

УДК 338.24

DOI: 10.30857/2786-5398.2022.6.9

Mariana S. Shkoda, Anna A. Oleshko

Kyiv National University of Technologies and Design

**THEORETICAL ASPECTS OF MANAGING THE ENERGY SUPPLY POTENTIAL
OF SUSTAINABLE REGIONAL DEVELOPMENT**

The article presents the results of research on the theoretical aspects of energy supply management in conditions of sustainable development. The concept and structural components of energy saving of enterprises in the conditions of sustainable development are studied, which is presented as a set of measures aimed at reducing energy losses, which comes both from external sources and is used inside the production system and requires the use of energy-saving equipment, energy-saving technologies of production, transportation and storage. The relationship between the categories: management of "energy potential", "resource potential", and "energy saving potential" is determined. This categorical series was studied and the concept of the energy saving potential of the enterprise in conditions of sustainable development was determined, which is presented as the realization of the energy potential as a set of reserves for reducing energy consumption, the ability and adaptability of the object management system to rationally use fuel and energy resources. As a result of the study, it was proved that the management of energy supply in conditions of sustainable development, aimed at ensuring the rational use of available energy resources, is based on conducting energy technological measurements, inspections, analyzing energy use and implementing an automated system for possible energy-saving measures.

Keywords: energy supply; energy management; economic potential; resource; potential; Sustainability; National economy.

Мар'яна С. Шкода, Анна А. Олешко

Київський національний університет технологій та дизайну

**ТЕОРЕТИЧНІ АСПЕКТИ УПРАВЛІННЯ ПОТЕНЦІАЛОМ ЕНЕРГОЗАБЕЗПЕЧЕННЯ
СТАЛОГО РЕГІОНАЛЬНОГО РОЗВИТКУ**

В статті викладено результати досліджень щодо теоретичних аспектів управління енергозабезпеченням в умовах сталого розвитку. Досліджено поняття та структурні компоненти енергозбереження підприємств в умовах сталого розвитку, що представлено як комплекс заходів, спрямованих на скорочення втрат енергії, яка поступає як від зовнішніх джерел, так і використовується всередині виробничої системи та вимагає застосування енергозберігаючого устаткування, енергозберігаючих технологій виробництва, транспортування та зберігання. Визначено взаємозв'язок категорій: управління «енергетичним потенціалом», «ресурсним потенціалом» та «потенціалом енергозбереження». Досліджено цей категоріальний ряд та визначено поняття потенціалу енергозбереження підприємства в умовах сталого розвитку, що представлено як реалізацію енергетичного потенціалу як сукупності резервів зменшення енергоспоживання, здатності та адаптивності системи управління об'єктом раціонально використовувати паливно-енергетичні ресурси. В результаті дослідження доведено, що управління енергозабезпеченням в умовах сталого розвитку, спрямовано на забезпечення раціонального використання наявних енергетичних ресурсів, базується на проведенні енерготехнологічних вимірювань, перевірок, аналізуванні енерговикористання та впровадженні автоматизованої системи щодо можливих енергозберігаючих заходів.

Ключові слова енергозабезпечення; енергоменджмент; економічний потенціал; ресурси; потенціал; сталий розвиток; національна економіка.

Formulation of the problem. Studies have proven that the concept of potential in the scientific literature is interpreted in different ways – from a narrow understanding of it as the potential volume of production, resource provision of business processes to the category of socio-economic, production system, which allows investigating potential from two sides: on the one hand, as the set of resources of the business entity. In this case, the assessment of a certain type of potential comes down to determining the value of available resources (assets). On the other hand, it is the effectiveness of business activity, when the potential reflects the ability of a business entity to use and process available resources to meet public needs. In this case, the assessment of the value of the potential is carried out by assessing the maximum potential amount of benefits that the business entity is able to obtain with a certain amount, quality and structure of available resources.

Analysis of recent research. In the scientific literature, in most cases, in a general sense, potential is considered as sources, opportunities, means, reserves that can be used to achieve a certain goal. Most publications contain various aspects of the concept of "potential". Etymologically, the term "potential" is of Latin origin. Potential management is "not only a system of managing resources that are available, but also alternative resources and their sources, that is, a new representation of resources that did not exist (or were not used) before, the possibility of using them is scientifically justified and the acquisition (or use) foreseen in this period prospectively" [1, 9, 13–15].

Unsolved parts of the problem. Summarizing the scientific directions, we can say that the potential of energy supply is its ability for further activity based on the availability of resources. That is, the potential capabilities of the enterprise are determined by the availability of resources for business activities and the possibility of using certain reserves, which are considered material resources that are temporarily not used for their intended purpose. Reserves of this kind are systematically created to meet the additional need for them arising under certain circumstances. In addition, reserves are understood as unused opportunities to increase production efficiency and increase business efficiency.

The purpose of the article there is a study of theoretical aspects of energy supply management in conditions of sustainable development.

Presentation of the main material The category: "energy potential" also has differences in definitions in the scientific literature. Most definitions can be divided into three groups: the first – experts believe that energy potential is a component of production or resource potential; the second – the energy potential represents a potential set of energy that can be used by the business object; the third – represents potential opportunities for consumption of various types of energy.

The point of view can be attributed to the first group V. Sevostianov, A. Sevostianova, O. Savina, which believes that any production of products is primarily a process of energy consumption for the purpose of reproduction of its carriers. Therefore, all components of the production potential of the enterprise are carriers of energy used in the production process, and in connection with the problem of rational use and conservation of energy, it is necessary to study the concepts of production, economic, resource, personnel potential, etc. to consider "energy potential" as a separate economic category. Each of the listed factors is a carrier of energy, and therefore the energy potential of the economic system, according to Savina, O, should be understood as "the total amount of actual and potential energy of human, natural and material resources of this economic system" [13].

A representative of the second group M. Shaaban, J. Scheffran, J. Böhner, M.S. Elsobki defines "energy potential" as "a general indicator of the total amount of potential energy inherent in a certain economic system, which is supported by natural, human and material resources" [14]. M. Shaaban, J. Scheffran, J. Böhner, M.S. Elsobki emphasizes that the concept of the energy potential of an enterprise should be interpreted as the total amount of energy, which is carried by

human and material resources (the sum of the energy potential of human resources (personnel energy potential) and the energy potential of material resources (material and technical energy potential) of a given enterprise) [14].

M. Shaaban, J. Scheffran, J. Böhner, M.S. Elsobki believes that "energy potential" is directly dependent on unconventional and renewable energy sources [14].

The third of the triad of categories: "energy saving potential" also has differences in definitions in the scientific literature.

"The theoretical potential of energy saving is the maximum saving of fuel and energy resources, which can be obtained as a result of the elimination of all types of energy losses in the national economy".

To assess the efficiency of consumption of fuel and energy resources, such indicators as the efficiency factor (Efficiency) and the amount of specific energy consumption are currently used. However, when solving the problems of planning the implementation of energy-saving measures, these indicators are not sufficiently informative, because they do not provide answers to the question of the priority of the implementation of energy-saving measures. It is proposed to use the concept of "energy saving potential" to evaluate the efficiency of energy consumption. The energy saving potential of an industrial enterprise, according to the author of the study, represents a set of energy saving reserves and the ability of the existing management system to stimulate the enterprise's personnel to rationally use fuel and energy resources. To detail the goals of management influences on energy saving, D. Sidorov, D. Panasetsky, N. Tomin, D. Karamov, A. Zhukov, I. Muftahov, suggests using a hierarchy of potentials, which depends on taking into account the factors of influence, the amount of energy resources involved and level of influence:

- market potential – significant public costs are not required, as it is believed that consumers themselves are interested in realizing the potential. Expenses are necessary only to maintain effectively operating market conditions of management and dissemination of information [15];

- economic – additional social costs are necessary to stimulate consumers to implement energy-saving measures, which are not attractive for them at a certain time and under certain conditions. Costs are needed to focus public attention through the introduction of economic stimulation mechanisms [15];

- scientific and technical – requires greater social costs (as well as justification of their necessity), since the costs of implementing known measures can significantly outweigh the benefits of their implementation (for a certain time). Thus, society can know about the available opportunity and not use it based on the cost/benefit criterion [15];

- strategic – there is a need for significant societal costs (in the long term) both for the development of fundamental science, including issues of energy use, and for changing the structure of the economy and methods of energy use [15];

- worldview – requires changing the foundations of social development, understanding the essence of energy consumption and labor efficiency, human behavior, affirming the priority of energy efficiency in human activity [15].

M. Shaaban, J. Scheffran, J. Böhner, M.S. Elsobki believes that the energy saving potential is determined by the technical, economic, financial capabilities of the industrial enterprise, as well as the level of development of scientific and technical progress. The increase in profit generated by the implementation of energy-saving measures is an indicator of the effective implementation of energy-saving potential [14].

S.V. Narayevskiyi define energy saving potential as economically feasible energy consumption [9].

A.Ya. Sokhnych, A.Yu. Yakymchuk, L.M. Kazachenko propose a classification of types of energy saving potential depending on the units for planning the implementation of energy saving measures [2].

One of the primary tasks in the assessment of energy saving potential is the grouping of units in accordance with energy saving at the enterprise, which makes it possible to effectively plan the process of implementing energy saving measures.

One of the most effective methods of classification is the use of neural networks, in particular the Kohonen network. The Kohonen network allows for the classification of energy-consuming objects of an industrial enterprise without the involvement of experts, which allows for continuous analysis and reduces the time for data processing. The number of classes when applying the Kohonen network is formed dynamically in the process of learning the network. The classification of units responsible for energy saving can be used to plan the implementation of energy-saving measures and evaluate the effectiveness of their implementation.

The energy-technical component of the energy-saving potential takes into account the possibilities of increasing the efficiency of energy consumption and, accordingly, reducing the energy intensity of production of products and providing services due to the introduction of the latest energy-efficient equipment, installations, technologies and energy-efficient measures. The technical component of the potential of energy saving makes it possible to increase the efficiency of production of production, transformation, transportation and consumption of energy resources and, accordingly, to reduce the energy intensity of products and the provision of services due to the introduction of the latest energy-efficient technologies and energy-saving measures.

Conclusions. The energy saving management system can be implemented due to a possible change in the proportions of energy consumption in order to reduce energy consumption levels; reduction of the specific weight of energy-intensive industries in the structure of the enterprise and transportation due to the development of knowledge-intensive industries with low energy and material intensity.

In turn, the introduction of structural and technological factors depends on inter-industry and intra-industry shifts in the country's economy.

Measures to improve the energy management component of energy saving potential include:

- structural restructuring of enterprises, which would contribute to the production of less energy-intensive products;
- training of specialists in the field of energy saving;
- development and implementation of new enterprise standards for energy saving;
- conducting regular energy audits of enterprises;
- use of energy management tools.

Measures to improve the energy-organizational component of energy-saving potential include:

- implementation of a system of reporting on measures and status of energy saving works;
- application of consulting schemes with the aim of saving energy and ecologically clean energy [1];
- creation of strict energy discipline.

The implementation of all these measures is possible by ensuring the formation of a legal framework for new and modernizing energy-saving facilities. Creating conditions for the introduction of a modern level of specific consumption of energy resources by industrial facilities by improving the legislative and regulatory framework will allow to reduce the consumption of energy resources by the state, to optimize the structure of consumption taking into account the tasks of the state regarding the priorities of the use of existing energy generating capacities.

References

Література

1. Yermoshenko, M. M., Hanushchak-Iefimenko, L. M. (2010). Mekhanizm rozvytku innovatsiinoho potentsialu klasteroob'iednanykh pidpriemstv: nauk. monohr. [Mechanism of development of innovative potential of cluster-united enterprises: scientific monograph]. Kyiv: National Academy of Management. 236 p. [in Ukrainian].
1. Єрмошенко М. М., Ганущак-Єфіменко Л. М. Механізм розвитку інноваційного потенціалу кластерооб'єднаних підприємств: наук. моногр. К.: Національна академія управління, 2010. 236 с.
2. Sokhnych, A. Ya., Yakymchuk, A. Yu., Kazachenko, L. M. (2020). Upravlinnia terytoriiamy, na yakykh roztashovani vidnovliuvani dzherela enerhii [Management of territories where renewable energy sources are located]. *Visnyk ekonomichnoi nauky Ukrainy = Herald of economic science of Ukraine*, 1 (38), 58–65 [in Ukrainian].
2. Сохнич А. Я., Якимчук А. Ю., Казаченко Л. М. Управління територіями, на яких розташовані відновлювані джерела енергії. *Вісник економічної науки України*. 2020. № 1 (38). С. 58–65.
3. Representation of the UN in Ukraine (2017). Natsionalna dopovid «Tsili Staloho Rozvytku: Ukraina» [National report "Sustainable Development Goals: Ukraine", September 15, 2017]. URL: <http://www.un.org.ua/ua/tsili-rozvytku-tysiacholittia/tsilistaloho-rozvytku> 50 [in Ukrainian].
3. Національна доповідь «Цілі Сталого Розвитку: Україна», 15.09.2017. *Представництво ООН в Україні*. URL: <http://www.un.org.ua/ua/tsili-rozvytku-tysiacholittia/tsilistaloho-rozvytku> 50.
4. Pro Natsionalnyi plan dii z vidnovliuvanoi enerhetyky na period do 2020 roku: Rozporiadzhennia Kabinetu Ministriv Ukrainy №902-r vid 01.10.2014 [On the National action plan for renewable energy for the period until 2020: Order of the Cabinet of Ministers of Ukraine No. 902-r dated October 1, 2014]. URL: <http://zakon3.rada.gov.ua/laws/show/902-2014-%D1%8051> [in Ukrainian].
4. Про Національний план дій з відновлюваної енергетики на період до 2020 року: Розпорядження Кабінету Міністрів України №902-р від 01.10.2014. URL: <http://zakon3.rada.gov.ua/laws/show/902-2014-%D1%8051>.
5. Pro skhvalennia Enerhetychnoi stratehii Ukrainy na period do 2035 roku «Bezpeka, enerhoefektyvnist, konkurentospromozhnist»: Rozporiadzhennia Kabinetu Ministriv Ukrainy №605-2017-r vid 18.08.2017 [On the approval of the Energy Strategy of Ukraine for the period until 2035 "Security, energy efficiency, competitiveness": Decree of the Cabinet of Ministers of Ukraine No. 605-2017-r dated 18.08.2017]. URL: <https://zakon.rada.gov.ua/laws/show/605-2017-%D1%8052> [in Ukrainian].
5. Про схвалення Енергетичної стратегії України на період до 2035 року «Безпека, енергоефективність, конкурентоспроможність»: Розпорядження Кабінету Міністрів України №605-2017-р від 18.08.2017. URL: <https://zakon.rada.gov.ua/laws/show/605-2017-%D1%8052>.
6. Ministry of Energy of Ukraine. Informatiina dovidka pro osnovni pokaznyky rozvytku haluzei palyvno-enerhetychnoho kompleksu Ukrainy [Informational reference on the main indicators of the development of branches of the fuel and energy complex of Ukraine]. URL: http://mpe.kmu.gov.ua/minugol/control/uk/publish/officialcategory?cat_id=35081 [in Ukrainian].
6. Інформаційна довідка про основні показники розвитку галузей паливно-енергетичного комплексу України. *Міністерство енергетики України*. URL: http://mpe.kmu.gov.ua/minugol/control/uk/publish/officialcategory?cat_id=35081.

7. Ministry of Education and Science of Ukraine. Official website. URL: <https://mon.gov.ua/>
8. Ministry of Development of Communities and Territories of Ukraine (2017). Rozvytok vidnovliuvanykh dzherel enerhii v Ukraini [Development of renewable energy sources in Ukraine]. URL: <https://www.minregion.gov.ua/wp-content/uploads/2017/03/Rozvitok-VDE-v-Ukraini.pdf> [in Ukrainian].
9. Naraievskiy, S. V. (2014). Zalezhnist sobivartosti elektroenerhii vid vartosti hroshovykh resursiv dlia riznykh vydiv heneratsii [Dependence of the cost of electricity on the cost of monetary resources for various types of generation]. *Ekonomika ta derzhava = Economy and the state*, 12, 101–105 [in Ukrainian].
10. National Commission, which carries out state regulation in the spheres of energy and communal services. Zahalnoukrainska informatsiia ta statystychna informatsiia yevropeyskykh instytutsii u sferi elektrychnoi enerhii [All-Ukrainian information and statistical information of European institutions in the field of electric energy]. URL: <https://www.nerc.gov.ua/sferidiyalnosti/elektroenergiya/energetichni-pidpriemstva/zagalnoukrayinskainformaciya-ta-statistichna-informaciya-yevropejskih-institucij-u-sferi-elektrichnoyienergiyi> [in Ukrainian].
11. National Council for the Recovery of Ukraine from the Consequences of the War. Proekt Planu vidnovlennia Ukrainy: Materialy robochoi hrupy «Enerhetychna bezpeka» [Project of the Recovery Plan of Ukraine: Materials of the "Energy Security" working group]. URL: <https://www.kmu.gov.ua/storage/app/sites/1/recoveryrada/ua/energy-security.pdf> [in Ukrainian].
12. National Institute of Strategic Studies (2019). Nyzkovuhletseva enerhetyka: stan ta stratehichni priorytety rozvytku v Ukraini [Low-carbon energy: status and strategic priorities of development in Ukraine]. URL: <https://niss.gov.ua/sites/default/files/2019-12/analit-bobro-1.pdf> [in Ukrainian].
13. Sevostianov, V., Sevostianova, A., Savina, O. (2022). Osoblyvosti proektiv v sferi vidnovliuvalnoi enerhetyky ta spetsyfika upravlinnia nymy [Peculiarities of projects in the field of renewable energy and the specifics of their management]. *Bulletin of the National Technical University "KhPI". Series: Strategic management, portfolio, program and project management*, 1(5), 62–69 [in Ukrainian].
7. Міністерство освіти і науки України. Офіційний вебсайт. URL: <https://mon.gov.ua/>
8. Розвиток відновлюваних джерел енергії в Україні. *Міністерство розвитку громад та територій України*. URL: <https://www.minregion.gov.ua/wp-content/uploads/2017/03/Rozvitok-VDE-v-Ukraini.pdf>.
9. Нараєвський С. В. Залежність собівартості електроенергії від вартості грошових ресурсів для різних видів генерації. *Економіка та держава*. 2014. № 12. С. 101–105.
10. Загальноукраїнська інформація та статистична інформація європейських інституцій у сфері електричної енергії. *Національна комісія, що здійснює державне регулювання у сферах енергетики та комунальних послуг*. URL: <https://www.nerc.gov.ua/sferidiyalnosti/elektroenergiya/energetichni-pidpriemstva/zagalnoukrayinskainformaciya-ta-statistichna-informaciya-yevropejskih-institucij-u-sferi-elektrichnoyienergiyi>.
11. Проект Плану відновлення України: Матеріали робочої групи «Енергетична безпека». *Національна рада з відновлення України від наслідків війни*. URL: <https://www.kmu.gov.ua/storage/app/sites/1/recoveryrada/ua/energy-security.pdf>.
12. Низьковуглецева енергетика: стан та стратегічні пріоритети розвитку в Україні. *Національний інститут стратегічних досліджень*. URL: <https://niss.gov.ua/sites/default/files/2019-12/analit-bobro-1.pdf>.
13. Sevostianov V., Sevostianova A., Savina O. Особливості проєктів в сфері відновлювальної енергетики та специфіка управління ними. *Bulletin of the National Technical University "KhPI". Series: Strategic management, portfolio, program and project management*. 2022. № 1(5). С. 62–69.

-
14. Shaaban, M., Scheffran, J., Böhner, J., Elsobki, M. S. (2018). Sustainability assessment of electricity generation technologies in Egypt using multicriteria decision analysis. *Energies*, 11(5), 1117.
15. Sidorov, D., Panasetsky, D., Tomin, N., Karamov, D., Zhukov, A., Muftahov, I., Li, Y. (2020). Toward Zero-Emission Hybrid AC/DC Power Systems with Renewable Energy Sources and Storages: A Case Study from Lake Baikal Region. *Energies*, 13(5), 1226.
14. Shaaban M., Scheffran J., Böhner J., Elsobki M. S. Sustainability assessment of electricity generation technologies in Egypt using multicriteria decision analysis. *Energies*. 2018. № 11(5). 1117.
15. Sidorov D., Panasetsky D., Tomin N., Karamov D., Zhukov A., Muftahov I., Li Y. Toward Zero-Emission Hybrid AC/DC Power Systems with Renewable Energy Sources and Storages: A Case Study from Lake Baikal Region. *Energies*. 2020. № 13(5). 1226.