by the highest energy potential, which is explained by significant differences in height along the channel (the fall of the river). However, their use for the establishment of hydroelectric power plants (HPP) in most cases is impossible or economically unprofitable due to low rates of water flow in the summer period [31].

Within Ukraine, the construction of small hydropower plants is economically feasible on rivers, where water consumption is more than 2 m³/s [32]. Accordingly, it can be argued that the Siverskyi Donets, Uda, Lopan, Kharkiv, Orel, Berestova, Bereka, Merla, Mzha, Vovcha, Velykyi Burluk rivers have an annual water flow sufficient to establish small hydropower plants. However, the hydropower potential of rivers and the possibility of its use depend not only on the values of water flow. No less important are the parameters of seasonal fluctuation of runoff, the fall of the river (water pressure), and other natural, social, economic, and environmental restrictions of the area.

In terms of volumes of technical potential, perspective for locating hydropower stations within the study area are:
- sections of the Siverskyi Donets River – north of Balakliia and in the southern part of the Balakliia District;
- Udy River – west of the Chuhuiv;
- Berestova River – Zachepylivka area;
- Mzha River – to the west of Zmiiv;
- Merla River – upstream and downstream from Krasnokutsk.

Sufficient hydropower potential is also characterized by Oskol River, but the potential of this river is almost completely used Chervonooskil hydroelectric station. Promising is the electrification of the dam of the Pechenihy reservoir, located on the Siverskyi Donets River near the Pechenihy village.

However, the main potential sites for the location of small hydropower stations are concentrated in the central, most densely populated part of the region. On the one hand, the proximity of the HPP location to the consumer is a positive thing, and on the other hand, the settlements create additional restrictions on the construction of reservoirs. In addition, the implementation of projects for the construction of hydropower plants in these areas may be limited by the presence of objects of the nature reserve fund and geological conditions, which requires additional research at the local level.

7. SWOT analysis of research results

Strengths. The strengths of the research include:
1. There is a clear state policy, regulatory framework providing incentives for the development of renewable energy (feed-in tariffs, mechanisms for connecting industry facilities to the unified energy system, tax incentives for heat generating and cogeneration plants).
2. All national strategies, plans, roadmaps, and development concepts related to the fuel and energy complex provide for an increase in the share of the use of renewable energy sources in the total energy balance.
3. The spatial approach, which involves analyzing the distribution of the energy potential of renewable energy sources in combination with other socio-economic factors, allows to select the optimal regions for the development of individual areas of the industry. At the stage of developing a strategy for the development of a certain territory, it helps to identify the types of resources that are characterized by high potential. Presentation of the assessment results of the potential of renewable energy sources in a cartographic form is the most visual and accessible for perception.
Weaknesses. The weaknesses of the research include:
1. Insufficient amount of resources and investments to increase the production capacity of renewable energy in Ukraine.
2. Considering the political aspect and the high dependence of the country’s energy sector on natural gas supplies, in the past two years, the emphasis of national policy has been somewhat shifted to a policy of increasing domestic gas production (the concept of development of the gas producing industry in Ukraine). At the same time, the development of renewable energy is not given enough attention.
3. In general, the information support of renewable energy in Ukraine lags behind the level of foreign countries. Comprehensive studies of the potential of renewable energy at the regional and subregional levels for all regions of the country have not been conducted.

Opportunities. The opportunities for research include:
1. The acquisition of industrial value of new types of resources, the creation of new technologies and equipment can in the future ensure both the development of the fuel and energy complex and associated industries.
2. The wide capabilities of geo-information technologies determine the popularity and distribution of various applications and specialized geo-information systems that allow for the rapid assessment, modeling and visualization of energy indicators of renewable energy resources. They also take into account local factors affecting the feasibility of using renewable energy resources.
3. It is advisable to create on the Internet mapping web services, web atlases and web GIS, in which information on renewable energy resources is presented in the form of interactive map data layers. Such resources contribute to the promotion of renewable energy among the general population and attract investment in the industry.

Threats. Research threats include:
1. Low rates of development of renewable energy, which may lead at a certain time of the energy crisis and increase dependence on energy imports.
2. Without introducing the necessary measures, the use of each of the renewable energy industries can have negative consequences for the environment. Thus, noise pollution and the death of birds are negative aspects of the development of wind power, changes in river ecosystems and the death of ichthyofauna – small hydropower, soil degradation – solar power, etc.

8. Conclusions
1. The presented maps of wind, solar, geothermal energy and small hydropower give an idea of the potential development of renewable energy in the Kharkiv region. Local authorities can apply cartographic data when concluding activities and plans for socio-economic development, and interested investors – when choosing a construction area and type of energy resource. In the future, it is advisable to conduct similar studies of the potential of renewable energy sources for all regions of Ukraine and create a single electronic web-mapping service that would combine and provide all the necessary information in open access.
2. Optimal areas for the construction of renewable energy facilities in the Kharkiv region have been determined. So, location:
   - wind power plants are recommended in Vovchaansk, Kharkiv, Velykyi Burluk regions;
   - solar power plants – in Blyznicky, Pervomaiskoi, Balakliia, Izium, Lozova and Borova;
   - geothermal power plants – in the south of Barvinkove and Blyznicky, southeast of Izium, Borova and Lozova districts.
3. Perspectives for locating small hydropower stations within the study area are sections of the Siverskyi Donets, Udy, Berestova, Mzha, Merla rivers.
4. It is proved that the application of the cartographic approach allows to determine the optimal location of renewable energy facilities taking into account a number of factors. Social, technical, economic and environmental factors are considered that influence the choice of location of energy facilities, as:
   - distance to the potential consumer;
   - features of connection to the united power grid;
   - possible impact on the environment and human activity.

Relevant recommendations on the location of wind, solar, geothermal energy and small hydropower facilities at the regional level are formed.

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