UDC: 338:336.02:621.311

IDENTIFICATION OF STRATEGIC PRIORITIES OF INVESTMENT INTO DEVELOPMENT OF ALTERNATIVE ENERGETICS

S. Sivitska, Ph.D., Associate Professor at Finance and Banking Department,
Vice-Rector for Scientific, Educational, Social Work and International Cooperation.
Poltava National Technical Yuri Kondratyuk University.

Стаття отримана редакцією 24.05.2017 р.

Introduction. The global processes in the modern world and growth of industrial production lead to substantial increase in energy resources consumption and as a consequence, significant ecological harm to the global environment. At the present stage there are grounds to consider environmental problems as the most important ones for future sustainable development of the humanity. These problems constitute the greatest threat to the global community. The ever increasing comprehension of acuteness and real threat of these problems positively impacted the development of alternative energetics. The alternative energy types are growing in Ukraine. However, the development of the relevant direction requires considerable volumes of investments.

Review of recent research and publications. The analysis of publications on this issue showed that the problems of investment into development of alternative energy in Ukraine were reviewed by a number of scientists, such as: M. Bezuhlyi, M. Volkov, E. Hutnik, H. Kaletnik, I. Mahiiovych, V. Onyshchenko, and others. At the same time, despite significant amount of adopted laws, programs, statutory acts and other documents, no considerable attention has been paid to identification of prospective directions of investment into alternative energetics in Ukraine.

The purpose of the article is to investigate and identify the strategic priorities of investment into development of alternative energetics.

The basic materials and results. Alternative energy sources are one of the most important criteria of global community sustainable development. New technologies are searched and the existing ones are developed, the technologies are brought up to economically efficient level and scope of their application is expanded. Expected exhaustion of stocks of organic fuels, sharp increase in their price, imperfection and low efficiency of their use and adverse effect on environment are main reasons of such attention.

Ukraine has considerable potential for the development of renewable energetics, at the same time, despite significant amount of adopted laws, programs, statutory acts and other documents, the implementation of alternate energy sources in the country is proceeding too slowly, the contribution to power balance of the country is insignificant, and the volumes of investment capital are insufficient [1].

There are many reasons of such situation, major of them are absence of economic incentives system of transition to the use of alternative energetics. So there is a question of identification of priority and the most perspective for investment types of alternative energetics in Ukraine. To that end, the theoretical justification of the calculation method of an integrated indicator of alternative energetics potential per types and identification of its territorial structure is required. According to the structure of investment process implementation after identification of alternative energetics potential, it is necessary to justify the selection of real investment objects (see Fig. 1).

Setting up the criteria for investment objects selection with further monitoring and assessment of the whole set of potential investment objects is a priority task. At the closing stage the selection of investment objects from the circle of potential ones is performed, in particular the index method with further calculation of integrated indicator is the most exact and simple one for assessment of the potential of alternative energetics types. In this case the calculated integral criterion defines the most perspective direction of alternative energetics as investment attractiveness is determined first of all by the level of investments efficiency.

The integral index of alternative energetics potential assessment per types and identification of its territorial structure is based on the calculation of separate indicators of the assessment of alternative energetics potential per types and considering the weight of the given indicators to be defined by the expert group, generally [3]. To avoid subjective statements while setting up the weight indicators, we apply hierarchy analysis method (HAM), assuming decomposition of the problem into ever simpler components.

As a result, the relative significance of the investigated alternatives of all criteria in the hierarchy is defined. The relative significance is expressed numerically through the vectors of priorities. The values of vectors thus obtained are assessed against a scale of relations and are corresponding to the so-called strict assessments.

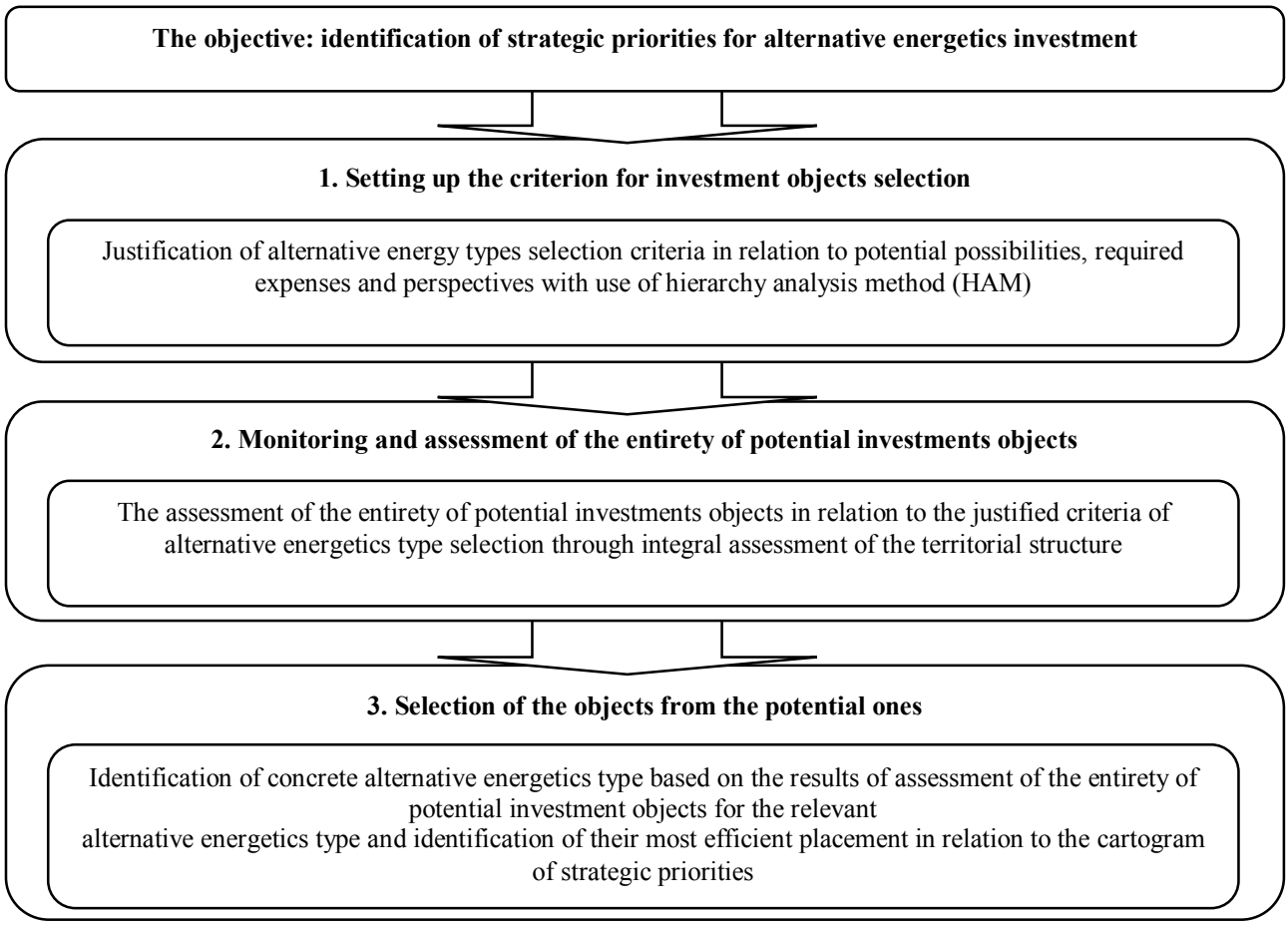

Fig. 1. The stages of selection method of strategic priorities of investment into alternative energetics

Source: built by the author

The integral index of alternative energetics potential assessment per types and identification of its territorial structure is based on the calculation of separate indicators of the assessment of alternative energetics potential per types and considering the weight of the given indicators to be defined by the expert group, generally [3]. To avoid subjective statements while setting up the weight indicators, we apply hierarchy analysis method (HAM), assuming decomposition of the problem into ever simpler components. As a result, the relative significance of the investigated alternatives of all criteria in the hierarchy is defined. The relative significance is expressed numerically through the vectors of priorities. The values of vectors thus obtained are assessed against a scale of relations and are corresponding to the so-called strict assessments.

Following the task of selection of alternative energetics priority type we have built a hierarchy with equal number and functional composition of the alternatives under the criteria (see Fig. 2). Actually the hierarchy includes the objective - selection of priority type of alternative energetics, located at the top, the intermediate levels and the alternatives – the alternative energetic types forming the lowermost hierarchical level.

Characterizing the selected criteria for the assessment of alternative energetics potential it should be noted that on January 1, 2017, in Ukraine the installed capacity of renewable energy facilities operating under the "green" tariff is 1117.7 MW [2].

The efficiency of investments into development of alternative energetics has inverse relation to the level of expenses for building of power stations of different types. The National Renewable Energy Laboratory of USA determined capital expenses on building of power stations of different types, shown in the Fig. 3.

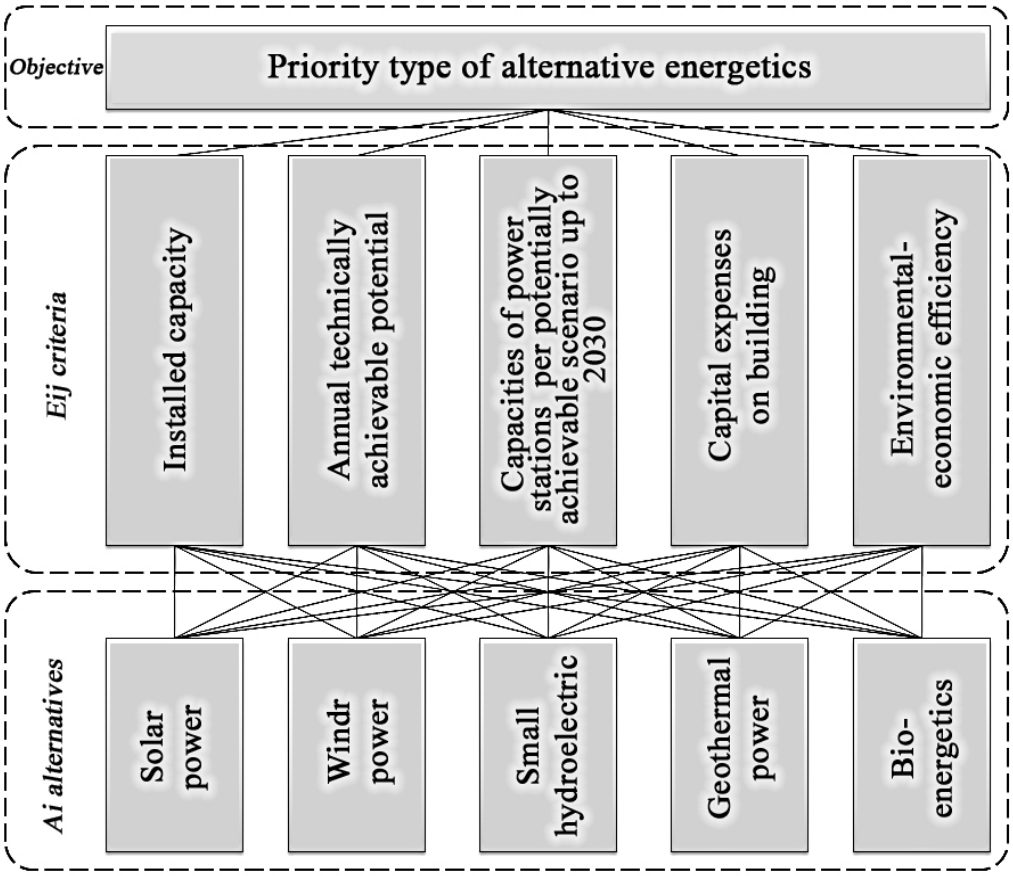

Fig. 2. Decomposition hierarchy of the set selection criteria of priority type of alternative energetics

Source: developed by the author

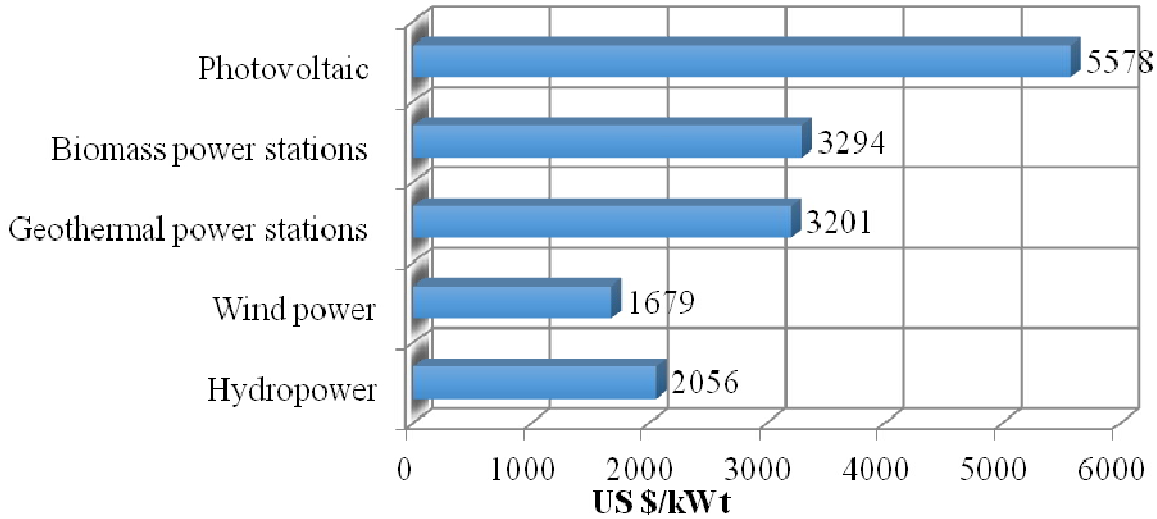

Fig. 3. Capital expenses for building of power stations of different types [4]

There is annual technically achievable potential of alternative energetics. In the estimation by specialists at the Institute of Renewable Energy accountable to NAS of Ukraine, the total annual technically achievable energy potential of renewed energy sources of Ukraine related to reference fuel is about 98

million tons of reference fuel (see Fig. 4) that makes over 50 % of total power consumption in Ukraine currently and 30 % of 2030 power consumption [1].

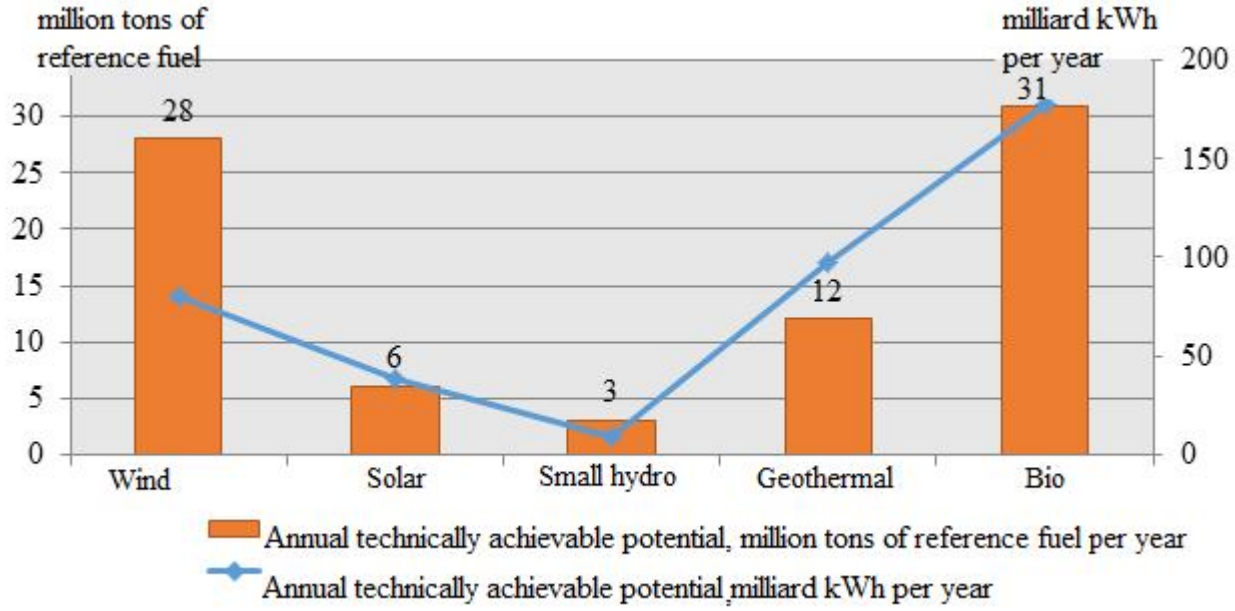

Fig. 4. Potential of renewable energetics in Ukraine [5]

The capacities of RES power stations in Ukraine according to potentially achievable development scenario up to 2030 are shown in Fig. 5. They have the trend of almost several-fold increase in power stations capacity demonstrating the considerable potential of alternative energy sources development in Ukraine.

Considering the value of selection criteria of priority type of alternative energetics, vectors of alternatives priorities should be developed. The general form of expression for calculation of alternatives priority vectors is the following:

$$WAEij = [WAE1i - 1, WAE2i - 1,., WAEni - 1]\ WEEji - 1,$$

where WAEij - vector of priorities of alternatives relating to element E1i - 1, the defining j-th column of matrix; WEEij - vector of priorities of elements E1i - 1, E2i - 1., Eni - 1, related to element Eij of upper hierarchy level.

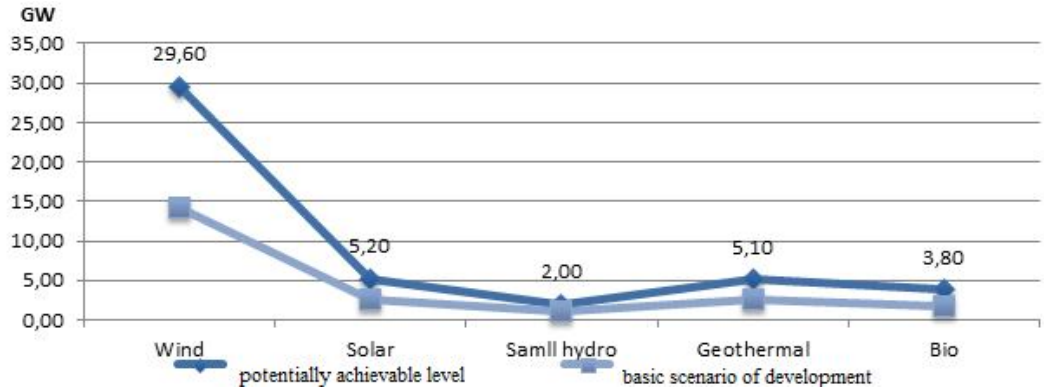

Fig. 5. Capacities of power stations on RES in Ukraine per potentially achievable and basic scenario of development up to 2030 [1]

The law of hierarchical continuity requires the elements of top level of hierarchy to be comparable in pairs relative to the elements of the following level and so on up to the top of the hierarchy.

The matrix of pair-wised comparisons for the second level of the task of selection of alternative energetics priority type has degree 5 (by quantity of criteria). After conducting all pair-wised comparisons the coherence, i.e. “consistency” of statements (the verbal information) should be determined. The coherence ratio (Iy) should not be higher than 10 % (in certain cases, when there is no requirement for high accuracy,

not higher than 20 % is allowed). In the performed calculations Iy <10 % demonstrating the consistency of pair-wised comparisons matrixes of 2nd and 3rd levels and to "non-contradiction" of assumptions.

The resultant vector of alternatives priorities in relation to hierarchy root top is calculated as follows:

$$WA = [WAE11\ WAE22.\ WAE2m]\ WEE11,$$

The calculation results of vectors of priorities and determination of global priorities from selection of priority type of alternative energetics are presented in the Tab. 1. The calculations show that solar power has greatest weight upon the considered criteria, wind-power something smaller, and bio-energetics has the least weight.

It should be noted that these parameters represent different relation pattern between indicator value and potential: the direct one – the higher indicator value, the potential value and inverted one – the higher indicator value, the lower the potential that, in turn, determines the direction of indicator optimization.

Table 1

Global priorities (weight of alternative energetics type)

Alternatives	Installed capacity of different types of power stations	Annual technically achievable potential	Capacities of power stations per potentially achievable scenario up to 2030	Capital expenses on building of power stations of different types	Environmental-economic efficiency of power stations of different types	Global priorities (weight of alternative energetics type)
	Numerical value of priority vector					
	0,051936	0,029755	0,143314	0,270603	0,504392	
Solar power	0,299201	0,077315	0,173481	0,033676	0,499740	**0,303880**
Wind power	0,141681	0,258770	0,608102	0,457113	0,103495	0,278106
Small hydroelectric power station	0,068629	0,032419	0,034784	0,322575	0,277621	0,236833
Geothermal power	0,034423	0,115582	0,122422	0,111618	0,069735	0,088150
Bio energetics	0,456066	0,515913	0,061211	0,075018	0,049410	**0,093032**

Source: calculated by the author

Therefore (based upon calculation of the integral indicator of potential of alternative energetics upon territorial pattern) we have developed the diagram of potential of alternative energetics in Ukraine (see Fig. 6) and matrix of selection of strategic investment priorities (see Tab. 2).

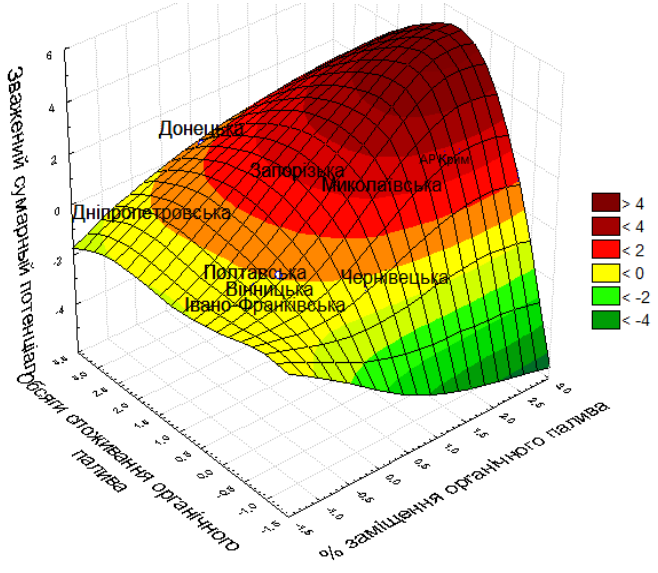

Fig. 6. The weighed total potential of alternative energetics

Source: developed by the author

Table 2

Matrix of selection of strategic investment priorities

Types of alternative energetics	Per weight of types of alternative energetics			Level of integrated potential of alternative energetics				
	Weight coefficient	Potential per types	Types of alternative energetics	0,9-1,0	0,7-0,9	0,5-0,7	0,3-0,6	< 0,3
				High	Above medium	Medium	Under medium	Low
				Type of strategic priority				
				Development of large-scale investment projects and government programs		Development of large investment projects	Development of medium investment projects	Development of small investment projects
	0,304	Significant	Solar power	x	Odesa, Dnipropetrovsk, Poltava, Kharkiv regions	Kirovohrad, Vinnytsia, Kyiv regions	Cherkassy region	x
	0,278		Wind power	Kherson, Zaporizhzhia, Mykolaiv regions	Donetsk regions	Luhansk regions	X	x
	0,237		Small hydro power stations	x	Zakarpattia and Lviv regions	X	X	x
	0,088	Less significant	Geothermal power	x	x	X	Rivne, Sumy regions	x
	0,093		Bio-energetics	x	x	Chernihiv, Zhytomyr regions	Volyn, Khmelnytskyi regions	Ternopil, Ivano-Frankivsk, Chernivtsi regions

Source: developed by the author

The performed integrated analysis demonstrates that Kherson, Zaporizhzhia and Mykolaiv regions have the greatest potential of alternative energetics; Odesa, Dnipropetrovsk, Lviv, Kharkiv, Zakarpattia and Poltava regions – rather high. Based on results of AHP calculations, the solar power has the greatest potential, however solar power stations should not be the main part in the total amount of RES to prevent undesirable consequences (upon experience of some EU countries) and diversification of energy sources [6]. Not less weighty and significant are wind and small hydropower.

Based on the results of application of the proposed methodical approach, a matrix of selection of strategic priorities of investment into objects of alternative energetics was built. This matrix determines dependence of strategic priorities on the types of alternative energy sources which have the greatest potential and economic attractiveness in the relevant region.

Conclusions and recommendations for further research. After identifying priority types of alternative energetics, strategic priorities of alternative energetics development in Ukraine should be outlined:

- identification of those types of renewable energetics which have the greatest potential and are economically attractive for the given locality and their involvement into fuel and energy balances of local types of fuel, secondary power resources, alternative energy sources;
- development of economically grounded investment plans for implementation of low carbon energetics, decrease in consumption of conventional fuel and reduction of harmful emissions, particularly as regards attraction of investments within joint implementation projects and sales of quotas in accordance with Kyoto protocol;

- promoting the business for achievement of long-term strategic aims to strengthen its competitive positions with increase in demand for environmentally acceptable power production and expansion of low carbon technologies and equipment market;

- stimulation of the private capital to implementation of alternative energetics, reinforcement of economic stimulus for reduction of harmful emissions by power manufacturer;

- expansion of implementation scales of advanced foreign technologies, in particular concerning use of heat pump technologies, technologies of biofuel burning, domestic and industrial waste processing;

- provision of transparency of alternative energy sources implementation processes and information accessibility;

- informational support for social recognition of economic long-term advantages of low carbon energy use.

Among the issues solution of which can give essential positive results on regional level, the following could be considered:

- converting the boiler-houses serving social sphere entities to the use of renewed energy sources and alternative types of fuel (chips, pellets, farming wastes, solid domestic wastes, etc.);

- use of waste heat potential of technogenic origin (ventilation releases and cooling water, technological and power-generating equipment of the factories, industrial sewage, heat of exhaust gases of heating boilers, etc.);

- use of heat pumps while converting low potential heat, particularly, the heat of sewer flows, heat of the soil and water reservoirs into thermal energy, suitable for heating and hot water supply of buildings of different purpose;

- use of solar power for heating and hot water supply of budgetary sphere, industrial and private sector objects;

- using other local energy sources, particularly, the heat of the drilled boreholes, geothermal sources, mine waters, mine methane, etc.

Therefore, inclusion of measures on implementation of alternative energy sources in the priority tasks of regional energy policy should raise reliability of provision with power resources of economy and population of regions, reduce adverse impact on environment, create new jobs and stimulate the development of the local industry.

ЛІТЕРАТУРА:

1. Енергетична стратегія України на період до 2030 року від 24 липня 2013 р. № 1071-р [Електронний ресурс]. – Режим доступу: http://mpe.kmu.gov.ua/minugol/doccatalog/document?id=260994

2. Актуальні статистичні дані щодо потужності та обсягів виробництва електроенергії об'єктами відновлюваної електроенергетики, які працюють за «зеленим» тарифом (станом на 01.01.2017 р.) [Електронний ресурс]. – Режим доступу: http://saee.gov.ua

3. Global Trends in Renewable Energy Investment 2017 [Електронний ресурс]. – Режим доступу: http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2017.pdf

4. Renewable energy projects handbook [Електронний ресурс]. – Режим доступу: http://www.worldenergy.org/wp-content/uploads/2012/10/PUB_Renewable_Energy_Projects_Handbook_2004_WEC.pdf

5. Офіційний сайт Інституту відновлюваної енергетики НАН України [Електронний ресурс]. – Режим доступу: http://ive.org.ua/

6. Onyschenko V. Organizational-Economic Mechanism of Investment Development of Alternative Energy in Terms of Energy Dependence / V.Onischenko, S. Sivitska // Economic Annals-XXII. – №9–10(1). – P. 34 – 37.

REFERENCES:

1. Energy strategy of Ukraine for the period till 2030 from July 24, 2013 № 1071-r [Electronic resource]. – Access mode: http://mpe.kmu.gov.ua/minugol/doccatalog/document?id=260994

2. Current statistics on capacity and volumes of electricity production by renewable energy companies operating under the "green" tariff (as of 01.01.2017) [Electronic resource]. – Access mode: http://saee.gov.ua

3. Global Trends in Renewable Energy Investment 2017 [Electronic resource]. – Access mode: http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2017.pdf

4. Renewable energy projects handbook [Electronic resource]. – Access mode: http://www.worldenergy.org/wp-content/uploads/2012/10/PUB_Renewable_Energy_Projects_Handbook_2004_WEC.pdf

5. Official site of the Institute of Renewable Energy of the National Academy of Sciences of Ukraine [Electronic resource]. – Access mode: http://ive.org.ua/

6. Onyschenko V. Organizational-Economic Mechanism of Investment Development of Alternative Energy in Terms of Energy Dependence / V.Onischenko, S. Sivitska // Economic Annals-XXII. – №9–10(1). – P. 34 – 37.

UDC 338:336.02:621.311

Svitlana Sivitska, Ph.D., Associate Professor at Finance and Banking Department, Vice-Rector for Scientific, Educational, Social Work and International Cooperation. Poltava National Technical Yuri Kondratyuk University. **Identification of strategic priorities of investment into development of alternative energetics.** There are the stages of the methodology for choosing the strategic priorities of investing in alternative energy explored in the article. The potential of alternative energy analyzed. The strategic priorities of alternative energy have been explored. An integrated analysis of the potential of alternative energy is carried out on the territorial basis done. The matrix of choice of strategic priorities of investing in alternative energy determined.

Keywords: energetic security, alternative energetics, renewable sources of energy, investment, strategic priorities, matrix.

УДК 338:336.02:621.311

Світлана Павлівна Сівіцька, кандидат економічних наук, доцент кафедри фінансів і банківської справи, проректор з науково-педагогічної, соціальної роботи та міжнародного співробітництва. Полтавський національний технічний університет імені Юрія Кондратюка. **Визначення стратегічних пріоритетів інвестування розвитку альтернативної енергетики.** Досліджено етапи методики вибору стратегічних пріоритетів інвестування альтернативної енергетики. Проаналізовано потенціал альтернативної енергетики. Досліджено стратегічні пріоритети альтернативної енергетики. Проведено інтегральний аналіз потенціалу альтернативної енергетики за територіальною ознакою. Визначено матрицю вибору стратегічних пріоритетів інвестування альтернативної енергетики.

Ключові слова: енергетична безпека, альтернативна енергетика, відновлювані джерела енергії, інвестування, стратегічні пріоритети, матриця.

УДК 338:336.02:621.311

Светлана Павловна Сивицкая, кандидат экономических наук, доцент кафедры финансов и банковского дела, проректор по научно-педагогической, социальной работе и международному сотрудничеству. Полтавский национальный технический университет имени Юрия Кондратюка. **Определение стратегических приоритетов инвестирования развития альтернативной энергетики.** Исследованы этапы методики выбора стратегических приоритетов инвестирования альтернативной энергетики. Проанализирован потенциал альтернативной энергетики. Исследованы стратегические приоритеты альтернативной энергетики. Проведен интегральный анализ потенциала альтернативной энергетики по территориальному признаку. Определена матрица выбора стратегических приоритетов инвестирования альтернативной энергетики.

Ключевые слова: энергетическая безопасность, альтернативная энергетика, возобновляемые источники энергии, инвестирование, стратегические приоритеты, матрица.