PROMISING DEVELOPMENT OF THE AGRO-INDUSTRIAL COMPLEX BASED ON THE INTEGRATION OF ALTERNATIVE ENERGY SOURCES

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Introduction. The energy sector is an integral part of the practical in each of the areas of human life in the modern world. Alternative energy sources that are actively used today have many features and advantages over classical energy sources. The concept of "alternative energy" includes three main components, presented in figure 1:

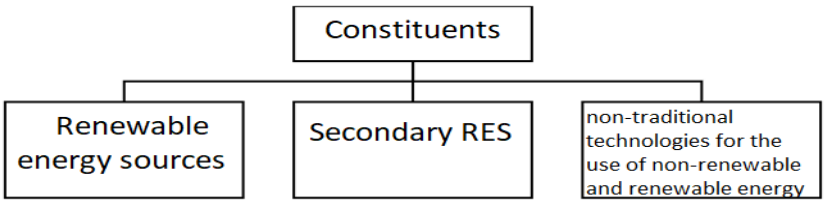

Figure 1. The main components of alternative energy sources

Most of the non-traditional energy sources are based on traditional principles, but at the same time, both local sources (geothermal, wind, etc.) and sources that are in the development status serve as primary energy in them, examples of which are fuel sources and elements, capable of finding applications in the future (thermonuclear energy, etc.). Fi-gure 2 shows an analysis of alternative energy sources that are actively developing in the field of agriculture today [Pavlova, 2013, 23-27]. The key features of non-traditional energy sources are their environmental friend-liness, as well as the enormous costs of capital construction and low unit capacity. For example, for the construction of a solar power plant in the agricultural complex of Armenia, with a capacity of 1000 MW, it will be necessary to attract expensive mirrors with an area of 4 km2.

Methodology. As a result of the work, theoretical and statistical research methods were used. To obtain the most relevant and objective data, statistical data were studied regarding the prospects and effectiveness of the integration of alternative energy sources. Due to the fact that the agro-industrial complex of Armenia is located remotely from the main generating stations, the issue related to the development of distributed generation based on alternative energy sources is of particular relevance. Statistical information is analyzed that reflects the essence of the current situation on this issue, and forecasts for

the coming years are made based on the results of the study. The sources of information in the work were various scientific materials published in domestic and foreign publiccations. So, for example, the work analyzed the scientific materials of such authors as: Esenov I.Kh., Eloeva R.K., Kenden, KV, Penjiev A.M., Mamedsakhatov B.D., Baranova MP, Klipatsky VN, Amuzade AS and others. In each of these works, the essence of the issue concerning the study of the field of application of alternative energy sources is separately disclosed. So, for example, in the materials used, such questions were raised as: actual problems of energy in agriculture; improvement of the food source in agriculture; autonomous power and water supply to desert pastures using solar photovoltaic installations and a number of others.

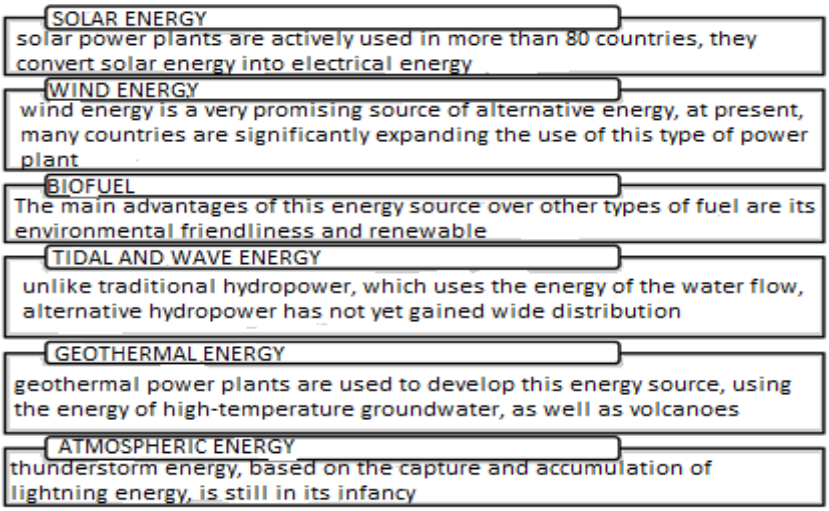

Figure 2. Analysis of alternative energy sources

Literature review. At present, the population of the Earth is increasing at a progressive rate, as well as the intensification of people's need for resources of various nature, including the electric power industry. Referring to the statistical information of the International Energy Agency, it can be said that electricity is at the center of the modern economy and provides a growing share of energy services. Demand for electricity in the coming years will increase as a result of rising household incomes, electrification of transport and heating, and an increase in demand for digital devices. Growth in demand for electricity was one of the key reasons why global CO2 emissions from the energy sector hit record highs in 2018, but the commercial availability of a diverse range of low-emissions generation technologies also helps guide efforts to fight climate change and pollution . In addition, decarbonized electricity [carbon-free energy sources] can become a platform for reducing CO2 emissions in other sectors with electricity-based fuels such as hydrogen or synthetic liquid fuels [Esenov, Eloeva, 2013. 11-15]. The need for energy system flexibility for Armenia's agriculture is growing even faster than the de-

mand for electricity, due to the growing share of variable renewable energy sources and the growing demand for both carbon reduction and electric vehicles. Power plants and power generation and transmission networks continue to be the backbone of power system flexibility. In this concept, renewable energy also plays an important role in ensuring access to electricity for all, and it is renewable energy that allows us to talk about a more sustainable development of the world, therefore, the Armenian Energy Agency pays attention to two concepts for the development of electricity in the agricultural field, presenting two scenarios: a modern policy in the field of the electric power industry and a policy of sustainable development of the electric power industry. In general, one can see in figure 3, which shows the dynamics of the development of energy sources in accordance with the above scenarios [Kenden, 2012, 34-39.]: figure 3 shows the dynamics of 2018-2040. terawatt-hour in two scenarios: current energy policy (left) and sustainnable electricity policy (right): light blue - coal, blue - natural gas, green - oil, turquoise - nuclear sources energy, yellow - hydropower, orange - wind energy, red - solar energy, purple - other sources of renewable energy. As you can see, the difference between the first policy and the second is significant.

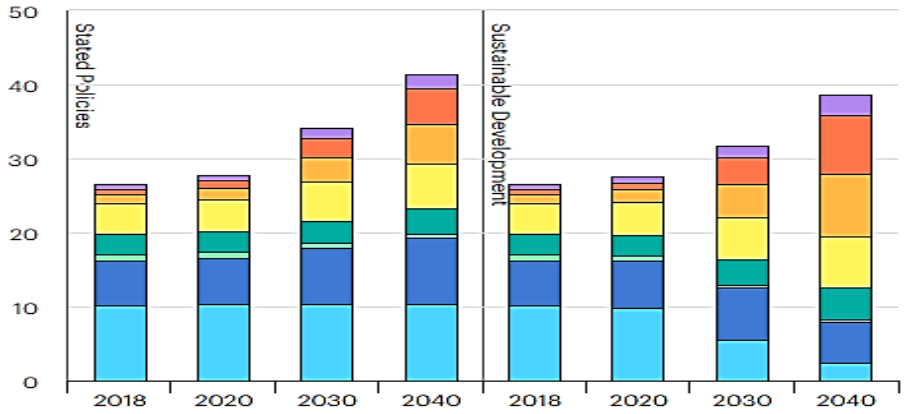

Figure 3. "Scenario" of fuel generation and its dynamics

The first policy assumes a "stop" on gas, coal and oil as the prevailing energy sources, which will further worsen the environment, while the sustainable development scenario allows us to talk about the dominance of renewable energy sources by 2040, which will significantly improve the environmental situation on the territory of Armenia. And, in principle, we can say that such a concept as distributed generation will help to achieve a paradigm of more conscious generation of electricity, as well as its use, which determines the relevance of our topic [Pendzhiev, Mamedsahatov, 2007, 112-115].

Analysis. So, as mentioned earlier, one of the most innovative technologies that can qualitatively increase the efficiency of energy generation and, in the long term, significantly reduce the cost of electricity for the agricultural segment of Armenia, are

distributed energy generation networks based on renewable sources. Alternative energy sources (RES) are among the most innovative forms of energy in use today. The main types of renewable energy sources include: hydropower, wind power, solar power [Baranova, 2016, 39-47].

Distributed generation based on renewable energy sources is one of the most relevant and promising areas for the development of the energy sector to supply energy to agriculture in the territory of Armenia. These technologies play a key role in improving the reliability and quality of the generated and supplied electrical energy. One of the positive arguments in favor of the implementation of distributed generation based on alternative sources is the absence of potential man-made disasters. This factor is especially relevant from the standpoint of strengthening energy security in local areas.

With regard to specific conditions, power plants based on renewable energy sources can be integrated into centralized networks. This scenario is the most relevant when the power of the power plant based on alternative sources is from several tens of kilowatts to several megawatts.

It is also worth emphasizing that with a low power source of energy, it would be most expedient to install it in close proximity to the end user. The most relevant role of distributed energy generation sources belongs to the case in which the end user has a remote location. In this case, distributed energy generation sources based on renewable sources will become the most economically and technically efficient technical solution for delivering electricity. The technical solution under study allows solving a number of urgent problems, taking into account the current difficulties in traditional energy, in particular, power supply systems for remote consumers [Trachuk, Linder, 2018, 231-236].

Continuing the conversation about the relevance and efficiency of the use of RES in agriculture in Armenia, it should be noted that the installation of autonomous energy sources based on renewable energy sources allows much more quickly and in real time to compensate for the interruption of electricity generation by other (centralized) energy installations .

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 effectiveness of integrating this technology into the energy balance is determined by a number of factors. Some of these factors are: capacity assessment; rationality of placement on the landscape; environmental assessment and others. Distributed generation based on renewable energy sources is inherently random in construction. In this regard, there is a need to change the typology of the network due to changes in power flows.

To solve this problem, in the modern energy complex of distributed generation in Armenia, various means of intelligent control or full-fledged networks of distributed generation are integrated at the borders of individual regions. It should be noted that the full potential and efficiency of integration of distributed energy generation systems based on renewable sources can be achieved with the availability of intelligent solutions, in particular, intelligent energy networks.

In general, it should be noted that distributed generation based on RES is a rather relevant phenomenon in modern electric power industry, which is confirmed by the experience of use in Denmark, Sweden, the USA, Norway and other countries. However, in Armenia, the concept of distributed generation also finds a synergistic response with the country's socio-economic development strategies. For example, back in 2016, according to a statistical study by the "Skolkovo" Innovation Center, the total installed capacity of power plants in Russia and neighboring countries reached 255 GW, of which about 237 GW is accounted for by centralized energy supply, represented by thermal power plants, hydraulic power plants, nuclear power plants and renewable energy sources [Klimovec, Zubakin, 2016, 11-16].

Distributed generation systems are widely used in the world. The "Skolkovo" Innovation Center conducted a study, as a result of which the relevance of distributed generation in the world was analyzed, which can be seen in figure 4:

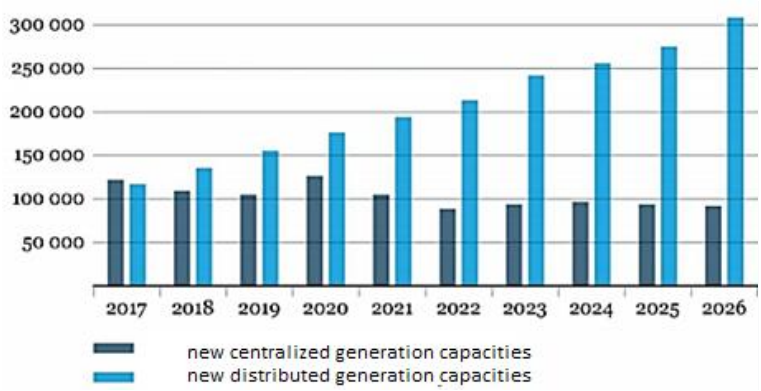

Figure 4. Forecast of commissioning of new capacities in the world, MW

As can be seen in fig. 4, by 2026 more and more distributed generation capacities will appear, but centralized generation and its capacities will gradually reduce their influence in the electric power industry. Moreover, the International Energy Agency assumes that after 2020 the world will begin a functional transition to greater use of renewable energy sources, which can be seen in figure 5 [Klipatsky, Amuzade, 2018, 21-27]:

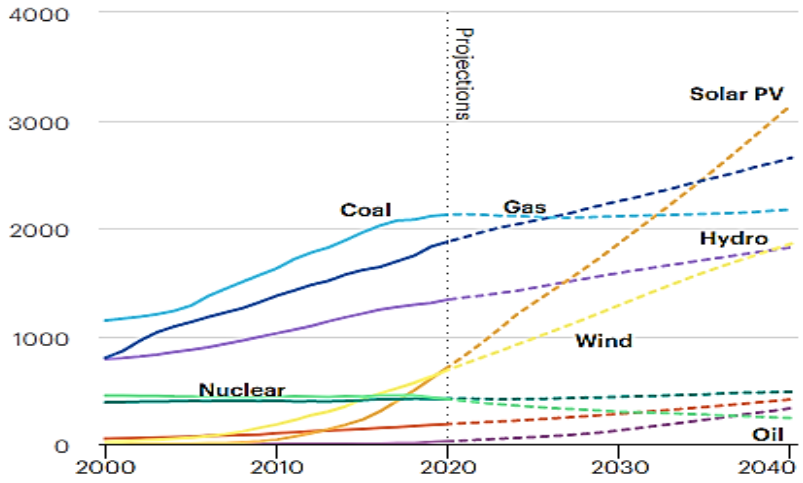

Figure 5. Installed generation capacity by source

Figure 5 shows the development scenario for 2000-2040, blue - coal, blue - natural gas, green - oil, turquoise - nuclear power, yellow - wind power, orange - solar power, red - other renewable sources, purple - hydropower, purple - rechargeable batteries.

Conclusions. Relative to the US and EU countries, the use of RES in agriculture in Armenia is at a low level. This situation can be explained by the availability of traditionnal fossil fuels. In parallel with this, one of the main barriers to the construction of large power plants based on renewable energy sources is the absence of a provision on an incentive tariff at which the state would buy electricity produced on the basis of renewable energy sources.

Modern progress in the energy field sets the trends for the development of the country's energy sector based on renewable energy sources in the context of the promising concept of a "smart" energy system. The Government of Armenia regularly allocates funds to study issues related to "green energy" and its use in agriculture that is, the generation of energy based on renewable sources, the type of generation of which leads to the development of the concept of distributed energy and, as a result, is able to provide prerequisites for the promising development of agriculture economy of the country.

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The presented work highlights in more detail one of the most pressing issues in the field of the agricultural complex of Armenia, associated with its development based on the integration of alternative energy sources. The economic development of the agro-industrial complex is highly relevant today. This factor is connected with the fact that this complex is the most important part of the modern economic system through which the modern population is provided with food. The main purpose of this article is to study the development of the agro-industrial complex through the development and implementation of alternative energy sources. The author works through the application of theoreticcal and statistical research methods. The work also uses scientific materials of foreign and domestic authorship. The main subtasks of this article are the study of the following aspects: the relevance of the development of the energy sector; the main components of alternative sources of energy; analysis of alternative energy sources; features of non-traditional energy sources; relevance and efficiency of integration of alternative energy sources in the agro-industrial complex of Armenia; necessity of development of distributed energy generation. The author analyzes not only the current situation around the presented issue, but also makes a prediction of the development of the issue for the coming decades.