IMPACTS FROM NEW 50 MW WIND POWER PLANT - BOGDNACI ON THE PRICE OF ELECTRICAL ENERGY IN MACEDONIA

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Annotation
The paper presents the impact from the new planned wind power plant Bogdanci on the price for the end users of electrical energy in Republic of Macedonia. In the next years, 50 MW wind power will be installed in the Macedonian electric power system. Production of electricity from wind power plants is unpredictable and of stochastic nature i.e. depends on the weather or the wind speed at the appropriate locations. Output of wind power plants is changing every minute, thus changing in the hourly level can be from 0 - 100%, even several times depending on the occurrence of winds. Changes in output of wind power plants, leads to increased demand for operational reserve in a power system. Preferential price of electrical energy from the wind power plants and increased operational reserve in the electric power system will have big impact on the final price of electrical energy in Republic of Macedonia.

Keywords
Wind power plants, power system, price of electrical energy, operational reserve.

1 INTRODUCTION

Geographical and weather conditions in Republic of Macedonia do not allow installation of large wind power plants in power system. However there are certain locations where wind speed and its stability, giving the possibility for installing wind power plants.

According to the Strategy of utilization of renewable energy sources in Republic of Macedonia till year 2020 and Energy Law and the Decision of the Regulatory Commission of the Republic of Macedonia, the maximum planned installed capacity of wind power plants in the electric power system is from 150 to 180 MW, with annual expected electrical energy production from 300 to 360 GWh, and the overall electricity produced from wind power plants must be purchased by the market operator with a price of 89 €/MWh. At the end, these costs will be calculated into the cost for using the electricity market, which are payed from the end users of electricity in the Republic of Macedonia.

The question subject of discussion in this paper is what is the impact of 50 MW installed wind power plant Bogdanci and the annual expected electrical energy production of 120 GWh, with a preferential tariff of electricity produced, on the price of electricity in Republic of Macedonia (Fig. 1).

According to the decision of the ERC in 2012, the cost for using the electricity market is 0.0187 den./kWh or 0,3 €/MWh. In this price, the impact of produced electrical energy from renewable energy sources is 85.65%. In this price are not included costs for operating reserves (ancilliary services) resulting from the production of electricity from renewable sources.

Fig. 1 Electroenergetic map of Republic of Macedonia

2 IMPACT FROM THE WIND PARK BOGDANCI ON THE SECONDARY RESERVE

Production of electricity from wind power plants is unpredictable and stochastic nature i.e. depends on the weather or the wind speed at the appropriate locations. Output of wind power plants is changing every minute, thus changing in the hourly level can be from 0 - 100%, even several times depending on the occurrence of winds. Changes in output of wind power plants, leads to increased operational reserve in a power system - on the size of the secondary reserve in the electric power system:

$$SRV_T = \pm\sqrt{SRV^2_{ENTSO-E} + SRV^2_{DYN,WIND}} \quad (1)$$

Where: $SRV_{ENTSO-E}$ - is secondary reserve recommended by ENTSO-E for MEPSO – Macedonian Transmission system operator, and it is 35 MW.
$SRV_{DYN,WIND}$ – is dynamic fluctuations in electric power output from the wind power plants on the secondary reserve in the system.

$$SRV_{DYN,WIND} = \frac{R_\Phi}{2} + \sigma \quad (2)$$

Where: σ - is standard deviation;
R_ϕ - is arithmetic mean of the 10 minute values of maximum and minimum value of the power from wind power plants.

From the data available, standard deviation and arithmetic mean are:

R_ϕ = 24,11 MW
σ = 21,43 MW

And:

SRV_T = 48.5 MW

According to the data that were available for the authors, and according to calculations that were made, it was concluded that the installation of the wind park Bogdanci will contribute to increase the secondary reserve in electric power system of the Republic of Macedonia for additional 13,5 MW.

3 IMPACT FROM THE WIND PARK BOGDANCI ON THE END USERS PRICE OF ELECTRICAL ENERGY

If the price of the secondary reserve is 50 €/MWh (real price for secondary reserve), the Market Operator must to provide additional 5.913.000,00 € for operation reserves (ancilliary services) for operaton of 50 MW wind power plant Bogdanci.

The price for using the electricity market, with instalation of 50 MW wind power plant in the Macedonian electric power system will be 0.1006 den./kWh or 1,64 €/MWh and the end users price will be 71,68 €/MWh which is increment of 2,34 %.

From here we can conclude that the true price of electrical energy from the wind power in Macedonia is not 89 €/MWh, but it is 138,27 €/MWh.

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