

Project name: IRN AP14872147 «Development of an efficient power supply system for autonomous consumers based on a wind farm of a special design».

Relevance: In conditions of increasing energy consumption, it is important to reduce costs in the power supply system. This is relevant for autonomous consumers, who are usually low-power, and in agriculture, electricity consumption can also be seasonal, which leads to high costs.

The use of renewable energy will reduce the cost of energy consumed by replacing organic fuels. The climatic and natural conditions of the Republic of Kazakhstan provide ample opportunities for the use of wind energy.

The solution to this problem is possible by improving the wind turbine using a special design. The principle of rotation of the anchor and inductor parts of the generator from separate counter-rotating wind wheels is proposed.

Purpose: The purpose of the project is to develop an efficient power supply system for autonomous consumers based on a special design wind farm with increased electric power generation.

Expected and achieved results: The experience and conditions of using renewable energy in the power supply system will be analyzed and the structures of the power supply system using a wind power plant will be presented. The experience and terms of use will be systematized: wind energy, traditional energy sources and renewable energy in the autonomous power supply system. Based on the results of the research, a scientific article or review will be published in a peer-reviewed foreign or domestic publication recommended by CQAFES of the Ministry of Education and Science of the Republic of Kazakhstan. An application for a patent or utility model of the Republic of Kazakhstan will be submitted. An application for a patent of the Eurasian Patent Organization will be submitted. In the course of the study, the following will be determined: the main design and operating parameters of the wind turbine and their relationship based on the simulation of the power generation mode; aerodynamic characteristics of the wind wheel with the definition of the main parameters and indicators, such as the speed of the wind wheel, the developed moment. Models of interaction will be developed: wind flow with wind wheels, wind flow-wind wheel-electric generator. The following will be developed: a laboratory model of a wind turbine of a special design; a model of the wind-mechanical part of a wind turbine based on two; a model of an electric generator and a wind turbine. A pilot design sample of a wind turbine of special design for power supply systems will be created. The research results will be published in scientific articles and (or) reviews in peer-reviewed scientific publications in the scientific direction of the project, indexed in the Science Citation Index Expanded of the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 35 (thirty-five), in scientific articles or reviews in a peer-reviewed foreign or domestic the publication recommended by CQAFES MES RK. Applications for patents or utility models of the Republic of Kazakhstan will be submitted. Applications for patents of the Eurasian Patent Organization will be submitted. A wind turbine of a special design for power supply systems will be tested. The methodology and program of the

experiment will be developed. Conducting an experiment and collecting data. Analysis of experimental data and experimental results. The report of the scientific project will be issued and published. The research results will be published in scientific articles and (or) reviews in peer-reviewed scientific publications in the scientific direction of the project, indexed in the Science Citation Index Expanded of the Web of Science database and (or) having a Cite Score percentile in the Scopus database of at least 35 (thirty-five) and in scientific articles or reviews in a peer-reviewed foreign or domestic publication, recommended by CQAFES MES RK. A textbook and a monograph will be published in a domestic publishing house. As a result of the project implementation, the project supervisor will prepare one Doctor of Philosophy (PhD) and one Master of Technical Sciences in the group of educational programs M135 - Energy supply of agriculture.

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Information for potential users: To disseminate the results of the work among potential users, the community of scientists and the general public, the results of the project will be reported at scientific conferences, seminars, forums, published in domestic and foreign publications.

Additional information: A high social and economic effect will be obtained.

Achieved results (for 2022).

1. The experience and conditions of using renewable energy in the power supply system using a wind power plant are systematically analyzed. The study of domestic and foreign scientific, technical and patent-licensing information in the direction of research was carried out. The demand for small wind power plants (wind turbines) for agricultural facilities has been revealed, which creates prerequisites for the research and development of energy-efficient wind power systems for autonomous power supply.

2. The experience and conditions of using traditional energy sources in the autonomous power supply system are systematized. The analysis showed that the existing power supply schemes of industrial enterprises meet the necessary requirements for power supply. The power supply of agricultural consumers and settlements in rural areas looks somewhat different due to its peculiarity, the presence of a large number of low-power and dispersed consumers of electric energy over a large territory. The transmission of electric energy through rural electric networks, due to the length, requires high costs for their operation. At the same time, 75% of the cost of electricity is accounted for by its transmission. In order to maintain food security, it is necessary to develop agriculture. An important factor of development is the energy supply of consumers, first of all, the provision of high-quality electric energy.

3. The dynamics of the introduction of new capacities based on renewable energy over the past decade shows a steady increase in new capacities and the installed capacity is almost doubling. At the same time, the largest increase is observed in wind and solar energy. The development of renewable energy sources for the power supply of remote rural facilities will solve a number of important problems: effectively use all energy sources of remote areas for power supply by creating an autonomous power supply facility and ensure an uninterrupted process of production and consumption of produced energy due to the systematic operation of two or more renewable energy plants. Among renewable energy sources, wind power plants have received great development, since they are less capital-intensive. To use wind energy in the power supply system of remote rural facilities, it is necessary to study its features.

4. The experience and conditions of using wind energy for autonomous power supply are systematized. When analyzing the literature sources, it was revealed that the main indicator for evaluating the efficiency of wind power is effective structures for a territory with a low speed of wind flows. About 50% of the territory of Kazakhstan has an average annual wind speed of 4-5 m/s, and a number of districts have a wind speed of 6 m/s or more, which determines very good prospects for the development of low-power wind power.

Under these conditions, the development of low-power wind turbines of special design, generating electric energy at low wind speed, will increase the efficiency of wind use. Such wind turbines are in demand for power supply to low-

power agricultural consumers, and are more relevant for remote ones where autonomous power sources are required.

List of publications and patents filed published within the framework of a scientific project (with links).

1. S.S. Issenov, A.B. Kaidar, B.K. Shapkenov, S.K. Sheryazov Study of wind turbines in the autonomous power supply system. // Bulletin of Toraighyrov University, Pavlodar. Energy Series, No. 3. 2022. pp. 80-97. ISSN 2710-3420. The scientific journal is recommended by CQAFES MES RK. <http://vestnik-energy.tou.edu.kz/storage/journals/165.pdf>.

2. A.B. Kaidar, S.S. Issenov, S.K. Sheryazov Autonomous wind-solar power plants for agricultural consumers. // Collection of materials of the International Scientific and Practical Conference «Seifullin readings 18(2): «Science of the XXI century-the era of transformation», Volume I, part IV, (October 6, 2022): - Astana, 2022. - pp. 164-168. ISBN: 978-601-257-232-2. https://kazatu.edu.kz/ru/pages/nauka/novosti-nauki_20220121052309/sborniki-naucnyh-konferencij.

3. An application has been filed for obtaining 1 (one) patent or utility model of the Republic of Kazakhstan. The application was assigned registration number No. 2022/0738.1 dated 21.11.2022.

4. An application has been filed for obtaining 1 (one) patent of the Eurasian Patent Organization. The incoming number of the national office is 2022-53506. Registration number of the application in the national Office 2022/066 dated 22.11.2022.