






Integrated Use of Photovoltaic and Wind Power Plants in Power Supply Systems



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Abstract The use of energy from only one type of renewable energy source (e.g., solar and wind generation) leads to a significant increase in the cost of electricity supply due to the need to install a backup power source (energy storage system or power system). This phenomenon is caused by the significant dependence of these sources on weather conditions. The wind speed is less than 4 m/s for a long time in summer, and solar energy is not available at all in dark day periods, which in December can last up to 16 h. Accordingly, the effective use of such systems is possible only if constructing a complex application of several sources of different nature (solar and wind generation). This measure allows increasing their energy efficiency by 30–50%. The combined use of these types of distributed generation is accompanied by the equalization of the daily energy intake due to the spread of the annual maximums of energy intake, but the daily fluctuations remain pretty significant. As a result of the conducted researches, it is established that when using the share of solar energy at the level 0.4... 0.55 of the total amount, the shortest period of energy deficit (at the level of 8 days per year) is observed. At other ratios between the shares of solar and wind energy, the period of energy deficit will increase. In case of increased requirements for providing responsible consumers with electricity, it is advisable to use systems with buffer electricity storage. The developed mathematical models allow calculating the equipment parameters used in the construction of efficient power supply systems.

Keywords Renewable energy sources · Wind and solar generation · Power supply systems · Buffer batteries · Energy storage devices

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3 Conclusions

1. Effective use of RES in power supply systems is possible only if the construction of a complex application of several sources of different nature (solar and wind generation). It is essential to calculate the optimal share of a given energy source;
2. Proposed mathematical models allow the calculation of the parameters of the equipment used in the design of efficient power supply systems based on generated electric power.
3. Statistical data and conducted research showed that the lowest number of days in the year with a shortage of electricity was observed with a particular share of wind and solar generation. The obtained dependence showed that with the share of solar energy at the level 0.4... 0.55 of the total generation, there is the shortest period of energy deficit (at the level of 8 days per year). In the cases of higher requirements for the reliability of power supply, such systems should be equipped with buffer storage of electricity with appropriate parameters.

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