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FOREIGN AND UZBEKISTAN EXPERIENCE IN MAPPING ALTERNATIVE ENERGY RESOURCES

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ABSTRACT: In this article, the international and national experience of using alternative energy resources at the regional and local level, the rational use of alternative energy resources to provide electricity to all sectors of the economy, solving technological problems, bringing the legislation to the level of international requirements, ensuring the financial support of the relevant projects by the state, analyzing the territorial distribution of various alternative energy resources, first of all, issues such as carrying out geodetic and cartographic studies that assess the possibility of alternative energy resources and determine the rules of placement are reflected.

KEYWORDS: EU, USA, Japan, China, India, Denmark, Spain, Portugal, Ireland, Lithuania, Alternative energy resources, GAT, Commonwealth Scientific and Industrial Research Organisation CSIRO, International Renewable Energy Agency, IRENA, Google Maps.

INTRODUCTION

By the 21st century, natural hydrocarbon resources (coal, oil, natural gas, uranium) are the basis of the world energy balance. In the consumption of energy resources, the world's oil reserves can reach 45-50 years, natural gas - 70-75 years, coal - 165-170 years, lignite - 450-500 years. Therefore, the maximum use of environmentally safe alternative energy resources is one of the most urgent global problems of today.

The analysis of the use of alternative energy resources at the world level shows that today the European Union countries, the USA, Japan, China and India have achieved high results in the use of non-traditional types of renewable energy. There are more than 2 million solar thermal systems in the world. Israel has more than 800,000 solar installations that provide 70% of its hot water supply. North and South America, as well as some European countries (Denmark, Spain, Portugal, Ireland, Lithuania) widely use wind energy located mainly on the seashore.

Alternative energy resources are versatile and, therefore, their design, deployment, and continuous operation are diverse. However, there is no single idea about the purpose of creating such technologies in order to evaluate their deployment options - how and where, in which areas

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and in what quantities. For example, English and Russian researchers have pointed out that wind turbines and devices that use low-level heat are not used for regions with low temperatures in the cold season.

It is necessary to take into account the nature of each place and its socio-economic possibilities when using alternative energy resources in energetic quality. Geographical features of alternative energy resources are clearly shown in the cartographic atlas of Russian researchers O.S.Popel and S.E.Fried. It comprehensively reflects the region's natural resources (climate indicators, relief, natural resources, hydrological and hydrothermal resources), economic status (energy infrastructure, energy balance, power transmission lines, energy-using production sectors, agriculture) and social indicators (population, population density, employment, etc.). On the other hand, these data must be collected, modernized and displayed, transformed and analyzed quickly. Estimate costs are planned by forecasting based on this information.

In recent years, comprehensive geographic assessment of alternative energy resources has become extremely important. Because it is urgent to start using wind or bioenergy sources without leaving energy tools idle on days without sun. The use of geoinformation technology tools, including the geographic information system, is very effective in solving the use of hybrid power plants from a territorial point of view. An example of this is the experience of using GAT technologies at the stations of alternative energy resources located on the continental shelf of the Netherlands.

Limiting factors in this project:

- marine transport corridors and activity intensity;
- development of oil fields and laying of pipelines;
- flyways of bird migration populations on a regional and global scale;
- the real situation and processes, such as the traffic of military tanks and the possibilities of movement, were also taken into account.

Individual and complex consideration and assessment of various factors through GAT made it possible to forecast not only socio-economic, but also environmental aspects of the placement, construction and operation of electric power facilities. Territorial classification through GAT or its consideration and assessment by area: local, regional, national, global scale. In addition, single and multi-component assessment methods are used through GAT. In this:

- alternative energy resources climate and meteorological data;
- physical and chemical properties of geothermal deposits;
- description of hydrogeological wells;
- hydrological;
- derivatives of personal activity;
- demographic status, etc.

Economic opportunities in the design of power plants using alternative energy resources:

- engineering-technological description;
- economic efficiency;

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- energy balance of the region;
- activities of corporate entities;
- size and scope of investments;
- tax benefits;
- staff costs are also taken into account.

Social situations of using alternative energy resources:

- creating employment and potential jobs for the population;
- ratio of jobs to energy capacity;
- indicators such as waste and public health are taken into account.

Factors affecting the environmental situation in the use of alternative energy resources:

- hazardous waste;
- soil and water ecology;
- indicators such as radiation safety have to be comprehensively assessed.

Examples of alternative energy resource mapping, data visualization, and visualization software products produced by the National GAT include the Vermont Renewable Energy Atlas. The Atlas was created at the US National Renewable Energy Laboratory (NREL USA). It contains maps of natural resource assessment, i.e. alternative energy resources such as bioenergy, geothermal energy, small hydropower, solar and wind energy. But the atlas focuses more on statistics on Vermont's renewable energy facilities and resource components. Therefore, this atlas is not intended for specialists, but for the general public. The shortcoming of US national alternative energy resource atlases is that they do not fully cover the environmental safety and natural resource limitations aspects of the indicated energy devices and do not allow them to make appropriate local decisions.

The information on the alternative energy resources utilization map was created at the NREL USA laboratory based on the national GAT. In terms of breadth of topics, volume of data, and area covered on local alternative energy resources, this program is currently the most appropriate. It provides dynamic online cards based on an open database for use over the Internet, cards oriented according to the profession of users and related information. This open-access database provides an opportunity to determine which technologies are most competitive in the use of alternative energy resources for the United States and other countries.

Australia's Commonwealth Scientific and Industrial Research Organization CSIRO program is distinguished by its experience in mapping the energy potential of wind energy, taking into account the limiting factors. It provides regional wind potential maps representing the average wind speed in the atmosphere based on ground and satellite data, maps of vegetation cover and wind turbine siting constraints. The program is enriched with information about buildings, roads and other infrastructures located on the ground, as well as specially protected natural areas.

It is possible to determine the wind potential at 50, 70, 100 m height and its average speed through the interactive electronic card through the Swiss “Meteotest” program. It gives the

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following indicators depending on the criteria that exclude the use of the natural potential of wind energy:

- very steep terrain and forests;
- settlements;
- soils unsuitable for construction;
- cultural heritage sites and tourist routes;
- various landscape objects - wetlands, bird nesting areas, specially protected areas;
- water bodies - rivers, lakes, protected hydrogeological zones.

Since 2013, the International Renewable Energy Agency, IRENA, has created and is improving the global atlas of alternative energy resources. The project is developing regional maps of the energy potential of wind, solar, geothermal, bioenergy, taking into account the criteria that limit their use. Currently, Google Maps is also creating interactive maps of different types of renewable energy resources for some countries. Only: population density, large settlements and vegetation cover were taken into account as limiting criteria. The card does not have a single methodical guideline for defining limiting criteria. It is possible that in this project there is room for the participation of scientific institutions that carry out research in different regions at a specific regional level and conduct independent research.

The Energy Potential Mapping method, EPM project, developed at the Delft University of Technology in the Netherlands, aims to assess the possibility of increasing the efficiency of the use of alternative energy resources at the scale of cities and regions. However, it is very difficult to apply it in practice, because such a mapping process only takes into account technical and socio-political limitations. Such cards do not take into account the environmental impact of energy facilities.

Another noteworthy study is the NREL GIS program. It lists renewable sources on different cards related to alternative energy resources. All information is enriched not only with cards, but also with schemes depicting layers of the atmosphere and lithosphere. Its users can independently obtain, compare, summarize and model information for their own purposes through the Internet. Provides the ability to calculate and rate the amount of electricity produced by wind turbines or photoelectric converters at a specific geographic point through the wind energy database in the western and eastern parts of the United States. Since 2011, the NREL GIS package website has been used by researchers not only in the United States, but also in countries such as Afghanistan, Bangladesh, Bhutan, Brazil, China, El Salvador, Ghana, Guatemala, Honduras, India, Nepal, Nicaragua, Pakistan, Sri Lanka, and Turkey.

Currently, in the Russian Federation there are no analogues of foreign GAT technologies of mapping on the use of alternative energy resources. The beginning of work in this direction is the water and solar energy resource atlas and climate database projects for some remote regions.

In the development of regional and local level databases and maps on the use of alternative energy resources through GAT, first of all, there is the development of its structure, the nomenclature of databases is selected and analyzed. The database of using alternative energy resources with the help of GAT collects statistical data on resources such as wind, sun, small water flows, geothermal; their characteristics, i.e. wind speed, blowing and seasonality by height layers,

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solar radiation, hydrodynamic indicators of streams and rivers, indicators describing geothermal waters; theoretical modeling is carried out in the form of additional data (Figure 1).

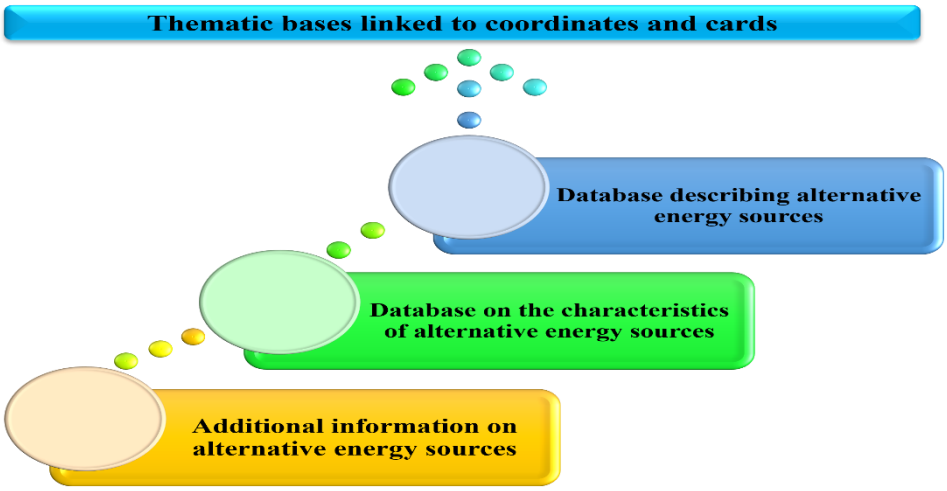

Figure 1. Types of database on the use of alternative energy resources using GAT

In its second stage, the model of creating a database of natural and socio-economic indicators on a local or regional scale and displaying them on thematic cards was developed as a result of the author's scientific research and theoretical research (Figure 2)

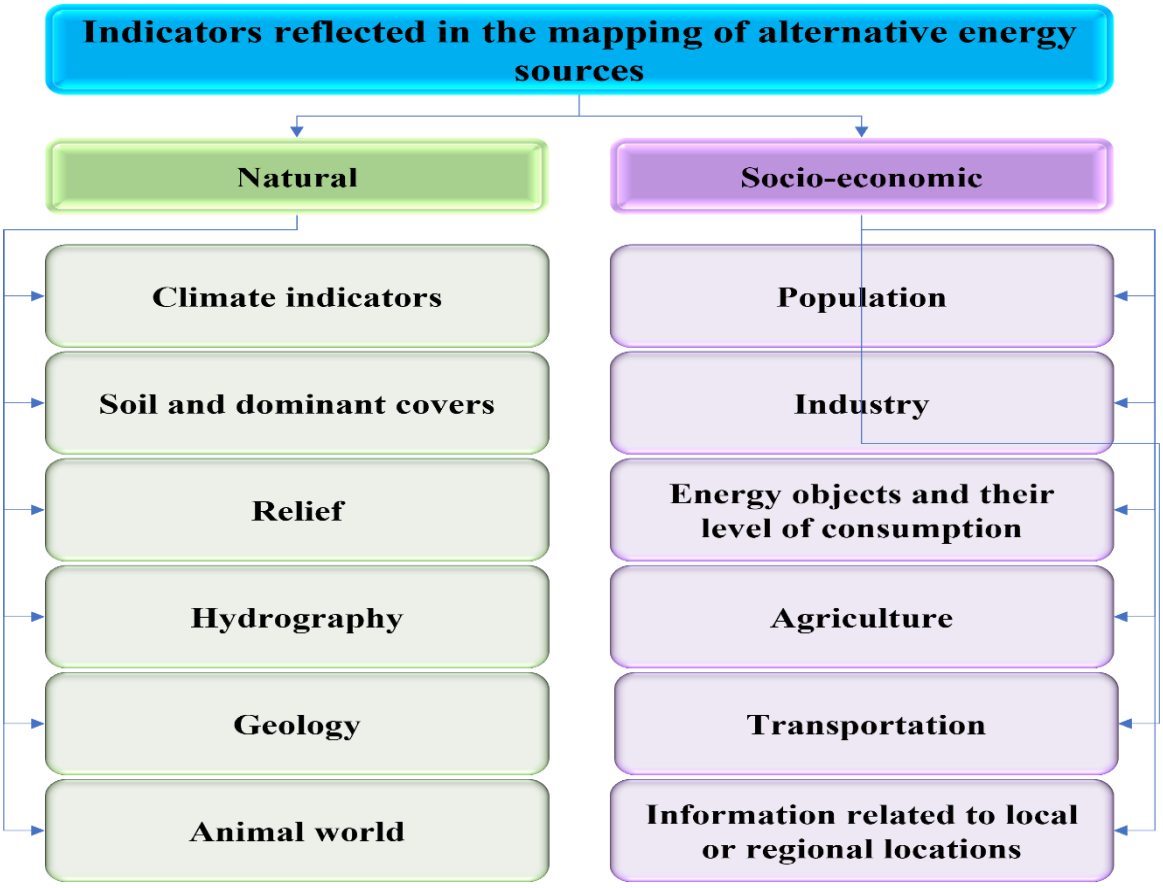

Figure 2. Natural and socio-economic indicators on dior thematic cards for the use of alternative energy resources

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For effective use of alternative energy resources, first of all, it is necessary to reveal the features of geographical distribution of alternative energy objects based on modern geodetic and cartographic methods. When assessing the possibilities of using alternative energy resources through GAT:

- which type of alternative energy resources can be used;
- modeling the use of the system of alternative energy resources and creating its cartographic representation tools;
- Indicators such as providing information on energy infrastructure elements from which alternative energy resources are obtained through GAT are obtained.

The analysis of research and practical results conducted in foreign countries shows that determining all the criteria of the impact of alternative energy resources on the environment, developing a methodological basis for mapping its potential, and analyzing its spatial distribution are useful in solving strategic tasks at the local and regional level.

In the Republic of Uzbekistan, the development of electricity and its use in all spheres of social life at the level of modern requirements has become a priority direction of our state policy. After all, there is no sector of the economy that can function without electricity.

However, the volume of electricity production in our republic is only 20-30% of domestic demand. Although Uzbekistan is one of the ten countries with the largest oil and gas production potential in the world. Since 1997, 50 billion m3 of gas and 8 mln. tons of oil are produced. But their stock may decrease dramatically by the 50s-60s of the 21st century. In the energy balance of Uzbekistan, the share of thermal power plants and thermal power centers specializing in coal and natural gas is 90%, and the use of alternative energy resources is somewhat less. (Figure 3).

In our republic, the annual increase of the population by 550-600 thousand people and the growth of industry by 7-8% increased energy consumption by 25% in 20 years. This indicates the need to use alternative energy resources in the production of electricity. Decree of the President of the Republic of Uzbekistan dated August 22, 2019 “Improving the energy efficiency of economic sectors and the social sphere, On the implementation of energy-saving technologies and rapid measures for the development of renewable energy resources” according to the decision PQ-4422, in the target parameters of the further development of renewable energy resources, by 2030 it is planned to develop 75% of the electricity generated by traditional, and 25% by renewable energy resources: hydro - 11.2%, solar - 8.8%, wind - 5%.

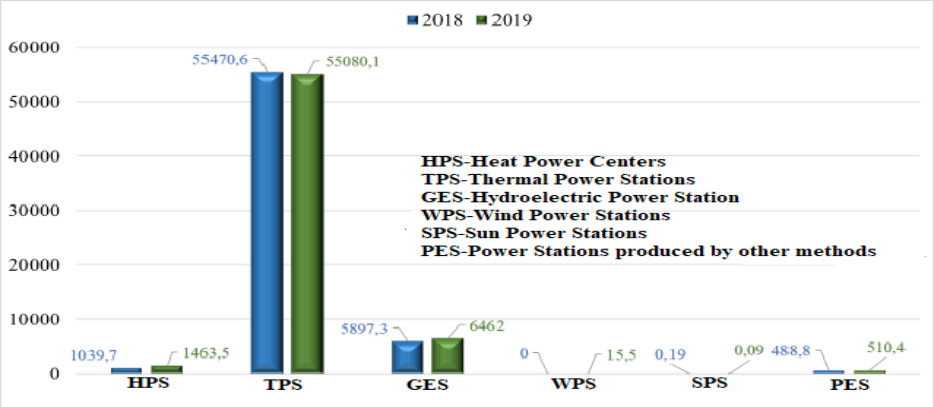

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Figure 3. The role of alternative energy resources in the production of electricity in Uzbekistan In the decision of the Cabinet of Ministers of the Republic of Uzbekistan dated July 23, 2020 No.

452 "On the measures of state accounting of renewable energy sources (QTEM) devices and the energy produced from them": creation of databases about uniform data and energy producers in an "online" automated manner to obtain a producer identification number, Scientific and practical subjects were assigned the task of forming information such as the type of QTEM used for energy production, the location and occupied area of production facilities, the manufacturer of QTEM devices, the date of manufacture, the type and capacity of the main energy-producing devices based on modern technologies.

In our country today, certain scientific research works on the use of alternative energy resources have been carried out and researches are being carried out continuously. For example, M.S. Rudak evaluated the wind and solar energy resources of Uzbekistan and the possibilities of their use. Professor H.T. Egamberdiev studied the effect of atmospheric clarity on solar energy resources in Uzbekistan, taking into account anthropogenic factors, and showed the regional characteristics of solar radiation in national geographical atlases. Sh.E.Zokirov and other scientists covered the scientific and practical aspects of renewable energy development in Uzbekistan. Professor Q. Allaev is conducting research on the technological possibilities of solar and wind energy. Researchers under the leadership of Professor A.A. Azizov evaluated the dynamic state of the natural and ecological properties of atmospheric air. A group of researchers of the National University of Uzbekistan under the leadership of Professor Yu. V. Petrov highlighted the possibilities of solar energy resources for some regional production complexes.

They put special emphasis on the cartographic principles of using helioresources. The creative group headed by G.K. Saidova focused on the economic possibilities of using alternative energy resources in Uzbekistan. S.L. Lutpullaev and H.K. Zaynutdinova are conducting research on the technical and technological possibilities of using solar energy in our country.

As a result of the targeted research, taking into account the characteristics of the classification of alternative energy resources given by the above-mentioned scientists and based on a systematic approach, a systematic GISAE (GISAE - Geographic Information System Alternative Energy) structure (Report on the global state of renewable energy sources) was developed, which consists of the following eight steps in the creation of electronic digital maps that reflect the main directions, properties and power of new alternative energy resources objects (Fig. 4).

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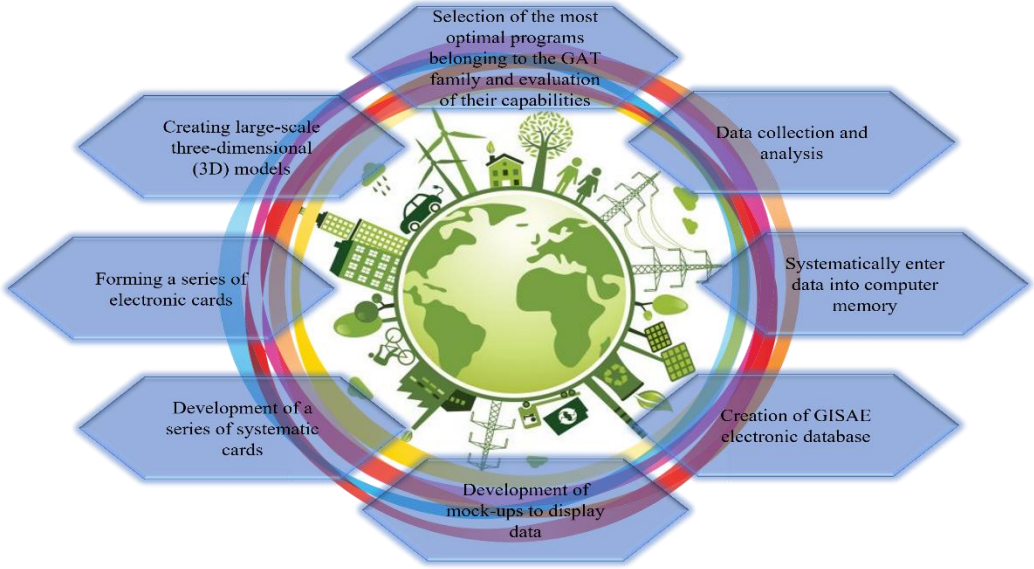

Figure 4. Systematized structure of GISAE in creating electronic digital cards

The international and national experience of using alternative energy resources at the regional and local level shows that providing electricity to all sectors of the economy requires rational use of alternative energy resources. For this, it is required not only to solve technological problems, but also to bring the legislation up to the level of international requirements, to ensure financial support of the relevant projects by the state, to analyze the territorial distribution of various alternative energy resources, and to carry out geodetic and cartographic studies that assess the possibility of alternative energy resources and determine the rules of their placement.

CONCLUSION

In the map developed using the data of the Global Solar Atlas (GSA) project compiled by the World Bank Group, the rate of sunlight reaching the surface of the country in the southern part of the country decreases from 4.8-5.3 kWh/m2 to the level of 4.0 kWh/m2 towards the north and up in the altitude zones. The annual indicator also decreases from 1830 to 1400 kWh/m2 based on the same geographical pattern. Such variability corresponds not only to zoning, but also to the laws of height zoning. The technical potential of alternative wind energy resources in Uzbekistan is 1 mln. It has more than GW/s of electricity or 520 MW. However, their geographical distribution characteristics are different from the intensity of sunlight falling on the earth's surface, the potential of wind energy at an altitude of 80 meters towards the northern regions and high mountain region is 5.5 m/sec. increased from 6.5 m/sec. Bekobad-Khovos of Syrdarya region and Kokan-Yazyovon zone of Fergana valley and Southern Surkhandarya zone where "Afghan" winds blow are exceptions.

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