

PROSPECTS FOR THE DEVELOPMENT OF RENEWABLE ENERGY SOURCES IN AGRICULTURE IN ARMENIA

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Introduction. In recent years, there has been active development of alternative energy sources. The leaders in this field are the countries of Europe and the USA, Germany, China, and Japan. Having achieved record figures for increasing the share of renewable energy sources in its energy balance, Germany has for many years continued to be the leader among the EU countries in terms of CO₂ emissions into the atmosphere. The Germans, consistently closing nuclear power plants, began to increase coal imports from Russia to make up for the missing electricity. A paradoxical situation was formed: to «green up» its energy sector as much as possible, Germany, on the contrary, increased "dirty" coal generation. Even in Denmark, that switches to renewable energy by 2050, disputes about economic efficiency of renewable energy sources leads to skepticism. Recently, there have been too many high-profile examples of projects that have not been implemented that are related to renewable energy [Khomushku et al., 2019, 67-72].

One of the main disadvantages of renewable energy sources is the dependence on external factors (the presence of solar radiation, wind, and so on) and the instability of electricity generation. To compensate for the differences that arise, again, it is necessary at the expense of basic generation. Technologies related to the accumulation and storage of renewable energy sources can solve this fundamental problem. It is the creation of industrial storage devices that can accumulate very large amounts of energy that will make it possible to make a final and total transition to «green» energy.

Methodology. We use theoretical and empirical research methods. As a result of the work, we made references to scientific materials of such authors as Khomushku O.A., Kuzhuget D.V., Platashin V.S., Shevchenko T.V., Kodirov R.S., Kiryigitov B.A., Libontova T.S., Akulova A.S., Galushko M.V., and others. Each of these papers examines in more detail one of the issues related to the topic of this study. Thus, the literature used revealed such issues as alternative energy sources in agriculture; bioenergy in the sustainable development of agriculture, problems and prospects for the development of the industry; prospects for the development of renewable energy sources; economic efficiency of alternative energy use, and others.

Literature review. There has not yet been a real breakthrough in this direction. Although the existing developments, which are mainly at the startup level, have been

actively conducted for more than one year. If modern lithium-ion batteries give only about 60% of the electricity that was spent on charging them, then this indicator exceeds 90% for supercapacitors. The company "TEEMP" is going to produce up to two hundred thousand supercapacitor cells per year. These modules have already been able to pass successful pilot tests in public transport, on the railway, and in aviation. Large corporations that conduct research in the field of developing unique models of energy storage devices do not lag behind global technological trends. According to the reports of the analytical company Navigant Research, the annual volume of the global electricity storage market will amount to about eighty-three billion dollars in 2025 (annual growth rates - up to 60%). Moreover, almost a third of this volume will fall on commercial and industrial enterprises, industrial equipment, and households [Rednikova, 2020, 31-36].

The size of the Armenian storage market is estimated from \$300 million to \$800 million per year. That is why supporting the formation of a new high-tech industry in Armenia, which is connected with energy storage systems and their components, is a very important task today. At the same time, one of the main drivers of the growth in demand for energy storage systems will be an increase in the number of "digital" productions with increased requirements for the quality of electricity. The main effects of the use of energy storage devices in the industry are quite obvious - it is a reduction in losses from the shutdown of production activities during power outages, a reduction in the cost of those connections and the electricity itself, savings on fuel consumption and maintenance of diesel generators, the development of related industries. The effect of creating a new high-tech industry that provides import substitution is estimated at seven to eight billion rubles of revenue per year at a localization level of 50%.

Analysis. From 2020 the level of projected electricity prices will be equal to the "upper" limit for industry and even slightly exceed it. At the same time, this price level will continue to be close to the "lower" limit. It follows from this fact that with a similar price level, problems can begin in the industrial sector. At the same time, the electric power industry as a whole will not begin to feel an excess of funds. Based on all this, there is a consequence that without the introduction of innovative resource and energy-saving technologies, without changing pricing principles, and without optimizing invested programs, the current balance of investors and producers will not be achievable [Platashin, et al., 2019, 75-81]. So, as mentioned earlier, one of the most innovative technologies that can qualitatively increase the efficiency of energy generation and significantly reduce the cost of electricity in the future is distributed energy generation networks based on renewable sources. Alternative energy sources are among the most innovative types of energy used today. The main types of renewable energy sources include hydropower, wind energy, and solar energy. In some places on our planet, there is an opportunity to develop wave and geothermal energy. Distributed generation based on renewable energy sources is one of the most relevant and promising areas of energy

development worldwide. These technologies play a key role in improving the reliability and quality of generated and supplied electric energy. One of the positive arguments for the implementation of distributed generation based on alternative sources is the absence of potential man-made disasters. This factor is especially relevant from the position of strengthening energy security in local territories [Libontova et al., 2019, 56-63]. Power plants based on renewable energy sources can be integrated into centralized networks. This scenario is most relevant when the capacity of a power plant based on alternative sources ranges from several tens of kilowatts to several megawatts. It is also worth emphasizing that with a low power source of energy, it is most expedient to install it nearby relative to the end-user. The most relevant role of distributed sources of energy generation belongs to the case in which the end-user has a remote location. In this case, distributed sources of energy generation based on renewable sources will become the most economically and technically efficient technical solution for the delivery of electricity. The studied technical solution makes it possible to solve several urgent tasks, taking into account the current difficulties in traditional energy, in particular, in power supply systems for remote consumers. The installation of autonomous energy sources based on renewable energy sources makes possible to compensate the cessation of electricity generation by other (centralized) power plants more quickly and in real-time.

One of the main factors determining the feasibility and relevance of integrated distributed sources of energy generation based on renewable sources is the assessment of their effectiveness. Thus, the efficiency of the integration of this technology into the energy balance is determined by several factors. One of these factors is an assessment of potential; rationality of placement on the landscape; environmental assessment and others. Distributed generation based on renewable energy sources is characterized by chaotic construction. In this regard, there is a need to change the network topology due to changes in power flows. To solve this problem, various means of intelligent control or full-fledged distributed generation networks at the borders of individual regions are integrated into the modern distributed generation energy complex. It should be noted that the full potential and efficiency of integration of distributed energy generation systems based on renewable sources can be achieved in the presence of intelligent solutions, in particular, intelligent energy networks [Kodirov et al., 2021, 20-23]. The efficiency of power plants using renewable energy sources is judged by the results of technical and economic calculations. When performing them, the energy and design parameters of the power plants under consideration should be taken into account separately. For comparison, a traditional power plant operating on hydrocarbon fuel (for example, a diesel, steam turbine, or gas turbine power plant of low power) is taken as a possible option. At the same time, it is assumed that a conventional power plant has similar energy characteristics (in terms of power and the amount of electricity generated, taking into account the type of fuel consumed). This approach ensures comparability

of different types of power plants when performing calculations of the comparative economic efficiency of their use for energy supply to an isolated consumer. The determining value from the point of view of assessing the effectiveness of investments in a specific project for obtaining energy from renewable energy sources is cost indicators, primarily the specific cost of capital investments in 1 kWh of installed capacity of a power plant. So, for Russian-made BSU, capital investments in 1 kW of installed capacity range from \$200 to \$500, depending on the configuration, and for foreign analogs \$250-750 / kW.

Concerning the use of non-traditional and renewable energy sources in the national economy, it proceeds from the following provisions. It is believed that the rational use of renewable energy sources and local fuels is important in the implementation of regional energy policy. The need to use these types of energy is determined by their essential role in solving the following problems [Zhaksylykov et al., 2019, 131-141]:

- ensuring sustainable heat and electricity supply to the population and production in the zones of decentralized energy supply, primarily in the regions of the North and territories equated to them. The volume of fuel imported to these areas is about 7 million tons of petroleum products and more than 23 million tons of coal;
- ensuring a guaranteed minimum of energy supply to the population and production in centralized power supply zones experiencing energy shortages, preventing damage from emergency and restrictive shutdowns;
- reduction of harmful emissions from power plants in cities and settlements with a difficult environmental situation, as well as in places of mass recreation of the population.

Conclusion. Unfortunately, alternative energy sources in Armenia today and in the near foreseeable future will not be able to fully replace traditional energy carriers. The energy of the sun is not capable of becoming such a source on an industrial scale for a simple reason – the low density of the solar energy flow. Taking into account the fact that only 2700 hours in year is sunny in Armenia: more than 30% of the republic's territory must be given over to solar power plants to meet its electricity demand. Modern progress in the energy field sets trends in the development of global energy based on renewable energy sources in the context of a promising concept of a "smart" energy system. The global energy community regularly continuously studies issues related to "green energy", that is, energy generation based on renewable sources, the type of generation which leads to the development of the concept of distributed energy [Libontova et al., 2019, 56-63]. The scientific significance of the presented work lies in the possibility of using the materials in further research aimed at designing and developing innovative energy supply systems in remote areas. The unique results of the study of the efficiency of integration of renewable energy sources were presented. As a result of the analysis, conclusions were obtained that shortly electricity prices may run

into their limit. Based on what, it is the use of renewable energy sources that can be the solution to overcome this crisis. That is why the development of alternative energy technologies can be considered a powerful driver of innovative development and the basis for the formation of a low-carbon («green») economy - the economy of the future, characterized by high technology, and energy security, and minimal impact on the environment. One can say the following: in the coming decades, developed countries will have economies with a new innovative and scientific, and technological basis.

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Narine KIRAKOSYAN, Gevorg KARAPETYAN, Gevorg HARUTYUNYAN Prospects for development of renewable energy sources in agriculture in Armenia

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Analysts consider the key problem of bioenergy in Armenia to be the fact that biogas plants are profitable only with a free and uninterrupted supply of waste. In addition, bioenergy producers need a guaranteed sale of the electricity produced, which is not yet observed in Russian conditions. Over the last period of development, several dozen small biogas plants for individual farms have been implemented by several Russian companies, among which the leading place is occupied by specialized institutes, in particular, the Institute of Electrification of Agriculture together with metalworking enterprises. The development of large industrial installations lagged behind small construction. In the last 10 years, only two large-scale projects have been implemented. Based on this, the problem associated with the development of alternative energy sources in agriculture is being actualized. The presented work is devoted to the study of the prospects for the development of renewable energy sources in agriculture in Armenia. We use scientific materials of domestic and foreign authorship, as well as theoretical and empirical research methods. The predominant part of the work is devoted to the study of problematic issues of the development of renewable energy sources in the agriculture of the country of Armenia.