready-to-go projects around the world: the Lublin Project (Poland), Kodiak Project (USA), Amaam Project (Russia), Makhadu Project (South Africa), and Crown Mountain Project (Canada), by means of information collected from investor presentations, feasibility or pre-feasibility studies, stock exchange announcements, company reports, competent persons reports,