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## Possibilities of Multiagent Simulation Model Application in the Emission Allowances Trading Area

Jarmila Zimmermannová<sup>a,\*</sup>, Petr Čermák<sup>b</sup>

<sup>a</sup>Moravian University College, tř. Kosmonautů 1288/1, Olomouc, 77900, Czech Republic

<sup>b</sup>Silesian University in Opava, Bezručovo náměstí 13, Opava, 74601, Czech Republic

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### Abstract

This paper is focused on possibilities of simulation of emission allowances trading within the EU emission trading system, using new designed multiagent simulation model, which integrates different original soft computing and decision making methods. Firstly, the paper presents the background of the EU emissions trading system and an overview of different methods used in current research connected with CO<sub>2</sub> emission allowances trading. The great contribution of presented paper is the simulation model. This model consists of submodels like model of emission allowances trading of agents – companies and model of ministerial supervision. Each model is described in terms of unconventional modeling methods (like soft computing and decision making methods). In the discussion part, the possibilities of practical usage of created multiagent simulation model in decision making process in companies and public economics are suggested.

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\* Corresponding author. Tel.: +420777174512

E-mail address: [jarmila.zimmermannova@mvsso.cz](mailto:jarmila.zimmermannova@mvsso.cz), [jarmila.zimmermannova@seznam.cz](mailto:jarmila.zimmermannova@seznam.cz)

## 1. Introduction

### 1.1. The EU Emissions Trading System Background

The European Union established a scheme for emission allowances trading, the EU Emissions Trading System, also called as the EU ETS, dealing with greenhouse gas emissions. The initial EU Emissions Trading System was based on Directive 2003/87/EC, which established a fundamentally decentralized system for the pilot phase of emissions trading (2005 to 2007) and the Kyoto Protocol commitment phase (2008 to 2012). The key instrument here was the preparation of National Allocation Plans (NAPs) (Wettestad et al., 2012). Currently, based on Directive 2009/29/EC, the EU ETS has step into Phase III (2013 to 2020), the post-Kyoto commitment period.

The EU ETS is actually the largest emissions market in the world; however in comparison with energy markets it is relatively small (Conrad et al., 2012). Generally, around 45 % of total EU emissions are limited by the EU ETS (European Commission, 2013).

A sufficiently high carbon price promotes investments in clean, low-carbon technologies. The regulatory framework of the EU ETS was largely unchanged for the first two trading periods of its operation, however the beginning of the third trading period in 2013 brings changes in common rules (based on Directive 2009/29/EC), which should strengthen the system – from year 2013 the most important yield of the emission allowances is auctioned. Sectorial differentiation was introduced, with (initially) far more auctioning of allowances for energy producers than energy-intensive industries. In addition, free allocations were further harmonized, to be based on common state-of-the-art technology benchmarks (Wettestad et al., 2012, p. 73). Policy makers give firms an incentive to move towards production that is less fossil-fuel intensive (Aatola et al., 2013).

In last years, CO<sub>2</sub> became a significant member of the European commodity trading market. However, there is a fundamental difference between trading in CO<sub>2</sub> and more traditional commodities. Sellers are expected to produce fewer emissions than they are allowed to, so they may sell the unused allowances to someone who emits more than the allocated amount. Therefore, the emissions become either an asset or a liability for the obligation to deliver allowances to cover those emissions (Benz and Trück, 2009).

Generally, the market price of the allowances is determined by supply and demand, however, there can be also other so called “price drivers” (Zimmermannová and Menšík, 2013). Both in the first and in the second trading period, the EU emission allowances were traded mostly on the BlueNext trading exchange (BlueNext, 2012). In the third trading period there has only been one big exchange which can be used for emission rights trading – European Energy Exchange – EEX (EEX, 2014).

EEX has offered trading of emission allowances on the basis of the EU ETS since 2005. EEX currently runs a secondary market for continuous trading on a Spot and Derivatives basis for EU ETS allowances (European Emissions Allowances – EUA, European Aviation Allowances – EUAA) and Kyoto credits (CER, ERU). In addition to the secondary market, EEX conducts large-scale primary auctions of emissions allowances on behalf of the EU Member States as well as for Germany and Poland, held four days per week. In the framework of these auctions, emission allowances are issued to the market participants for the first time (EEX, 2014).

### 1.2. Modeling of the EU Emissions Trading System

The authors of particular scientific papers have used various methods for their research connected with the EU ETS. Mainly in last years, we can find scientific studies, which describe particular models of the EU ETS, created with different methods and different targets. For example, Li et al. (2011) used fuzzy modeling (an interval-fuzzy two stage stochastic programming model) for planning CO<sub>2</sub> emission trading in industry systems under uncertainty. Conrad et al. (2012) used GARCH models for modeling the adjustment process of EUA’s prices to scheduled macroeconomic and regulatory announcements. Aatola et al. (2013) created an equilibrium model of the emission trading market for the purposes of the EU ETS price determination, Falbo et al. (2013) created model based on the profit function for tracking of impacts of EUAs on the optimal policy of a competitive electricity producer. Garcia – Martos et al. (2013) used both ARIMA and VARIMA models for building a multivariate model for the aforementioned prices and comparing its results with those of univariate ones, Lecuyer and Quirion (2013) created analytical and numerical model of the EU energy and carbon market for implications of the possibility of a nil

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