Slovak Society of Chemical Engineering
Institute of Chemical and Environmental Engineering
Slovak University of Technology in Bratislava

PROCEEDINGS

52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026

Hotel SOREA TRIGAN
Štrbské Pleso, Slovakia
May 26 - 29, 2026

Editors: Assoc. prof. Mário Mihaľ

ISBN: 978-80-8208-177-3, EAN: 9788082081773

Published by the Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2026

Szaryszová, P., Kuhnová, L., Variny, M.: Quantifying the digitalisation contribution to the management of increasing RES absorption in the electricity market: the case of Slovakia, Editors: Mihaľ, M., In *52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026*, Štrbské Pleso, Slovakia, 2026.

Quantifying the digitalisation contribution to the management of increasing RES absorption in the electricity market: the case of Slovakia

Szaryszová P.[1], Kuhnová L.[1], Variny M.[2,*]

[1]*Bratislava University of Economics and Business in Bratislava, Faculty of Business Economics with seat in Košice, Tajovského 13, 041 30 Košice, Slovak Republic*

[2]*Slovak University of Technology in Bratislava, Faculty of Chemical and Food Technology, Radlinského 9, 812 37 Bratislava, Slovak Republic*

e-mail: miroslav.variny@stuba.sk

Keywords: digitalisation, electricity market, imbalance cost, machine learning, renewable energy, price volatility

The transformation of the energy sector towards sustainable and low-carbon energy sources represents a major challenge for the stable and efficient operation of electricity systems. The increasing share of variable renewable energy sources raises the requirements for system flexibility and complicates the short-term balancing of electricity supply and demand. In this context, digitalisation technologies and advanced data-analytical tools are becoming increasingly important, as they enable more efficient processing of large volumes of data and support more accurate decision-making in energy system management. The aim of this paper is to quantify the contribution of digitalisation and advanced data-analytical tools in managing the short-term balance of the electricity system in Slovakia in the context of the ongoing transition towards sustainable energy sources. The research is based on the analysis of electricity market and power system operation data. The methodological approach includes the construction of analytical indicators, the application of predictive models, and the evaluation of their performance using statistical accuracy measures. The study also considers economic aspects derived from the results of the selected machine learning model and risk indicators such as Value at Risk (VaR), with a particular focus on their impact on imbalance costs and the functioning of balancing mechanisms. The results indicate that imbalance costs increase non-linearly with the market price level, with a fixed imbalance of 100 MWh generating costs ranging from approximately €7,500 under stable conditions to €50,000–€60,000 during stressed market periods. A stochastic analysis based on Monte Carlo simulation reveals an expected imbalance cost of approximately €19,000, while risk indicators confirm significant exposure to extreme price events. The research results in the proposal of a methodological framework that systematically links the statistical accuracy of the LightGBM model with its economic consequences in short-term electricity market environments, providing a basis for improved decision-making under conditions of increasing volatility and renewable energy penetration.

This research paper is a partial output of the project *VEGA 1/0713/24 Digital economy as a key challenge for the transformation of enterprises in Slovakia* financed by the Ministry of Education, Research, Development and Youth of the Slovak Republic.