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THE ROLE OF ENERGY EFFICIENCY IN ENSURING SUSTAINABLE DEVELOPMENT

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The aim of the article is to study and summarize international experience improving the energy efficiency of national economies to make proposals for implementation of its concept in Ukraine. The paper's goal is to define the directions of the formation regional innovation system based on the creation energy clusters as a basis for policy implementation energy efficiency in the region. The main prerequisites for the implementation of effective implementation of energy-saving technologies in the regional economy based on development of innovative activities of cluster members. Proposed measures to ensure the implementation of the energy saving strategy and energy efficiency in the region using modern cluster technologies.

The paper highlights the role of energy efficiency technologies in the context of achieving sustainable development. The work defines that the usage of energy efficient technologies is a prerequisite of economic sustainability. The best practices of the EU in energy efficiency implementation are discussed. The paper considers that achieving the expected results in energy efficiency is possible with the development of an effective sustainable management system. The paper proposes to enhance the actions in sustainable use of energy sources and activate the usage of energy saving technologies to ensure the sustainable development.

The reduction in energy consumption is possible in the case if society will work fruitfully in the following main areas: formation of energy-saving worldview involving all stakeholders; awareness of the general relationship between economic and ecological development at the local, regional and state levels; flexible energy and economic policy of governmental bodies on the national and local levels; strengthening international cooperation in the field of energy saving.

Keywords: *sustainable development, energy efficiency, energy cluster, energy consumption, sustainable management system.*

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სტატიის მიზანია ეროვნული ეკონომიკის ენერგოეფექტურობის გაუმჯობესების საერთაშორისო გამოცდილების შესწავლა და შეჯამება, უკრაინაში მისი კონცეფციის განსახორციელებლად წინადადებების წარდგენის მიზნით.

ნაშრომის მიზანია განსაზღვროს რეგიონული ინოვაციური სისტემის ფორმირების მიმართულებები, რომელიც დაფუძნებული იქნება ენერგეტიკული კლასტერების შექმნაზე, როგორც რეგიონში პოლიტიკის განხორციელების საფუძველი ენერგოეფექტურობისა.

რეგიონულ ეკონომიკაში ენერჯის დაზოგვის ტექნოლოგიების ეფექტური დანერგვის ძირითადი წინაპირობებია, რომლებიც დაფუძნებულია კლასტერის წევრების ინოვაციური საქმიანობის განვითარებაზე. შემოთავაზებული ზომები რეგიონში ენერჯის დაზოგვის სტრატეგიისა და ენერგოეფექტურობის განხორციელების უზრუნველსაყოფად თანამედროვე კასეტური ტექნოლოგიების გამოყენებით.

ნაშრომში ხაზგასმულია ენერგოეფექტურობის ტექნოლოგიების როლი მდგრადი განვითარების მისაღწევად. ნაშრომში განსაზღვრულია, რომ ენერგოეფექტური ტექნოლოგიების გამოყენება ეკონომიკური მდგრადობის წინაპირობაა. განხილულია ევროკავშირის საუკეთესო პრაქტიკა ენერგოეფექტურობის განხორციელებაში. მიჩნეულია, რომ ენერგოეფექტურობაში მოსალოდნელი შედეგების მიღწევა შესაძლებელია ეფექტური მდგრადი მართვის სისტემის შემუშავებით. ნაშრომში მოცემულია ენერჯის წყაროების მდგრადი გამოყენების ქმედებების გაძლიერება და ენერჯის დაზოგვის ტექნოლოგიების გამოყენების გააქტიურება მდგრადი განვითარების უზრუნველსაყოფად.

ენერჯის მოხმარების შემცირება შესაძლებელია იმ შემთხვევაში, თუ საზოგადოება ნაყოფიერად იმუშავებს შემდეგ ძირითად მიმართულებებში: ენერჯის დაზოგვის მსოფლმხედველობის ფორმირება ყველა დაინტერესებული მხარის მონაწილეობით; ადგილობრივი, რეგიონული და სახელმწიფო დონეზე ეკონომიკურ და ეკოლოგიურ განვითარებას შორის ზოგადი კავშირის ცოდნა; ეროვნულ

და ადგილობრივ დონეზე სამთავრობო ორგანოების მოქნილი ენერგეტიკული და ეკონომიკური პოლიტიკა; ენერჯის დაზოგვის სფეროში საერთაშორისო თანამშრომლობის გაძლიერება.

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საკვანძო სიტყვები: მდგრადი განვითარება, ენერგოეფექტურობა, ენერჯის კლასტერი, ენერჯის მოხმარება, მდგრადი მართვის სისტემა.

Introduction

The issues of limited energy resources and their sustainable usage are becoming more important every year in the global context. The global community is taking active steps to reduce the negative impact on ecology, increase the efficiency of existing resources and find new, more efficient sources of energy. Despite the efforts of the governmental, scientific, educational and business communities to promote non-traditional energy sources and energy efficiency, most of the world's economy is still working on fossil fuels. In modern turbulent conditions of uncertainty, there is a challenge for economic sustainability and the problem of high-energy consumption, energy efficiency and the development of renewable energy. In addition, the challenge is the lack of understanding by citizens of the need to reduce energy consumption. This is due to the lack of proper consideration of these issues in educational environment, consumer approach to the ecology and the lack of targeted government policies to generate energy savings for citizens.

Ensuring a sufficient level of economic security is a necessary component for the sustainable development of any country. Economic security is a complex multifactorial category that allows maintaining resilience to external and internal threats, characterizes the ability of the national economy to expand self-reproduction to meet the needs of citizens, society and the state at a certain level. Economic security is a state of the national economy that allows maintaining resilience to internal and external threats, to ensure high competitiveness in the global economic environment and characterizes the ability of the national economy to sustainable and balanced growth [1].

Energy security is a state of the economy that contributes to the efficient use of the country's energy resources, the availability of a sufficient number of energy producers and suppliers in

the energy market, as well as the availability, differentiation and environmental friendliness of energy resources. Energy security is a state of the economy that protects national interests in the energy sector from existing and potential threats of internal and external nature, allows meeting the real needs for fuel and energy resources to ensure the livelihood and reliable functioning of the national economy in normal, emergency and martial law. Energy security is an integral part of economic and national security and a necessary condition for the existence and development of the country [2].

The inclusion of energy factors in the system of international assessments is fast-growing, global trend of development of the world economic system. Concept of sustainable development in recent years is closely linked to the concept of a "green" economy, for which the main priorities are high-energy efficiency and minimal impact on the environment. The global community, moving towards improving the quality of societal development, puts forward a new concept of development, in which increasing the welfare of society accompanied by a careful attitude to the environment and the preservation of natural resources for future generations. Despite the fact that the world experience of application energy efficiency policy is a relatively new trend in social development, most developed countries successfully implement national development strategies based on energy saving.

EU experience in the application of energy efficient technologies

EU countries are an example of the successful application of energy efficient technologies. Thus, in particular, the European Union successfully combines the principles of sustainable economic development with the preservation of environmental safety. For example, Program to reduce by 20% greenhouse gas emissions

and specific energy costs per unit of GDP. It is also increasing in the sharing of renewable energy sources by 20% in the energy balance of each country. The most developed countries are already exceeding the targets. For example, Denmark plans to receive 60% of electricity from renewable energy sources, and Germany and Austria - 40-50%. This is facilitated by a multi-level system of legislative regulation and encouraging consumers to save energy. Biogas technology, which uses animal and vegetable residues, has developed powerfully in Germany. From 1999 to 2011, the number of biogas plants increased from 700 to 7,000 with a total capacity of 2,850 MW. The Czech Republic is also a good example of electricity production from biogas. Its production reached 2243 gigawatts / hour. The Czech Republic has more than 500 biogas plants, making it the 5th largest in Europe with 13,800 such plants. Most of them are in Germany, Italy, Switzerland and France. One such station is located in Scots city. It is designed to transfer the produced gas to the general pipeline system. It produces 3 million cubic meters of biogas annually. Corn silage, sugar waste, and raw materials from private farms are used for production [3].

One of the best practices of successful experience in the usage of energy-saving technologies is Sweden, where an active policy of energy saving and energy efficiency is pursued at the state level, which has its positive results. The country has a clear system of control over the use of energy resources. Economic incentives are actively used to promote the usage of non-traditional and alternative energy sources: exemption for a period of 5 years from the energy tax, state subsidies for the reconstruction of old buildings, simplified obtaining permits for wind farms and more. Another feature of the Swedish energy sector is central heating and cooling of premises (supermarkets, exhibition halls, etc.). This is realized through the operation of heat pump

stations, and the raw material is the potential of land and water. In addition to traditional gasoline and diesel fuel, at large gas stations, the sale of alternative fuels is mandatory. In Sweden, heat pumps with a capacity of 25-40 kW are installed for apartment buildings, which are quite energy efficient and reduce the harmful effects on the environment [4].

The role of sustainable management system in achieving energy efficiency: Ukrainian context

Energy efficiency is more important today than ever before. It is a tool that simultaneously contributes to the achievement of three main goals of energy policy: increasing energy security; reduction of harmful environmental impact due to the use of energy resources and increasing the competitiveness of the enterprises. Achieving the desired result of efficient energy use in Ukraine is possible only if an appropriate and effective sustainable management system is created at all levels of government and the conditions for its perception by the public of Ukraine are provided.

Ukraine has a very high-energy intensity of GDP, or, in other words, the country's economy is extremely energy-intensive. Energy consumption in our country per unit of GDP is one of the highest in Europe. Although over the last fifteen years in Ukraine there has been a positive trend of declining GDP, it continues to be quite high and 2.1-3.7 times higher than the energy intensity of economically developed countries. In addition, if in the industrial sector energy-efficient technologies are gradually introduced, in the residential sector this process remains almost unchanged [5].

Therefore, Ukraine needs to make every effort to reduce its dependence on expensive imported energy resources and to mitigate the sharp increase in utility tariffs for the population, thereby increasing economic sustainability [6]. Today in our state active actions in this direction are carried out. Thus, in particular, the State Agency for Energy Efficiency and Energy Saving of

Ukraine has developed a mechanism to encourage the population to implement energy efficiency measures. Thanks to this mechanism, the state will reimburse part of the body of the loan in the following amounts:

- 20% (but not more than 5 thousand UAH) - the current mechanism of replacement of gas boilers;
- 30% (but not more than 10 thousand UAH) - for individuals (population) for the implementation of measures in apartment buildings (and apartments of apartment buildings);
- 40% - for condominiums (HBC) for the implementation of measures in apartment buildings.

The foreign investors are stepping up cooperation with Ukraine on the development of renewable energy sources. In particular, the co-owner of 2ZK (Belgium) and the representative of "Traficon" (Czech Republic) presented the "Bioteplo 100" project. This project is a collective initiative of a group of industry companies to create infrastructure in Ukraine to grow and ensure the supply of biomass on a long-term basis. Presenting the "Bioteplo 100" project, a representative of Traficon (Czech Republic), noted that as of today international and Ukrainian project participants have been involved, a concept for implementing the initiative has been developed, letters of support have been received from many state organizations and industry associations. Such international donor and investment organizations as USAID, NEFCO, DCIF (Danish Climate Investment Fund), EBRD and others [7].

Ukraine has significant potential for biomass use. A new direction in the development of energy efficient technologies in Ukraine is geothermal energy. Iceland has a unique experience in this matter. The annual technically achievable thermal potential of geothermal energy in Ukraine is equivalent to about 90,000 million kWh / year, and

its use saves about 10 billion cubic meters of gas. According to the Institute of Renewable Energy of the National Academy of Sciences of Ukraine, the largest technically achievable energy geothermal potential is: Kharkiv region - 7350 million kWh / year, Poltava - 7139 million kWh / year, Kherson - 7049 million kWh / year, Sumy - 6976 million kWh / year, Zakarpattia - 6919 million kWh / year, Lviv - 6439 million kWh / year, Rivne - 6024 million kWh / year [8].

According to experts from the International Renewable Energy Agency IRENA, if Ukraine makes every effort to use energy efficient technologies, then in 2030 the share of energy from renewable sources in final energy consumption may be at least 21%. Experts predict that 72% of energy from renewable sources will be used for heat generation, 20% - for electricity generation, and 8% - in the transport sector, and the most promising area of renewable energy will be the development of bioenergy [9].

The impact of energy efficiency clusters on sustainable development of Ukraine

One of the ways to ensure the environmental security of Ukraine may be the use of energy efficiency clusters, which are quite successful in countries with developed economies. The basis of any cluster is its core. A demonstration company uses the latest and most effective technologies and serves as a model for other member companies of the cluster. This position of this enterprise can be ensured through the active support of state and territorial authorities, cooperation with scientific institutions, as well as representatives of the infrastructure.

The formation of cluster core will accelerate the diffusion of knowledge and technology. The external contour of the cluster includes enterprises and organizations of market infrastructure that provide information, financial, consulting and others. Services providing business support,

innovation infrastructure, specialized higher educational institutions that train specialists in innovation activities, innovation centres, etc., which ensure effective research and innovation activities, as well as authorities and regulatory bodies that control, coordinate and regulate activities in the energy sector. The internal contour of the energy cluster connects enterprises and organizations specializing in the production, supply, distribution and consumption of energy, as well as those that service these processes, carry out design, construction, installation and repair work. Their interaction is based on voluntary principles. The relations between the participants are regulated by the Cluster Coordination Council, which should prevent conflict situations by its actions. The Coordinating Council on the principles of parity and equality consists of one representative from each member of the cluster. Thus, the cluster forms a network of participants with a single technological process and provides both vertical, along the energy chain, and horizontal (organizations that are at the same stage of the energy chain) integration.

Analysing the experience of other countries, it should be noted that such clusters function successfully, providing competitive advantages from the interaction of all participants. Thus, in particular in neighbouring Poland, innovative enterprises in the field of alternative energy sources are developing. Poland is confidently working in the European development support system, which is needed in all sectors, especially in energy. This version of the country's economy creates new jobs, new efficient technologies, draws the attention of other countries to interesting and useful scientific and technical solutions created by innovators. One of such energy clusters is "Lublin Ecoenergy Cluster", the main activity of which is renewable energy. Today, it brings together entities working in the fields of solar energy, wind generation, energy efficiency and environmentally

friendly construction. This cluster includes 41 companies, 3 research organizations, 3 business support institutions. One of the first projects of the cluster was the initiative "Energy Creators of Change", which explored the investment potential in alternative energy in 20 counties of the Lublin Voivodeship. As a result of the project, three strategies for attracting investment in initiatives for the introduction of alternative energy have been developed, within which the first industrial solar power plant has already been built [10].

For the successful implementation of an energy saving strategy and energy efficiency in the region based on the application of modern cluster technologies it is important to concentrate joint actions of government agencies, research organizations, educational institutions, large industrial enterprises, medium and small businesses on the implementation of the following activities:

- Establishment of regional development corporations as the operators of industrial regional parks to provide effective assistance to economic entities in implementation of investment projects and programs on energy saving technologies;
- Formation of steady demand for innovations with the usage of energy saving technologies, ways to increase the culture of consumption with the waste processing technologies;
- Development of energy efficiency programs of innovative development for the large companies included in the cluster of innovative development of regional economy;
- Stimulation of innovative activity and creative initiative in the development of energy saving technologies in the implementation of investment projects;
- Providing effective motivational mechanisms for the development of energy efficiency policies of all cluster members taking into account the methods of ensuring sustainable

- economic development of the region;
- Development and consolidation of strict energy efficiency parameters for the cluster;
- Constructing the image of an energy efficient region with orientation on increasing competitiveness of the region's economy based on achieving stable energy savings by all members of the energy cluster;
- Emphasis on joint projects, development of network contacts, strategic interaction on joint positioning of innovative products and energy-saving technologies, common goals and the interests of cluster members.

Conclusions

According to the unstable geopolitical situation due to the conditions in the East of Ukraine and complicated economic situation in the period of Covid-19 pandemic, issues of economic sustainability in the context of energy supply and efficient use of energy resources become particularly relevant. Today, Ukraine occupies one of the leading positions in the world in terms of energy consumption. Significant parts of them are imported resources. Increased focus on energy conservation is almost the only way to develop the country's energy. Therefore, the issues of sustainable consumption of fuel and energy resources, replacement of gas with alternative fuels, the use of energy-saving technologies have become priorities in ensuring economic security and need immediate solution.

The challenges in the energy sector require new approaches and the application of more effective ways to achieve economic and

environmental security. The clustering pathway can be effective in this area. Analysing the experience of other countries, it should be noted that such clusters function successfully, providing competitive advantages from the interaction of all participants. However, Ukraine is only taking the first steps towards the introduction of eco-energy clusters. The main tool for achieving the overall goal of building a regional eco-energy cluster should be the development and implementation of a comprehensive energy saving policy at the enterprises of the industries that are part of the cluster. This implies the inclusion in the investment programs of such enterprises of a component aimed at the development and implementation of resource-saving and energy-saving technologies. This approach requires a rethinking of the principles of state regional, energy, environmental, industrial policy, policy in science and education. The purpose of creating eco-energy clusters should be the development of energy and related industries by stimulating a group of companies that interact with energy companies to implement energy saving policies and reduce the cost of products and services on this basis.

The transition to clean innovative technologies with the help of energy efficiency clusters will not only guarantee Ukraine's economic growth in the future, but will also help solve such global environmental problems as water and air pollution, climate change, and scarcity of clean water resources. By choosing a new model of development, the state can count on strengthening energy and food security through the development of alternative energy sources, organic agriculture, ecological transport, and energy efficiency.

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