



## Effect of regulation on power-plant operation and investment in the South East Europe Market: An analysis of two cases



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### ABSTRACT

This paper analyses the differences between investment decisions for coal-fired power plants in Croatia and in Bosnia and Herzegovina (BiH). The long-run marginal cost (LRMC) of each plant is calculated based on a technical analysis that accounts for the important influences on overall project costs by combining a mathematical model and a simulation model. The former was used to calculate annual costs and the latter to predict power plant performance on the electricity market. This research offers insights about potential risks associated with power-plant investment with a particular focus on the regulatory framework and the relevance of participation in the European Union Emissions Trading Scheme (EU ETS) for costs, prices, and environmental impacts.

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### 1. Introduction

When looking at the electricity generation by resource, fossil fuels are used to produce around two thirds of the world's electricity; coal, natural gas, and oil contribute about 41%, 22% and 5% respectively (International Energy Agency, 2012). Despite the move towards a sustainable worldwide energy system mainly to be based on renewables and possibly nuclear sources, fossil fuels and coal in particular are expected to remain a significant source of energy for several decades (Lucquiaud and Gibbins, 2011). European Union (EU), in its fight for a sustainable and environmentally acceptable source of energy, has set up the EU Emission Trading Scheme (EU ETS) as one of the key tools for reducing industrial greenhouse gases emissions. For 2020, the EU has committed to cutting its emissions to 20% below 1990 levels (European Commission, 2008). This commitment is one of the headline targets of the Europe 20–20–20 growth strategy. Because of exceptionally high investment costs, which for thermal power plant projects can be a few hundred million euros, it is very important to be more aware of all the possibilities and risks involved in these projects.

The aim of this paper is to study the influence of different factors on the financial performance of a coal-fired power plant with particular consideration of the specific location of the plant. The driving factors considered were the investment costs, the burden of

EU ETS, and the influence of different fuel options and their costs. For this research the two cases were analysed based on the assumption that one power plant is positioned in Croatia and one in Bosnia and Herzegovina (BiH). These two countries were selected for a number of reasons. The main reason is the fact that they are neighbouring countries, but with considerably different laws and regulations regarding the electricity sector; the most significant difference being participation in the EU ETS. The South East Europe Regional Electricity Market (SEE REM) is a particularly specific area going through extensive structural changes pursuing the goal of creating a more stable and efficient electricity sector looking up to the EU as a role model for these efforts. Croatia, due to its accession to the EU, is now a “borderline country” extensively involved with the dealings of SEE, but also facing the difficult task of adapting its system to the EU *acquis communautaire*. BiH is not burdened by such laws and regulations; nor are its generating capacities obligated to pay carbon taxes. This offers a unique opportunity to study the impact of the EU ETS on market competitors. One of the main goals of the paper, therefore, is to determine the impact of the EU ETS in terms of creating an imbalance between competitors using the same technology (equally environmentally unfriendly) and operating in the same market, but having different starting positions and obligations due to their country location. Despite the EU ETS being a topic of the utmost importance in the today's electricity sector, there are too few studies that analyse this imbalance. Most focus on the perspective of a single country and different generating technologies, where authors compare a coal coal-fired and liquefied natural gas combined cycle power plants considering

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carbon tax (Jeong et al., 2008), or analyse the impact of the EU ETS on electricity prices (Sijm et al., 2008).

The long-run marginal cost (LRMC) of each plant is calculated based on an analysis that accounts for the relevant technical and policy influences on overall project costs by combining a mathematical model and a simulation model. The former was used to calculate annual costs and the latter to predict of the power plant performance on the electricity market. The overall financial performance of the two investments was obtained through an extension of the original software produced by the authors of this article. The results provide a more reliable tool for evaluating optimal investment in the South East Europe (SEE) power sector. What adds value to this type of research is the consideration of the regulatory environment and the surrounding competition of the power-plant investment.

The paper is organized as follows. Section 2 describes the regulatory framework of the SEE electricity sector and the EU ETS. Section 3 contains the description of the surrounding area and two countries that are of interest for the purposes of this paper. The technical model of the considered power plant is presented in Section 4. The mathematical calculation of the plant costs is discussed in Section 5. In Section 6, both the simulation model used for this study is described and the results of the market analyses are presented. In Section 7 our conclusions are drawn and an outlook for further related research is provided.

## 2. SEE regulatory framework

Recent estimates produced by the International Energy Agency (IEA) predict huge capital investments that will have to be allocated in the European power sector in order provide for the increasing demand for power and modernisation of the current production capacities (IEA, 2010). An increasing number of these investments are achieved by project financing arrangements that raise the importance of financial institutions. Principal concerns from lenders' perspective are sponsor creditworthiness, project commercial viability, and appropriate risk allocation. Other key points required to achieve successful financing are a stable regulatory system, merchant risk mitigation with Power Purchase Agreements (PPA), and application of mature technology (KPMG, 2011). If these points are not satisfactory, investors and lenders will either raise their required compensation or decide not to participate in the project. Banks are willing to fund well-structured projects but look for opportunities with limited risk. To summarise, in order to achieve successful financing of the project, it is important to have sponsor creditworthiness, stability and credibility of the regulatory framework, an established market, low level of country risk, low project-specific risks (such as construction risk), a security plan that is in place, project returns and cash coverage ratios, as low as possible merchant risk.

One of the most important elements for successful project financing is the presence of a national regulatory framework that is capable of ensuring certainty over the long run. Effective institutions have a significant impact on forming and implementing a regulatory framework that will achieve desired outcomes (Jamásb et al., 2005). Regulation refers to the set of laws, sub-laws and methods whose general aim is to provide companies in the energy sector with incentives to improve the efficiency and lower system costs. During the past twenty years, the electricity sector in SEE has gone through extensive economic reforms. As far as the electricity sector is concerned, they were mostly aimed at changing the centralized organization of monopolistic utilities and to introduce market-oriented structures and public regulation. Research has shown that privately owned generating companies are moving faster toward the efficiency frontier (Jamásb, 2002). These reforms

have been additionally motivated by the EU initiative to establish the regional electricity market that would be compatible with the internal electricity market of the EU (Memorandum, ). Trading on the electricity market should afford opportunities to diversify energy sources and develop alternative supply routes (Deitz et al., 2009).

Best practice in regulatory reform involves three aspects: form, progress, and outcome of regulation (Green et al., 2006). All countries of the region inclined to the EU are required to implement the EU Energy Policy and pursue its three fundamental objectives: competitiveness, security of supply and sustainability (Hooper and Medvedev, 2009). With the assistance of EU, the SEE countries have not only a clear reform model to follow, but also access to technical assistance to help with the process. Because of this, SEE is and will be a test of transferability of the EU reform model within the EU as well as its transferability to a set of developing countries (Pollitt, 2009). Power plant operators need decision support with respect to potential investments. The current and future regulatory frameworks are important to ensure efficiency. The main driving factor for the electricity market reform has primarily been the perceived inefficiency of the vertically integrated electricity industry (Helm, 2004).

There is a considerable difference between state and privately owned electricity generating companies; competition and stronger desire for higher profits are expected to drive changes resulting in a more efficient system (Arocena and Waddams, 2002). The electricity industry in developed countries in the early 1980s, for the most part, had excess capacity and an inappropriate generation mix unnecessarily causing elevated costs. The developing countries, to which SEE countries look after, on the other hand, had problems with capacity shortages. Electricity supply was often unreliable and the need for significant investments in generation capacities and the extension of networks was avoided due to the lack of funds (Bergara et al., 1997). During the past decade, there has been a significant increase in the importance of regulation with regard to energy activities. Regulation can have a positive but also a negative impact. In theory, it should protect consumers from monopolies and ensure a more efficient system. The most significant negative effects that regulation may bring are lengthy and costly regulatory procedures and distortions in the energy market. Unregulated markets, however, may lead to imposing costs on costumers that are not consistent with incurred expenses. In addition, without regulation, companies may tend to rely on the less environmentally acceptable sources because of their higher profitability. Environmental regulation can address this issue by lowering the pollution allowed in the process of electricity production. The four most important economic regulatory functions are (Banovac et al., 2007a; Banovac et al., 2007b; Banovac et al., 2009):

- 1) Licensing. The process of issuing licenses to energy undertakings for carrying out certain activities.
- 2) Monitoring. Control and inspection of the licensed activities. Monitoring includes supervising technical and financial performance, as well as ensuring compliance with requirements for staff professional qualifications. It also includes collecting economic data such as prices, costs and revenues, together with general market assessments.
- 3) Setting and implementing tariffs that are linked to price regulation.
- 4) Customer protection. Related to efficient dispute resolution and maintenance of quality of supply.

The aforementioned terms were the main reasons for establishing the Energy Community of South East Europe (ECSEE). It was

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