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ECONOMIC STIMULATION OF ENTREPRENEURSHIP DEVELOPMENT IN THE FIELD OF RENEWABLE ENERGY IN THE WORLD AND IN UKRAINE

ABSTRACT

The article is devoted to the study of areas of economic incentives for entrepreneurship development in the field of renewable energy in the world and Ukraine. Indicators of energy security, economic measurement, and cost of electricity for business are systematized. A graphical interpretation of the cost of electricity in terms of the ratio of the index of economic dimension and energy security in selected countries – some neighbouring countries, partners of Ukraine, and countries with leading economies, which allowed to implement a methodological approach to identify key areas for effective energy development. The expediency of using the experience and adaptation of measures in the energy policy for the development of renewable energy in countries such as Canada, Germany, France, and Turkey are substantiated. It is determined that in these countries the directions of economic stimulation of entrepreneurship in the field of renewable energy are developed, which is reflected in the basic strategies of their energy development. The main mechanisms of financial incentives for renewable and alternative energy in EU member states are presented, in particular, mechanisms with the use of benefits with pricing tools, regulatory mechanisms with quotas, green certificates, tariff auctions. The current mechanisms for stimulating renewable energy in Ukraine are analysed and the dynamics of the levelized cost of electricity and the "green" tariff for electricity from solar and wind power plants from 2009 to 2019 are presented. The main problems in the field of renewable energy regulation in Ukraine are identified. Recommendations for improving the renewable energy market in Ukraine and accelerating the achievement of the Goal 7 of sustainable development in Ukraine are provided.

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ЕКОНОМІЧНЕ СТИМУЛЮВАННЯ РОЗВИТКУ ПІДПРИЄМНИЦТВА В СФЕРІ ВІДНОВЛЮВАНОЇ ЕНЕРГЕТИКИ В СВІТІ ТА УКРАЇНІ

АНОТАЦІЯ

Стаття присвячена дослідженню напрямів економічного стимулювання розвитку підприємництва в сфері відновлюваної енергетики в світі та Україні. Систематизовано показники енергетичної безпеки, економічного виміру та вартості електроенергії для бізнесу. Представлено графічну інтерпретацію вартості електроенергії у розрізі співвідношення індексу економічного виміру та енергетичної безпеки в обраних країнах – деяких країн-сусідів, партнерів України та країн з провідною економікою, що дозволило реалізувати методичний підхід щодо визначення основних напрямів для ефективного розвитку енергетичної сфери. Обґрунтовано доцільність використання досвіду та адаптації заходів в енергетичній політиці стосовно розвитку відновлюваної енергетики таких країн як Канада, Німеччина, Франція та Туреччина. Визначено, що в даних країнах розвинені напрями економічного стимулювання підприємництва в сфері відновлюваної енергетики, що відображено в базових стратегіях їх енергетичного розвитку. Наведено основні механізми фінансового стимулювання відновлюваної та альтернативної енергетики в країнах-членах ЄС, зокрема, механізми з використанням пільг з інструментами ціноутворення, регуляторні механізми із застосуванням квот, зелених сертифікатів, тарифних аукціонів. Проаналізовано діючі механізми стимулювання відновлюваної енергетики в Україні та представлено динаміку нормованої вартості електроенергії та «зеленого» тарифу на електричну енергію від сонячних та вітрових електростанцій з 2009 по 2019 рр. Визначено основні проблеми в сфері регулювання відновлюваної енергетики в Україні. Надано рекомендації щодо удосконалення ринку відновлюваної енергетики в Україні та прискорення досягнення цілі сталого розвитку 7 в Україні.

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Ключові слова: відновлювана енергетика; стимулювання підприємництва; інновації; регуляторні механізми

Introduction

The adoption of the Paris Climate Agreement has set the agenda for preserving the environment and developing a carbon-free economy and energy for the third decade of the 21st century, which aims to reduce greenhouse gas emissions and combat global warming. Most countries around the world are developing and implementing the concept of energy transition – the transition from traditional fossil energy resources to renewable energy sources, the introduction of energy-efficient technologies, which indicates the innovative development of the energy sector. Thus, the innovative development of the energy sector will ensure the development of the socio-economic sphere in the Sixth Technological Paradigm, the Post-Industrial Age, the Knowledge Economy, the Fourth Industrial Revolution (Industry 4.0). As well as compliance with the provisions of sustainable development, resource savings, energy efficiency, environmental protection for future generations. That is why the development of renewable energy (Sustainable Development Goal 7) is one of the 17 Global Sustainable Development Goals by 2030, approved at the UN summit in 2015. To increase energy capacity based on the renewable energy sources in Ukraine, it is important to create a supportive environment for entrepreneurship development in this area, which determines the relevance of this study.

Issues of renewable energy development and energy innovations have been studied by foreign and Ukrainian scientists, in particular: F. V. Hackstein, R. Madeleine, D. Balzan-Alzate, F. Libertson, L. Friedstrom, W. Ostley, P. F. Borowski, D. I. Kurbatov, O. V. Prokopenko, N. O. Ryazanova and others. However, the study of the directions of economic stimulation of entrepreneurship development in the field of renewable energy needs to be updated, taking into account the global energy crisis, the main priorities of sustainable development, and modern foreign experience.

The purpose and objectives of the article

The purpose of the article is to determine the main directions and measures in the framework of economic incentives for entrepreneurship development in the field of renewable energy. This defines the main objectives of the article, namely: to analyse the position of selected countries (according to certain criteria) in the coordinates of the energy security index, the index of economic measurement and the cost of electricity for business; identify countries with a balanced ratio of these indicators and analyse measures for the development of renewable energy; to determine the directions of economic stimulation of entrepreneurship development in the field of renewable energy in the world; identify problems, and recommend measures for the RES development in Ukraine.

Research results

The following indicators were selected for the analysis: energy security, index of economic measurement, cost of electricity for business (see Table 1). These indicators were analysed in such countries as Belarus, Poland, Hungary, Latvia, Estonia, Canada, Germany, France, Turkey, Portugal, and Italy. These countries were selected according to the following criteria: neighbouring countries, similar resource opportunities, countries with which Ukraine cooperates in various areas, countries with leading economies, and high levels of GDP.

The value of these indicators was determined using the appropriate methodology in the World Data Centre for Geoinformatics and Sustainable Development [1]. Thus, the basis for calculating the components of energy security of countries are the following indicators: coal reserves, natural gas reserves, uranium reserves, oil reserves, the use of alternative energy sources [1]. Index of economic dimension according to the methodology of assessing sustainable

development in the context of quality and safety of human life [1; 2] is formed from two global indices: the index of global competitiveness and the index of economic freedom.

The Global Competitiveness Index was developed by the organizers of the World Economic Forum [3], is calculated annually for most world economies, and is formed from three groups of indicators: 1 — Enabling environment; 2 — Human capital and 3 – Markets. The first group includes four complex categories of economic policy: Institutions (Security, Social capital, Checks and balances, Public-sector performance, Transparency, Property rights, Corporate governance, Future orientation of government); Infrastructure (Transport infrastructure, Utility infrastructure, Water); ICT adoption and Macroeconomic stability. The second group of indicators concerns human capital and contains two categories: Health and Skills (Current workforce Future workforce). The third group includes five important comprehensive indicators: Product market (Domestic market competition, Trade openness), Labour market (Flexibility, Meritocracy, and Incentivization) Financial system (Depth Stability), Market size (GDP, Imports of goods and services), Innovation capability (Business dynamism, Innovation capability).

Index of Economic Freedom (IEF), developed by the Heritage Foundation [4]. This index is formed from the following twelve indicators: property rights, judicial effectiveness, government integrity, tax burden, government spending, fiscal health, business freedom, labour freedom, monetary freedom, trade freedom, investment freedom, and financial freedom. These indicators are calculated based on the expert evaluation and the use of various economic, financial, legislative, and administrative data.

After comparing these indicators (Fig. 1) for selected countries with the help of graphical visualization we obtained a graphical interpretation of the ratio of the energy security index with the index of economic dimension. This provides an opportunity to qualitatively compare the countries in terms of the cost of electricity (the area of the circle indirectly reflects the cost of electricity for business) and analyse the selected indicators.

Table 1. Initial data for visualization the ratio of indices of energy security, economic measurement and the cost of electricity for business in 2020

Country	Energy Security Index	Index of economic dimension	Cost of electricity for business, December 2020, Euro per kWh
France	0,65	0,61	0,153
Germany	0,72	0,76	0,232
Estonia	0,40	0,67	0,092
Canada	0,74	0,74	0,093
Belarus	0,47	0,44	0,096
Latvia	0,47	0,64	0,140
Hungary	0,48	0,56	0,148
Portugal	0,49	0,51	0,172
Poland	0,51	0,59	0,144
Italy	0,62	0,56	0,230
Ukraine	0,50	0,31	0,091
Turkey	0,54	0,53	0,089

Source: compiled by the authors based on [1; 2; 5].

The defined indicators for the studied countries were visualized (Fig. 1), which will allow determining the main directions and elements of pricing mechanisms for the effective development of the energy sector [6; 7]. In fig. 1 area of the circle reflects the cost of electricity for business.

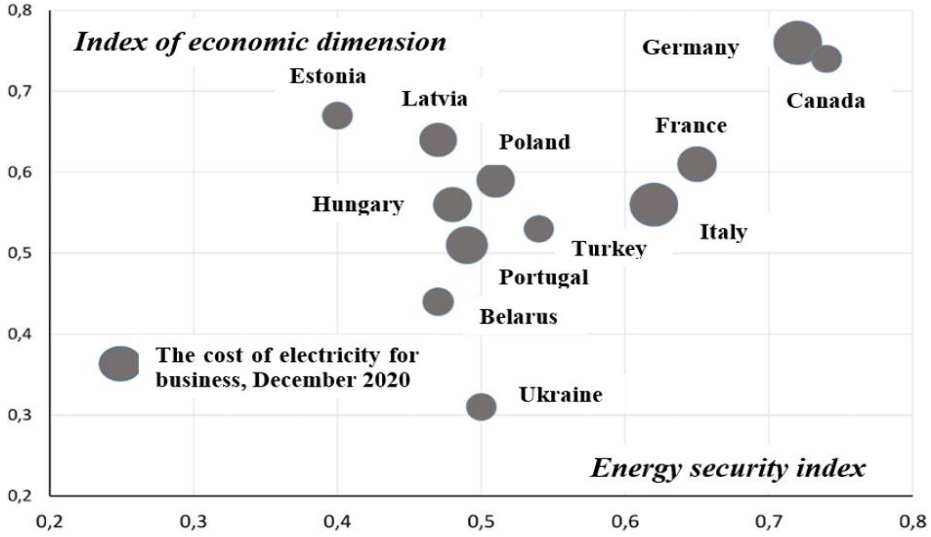

Figure 1. Visualization of electricity costs in the coordinates of the index of economic dimension and energy security in selected countries

Compiled by the authors.

Figure 1 shows that the highest level of economic dimension and energy security is observed in Germany, but with a high cost of electricity 0.232 euros per kWh. Canada is next in terms of the ratio of the economic dimension index and energy security, but the cost is only slightly higher than in Ukraine – 0.093 euros per kWh. It is important to take into account Canada's efforts in the energy sector and in the economy as a whole, considering high indicators of indices and the low cost of electricity for enterprises. France's position is quite balanced, Turkey is also characterized by a balanced ratio of indices. Therefore, in our opinion, these countries can be identified for the adaptation of measures in energy policy by priority – Canada, Germany, France, and Turkey.

Regarding the pricing of electricity for businesses in the countries selected for the calculation, it should be noted that there are two clear patterns. The first one concerns countries with relatively high electricity prices. Thus, for Portugal, Italy, France, and Germany, we have a direct dependence on their position in the coordinates of the Energy Security Index and the Economic Dimension Index. Another situation is with countries with lower electricity costs. There are three directions. All these directions in the specified coordinates begin with the centre of the totality. The first direction, from the centre to the bottom, includes Belarus and Ukraine. The second direction, from the centre to the increase of the Economic Dimension Index and the decrease of the Energy Security Index, includes such countries as Hungary, Latvia, and Estonia. And the third direction is characterized by the fact that there is a simultaneous increase in the Index of Economic Dimension and the Index of Energy Security. This direction includes Italy and Germany. Regarding the exceptions that can be seen in the graph, it is worth noting Canada, which has high values of the Index of Economic Dimension and the Index of Energy Security at the low cost of electricity.

According to the results of the study in the coordinates of the indices and the cost of electricity for business among the studied countries, it was determined that it is necessary to take into account measures

within the energy policy of countries such as Canada, Germany, France, and Turkey.

It should be noted that renewable energy is actively developing in these countries today. Canada is one of the world's leaders in renewable energy development. More than 60% of its own electricity is produced based on renewable energy sources. It is worth noting a thorough national study, Canada's Energy Future 2020: Energy Supply and Demand Forecasts for 2050 (EF2020), which identifies how new technologies and climate policies will affect Canada's energy consumption and production trends. Depending on the pace of change in technology and government policy, two scenarios are considered: a new scenario for the development of the energy system and a scenario for a reference energy system [8].

Renewable energy in Turkey is developing quite rapidly. Thus, the National Energy Efficiency Action Plan (NEEAP) for the period 2017-2023 of Turkey identifies activities to reduce primary energy consumption by 14% compared to the usual level in the sectors, including buildings and services, electricity and heat, transport, industry and technology, agriculture, etc.

The Multiannual Energy Plan 2018-2030 in France aims to complete the energy transition to ensure sustainable energy, reduce energy consumption, especially energy from fossil fuels, and ensure a harmonious balance between different energy sources [9]. This will help achieve the goals of minimizing greenhouse gas emissions, commitments to the EU and the Paris Climate Agreement to protect human health and the environment, and providing access to energy at reasonable prices while stimulating economic activity and employment in France.

The German plan for the 2010-2050 Energiewende energy transition is large-scale. Germany's energy concept, which envisages activities for Germany's transition to a low-carbon, environmentally friendly, reliable, and affordable energy supply.

The above proves that these countries have developed areas of economic stimulation of entrepreneurship in the field of renewable energy, which is provided for in the basic strategies of their energy development.

The new EU Renewable Energy Directive (REDII) [10] was approved on 3 December 2018. The EU's main target for the share of renewable energy is 32% of final energy consumption by 2030. This target has not been shared among the Member States, but the share of renewable energy in the Member States should be at least the same as in 2020. That is why today it is important to analyse the successful experience of other countries in the application of innovations in the energy sector and implement innovations in the energy sector of Ukraine, based on the effective use of the existing potential of alternative energy sources and external opportunities.

Today, various mechanisms for financial incentives for renewable and alternative energy development were launched and implemented [11-16]. In particular, such mechanisms are being implemented in EU member states:

1. Mechanisms with the use of benefits ("green" tariffs and surcharges), which are based on pricing tools. The mechanism is that the government fixes the price and the amount of electricity is already determined by the market. The green tariff is often set for a long period and then gradually reduced, as well as differentiated for different technologies and installed capacities. Germany, France, Austria, Denmark are examples of effective implementation of such mechanisms.

2. Regulatory mechanisms with the use of quotas, green certificates, implemented on a quantitative basis. The mechanisms are that the amount of electricity is fixed by the government and the price is set by the market.

– Within the framework of quotas, the regulator sets the minimum share of "clean" electricity in the overall structure

of electricity, and the regulator determines the obligation to use "clean" electricity by setting quotas. Quota mechanisms are often combined with the use of "green" certificates. Examples of countries implementing these mechanisms are Belgium, Poland, Italy, Sweden, and Romania.

- Within the framework of the implementation of mechanisms with the use of "green" certificates, the obligated party under the quota issues a certificate for the amount of electricity produced. In the case of production of more "green" energy than provided for in the quota, the producer may sell these volumes on the certificate to another entity that has not yet fulfilled its obligations under the quota.

3. Tariff auctions ("green" auctions) are a mechanism in which potential producers of "green" electricity offer tariffs at which they are willing to sell energy from newly built facilities. In 2015, the International Renewable Energy Agency (IRENA) [17] introduced recommendations for the launch of auctions in the field of renewable energy, the main stages for the implementation of the mechanism are:

- formation of the lot request (setting the volume and type of energy generation or the appropriate generation structure for the auction);
- definition of qualification requirements (establishment of the minimum level of requirements for potential participants in the auction);
- the procedure of the winner selection (establishing the procedure of collecting applications and the criteria according to which the winner will be selected).

In Ukraine, "green" tariffs were introduced in 2009 in accordance with the Law of Ukraine "On Amendments to the Law of Ukraine "On Electric Power Industry" to stimulate the use of alternative energy sources", which has expired today. This law provided the establishment of "green" tariffs until January 1, 2030. This mechanism was to promote the development of the industrial sector and economic growth and provide an opportunity to stimulate environmental energy production [15]. After all, it was introduced only for those producers who used a significant share of Ukrainian raw materials, fixed assets, works, and services. Such a mechanism was an important stimulus for the development of renewable energy, as it provided an opportunity to cover the high capital investment of producers.

Thus, in September 2014, the National Energy and Utilities Regulatory Commission stopped reviewing "green" tariffs, in February and March 2015 reduced the "green" tariffs for RES producers. However, these reductions were not provided for in the Law "On Electric Power Industry" and were challenged in the courts by RES producers. By the end of 2015, RES producers had received compensation for unjustified revisions and tariff reductions. This situation has also led to a change in the order of revision of "green" tariffs and a partial reduction of tariffs for future projects. In particular, the Law of Ukraine “On Amendments to Certain Laws of Ukraine on Ensuring Competitive Conditions for Production of Electricity from Alternative Energy Sources” of June 4, 2014, № 514-VIII was adopted [18].

Figure 2 presents the indicators of the "green" tariff for electricity from SPP with a capacity of 10 MW and WPP with a capacity of 2000 MW turbine, as well as the indicator of the levelized cost of electricity of SPP and WPP – the estimated weighted average price for electricity (LCOE), which the electricity producer transmits to the grid at the node of the power grid, and includes investments, costs and revenues.

It can be seen that from 2009 to 2019 the normalized cost of electricity SPP decreased almost 9 times; the normalized cost of wind generation decreased more than 3 times. At the same time, the reduction of "green" tariffs was not so significant during this period. This can be explained by the need to take into account the costs of raising credit funds, ensuring the return on investment,

and covering the overall risks of the investment environment in Ukraine.

According to the results of the analysis of the renewable energy market, the unbalanced development of this innovation sphere has been determined. After all, different tariffs should be applied for balancing for each separate energy production technology. In Ukraine, since the beginning of the "green" tariff mechanism, tariffs for solar energy have been set higher than for wind energy [19]. As the cost of technology decreases faster for solar generation projects and less time is required to implement the project, as a result, there is a surplus of generation from solar energy, which was contrary to the National Renewable Energy Action Plan until 2020 [20].

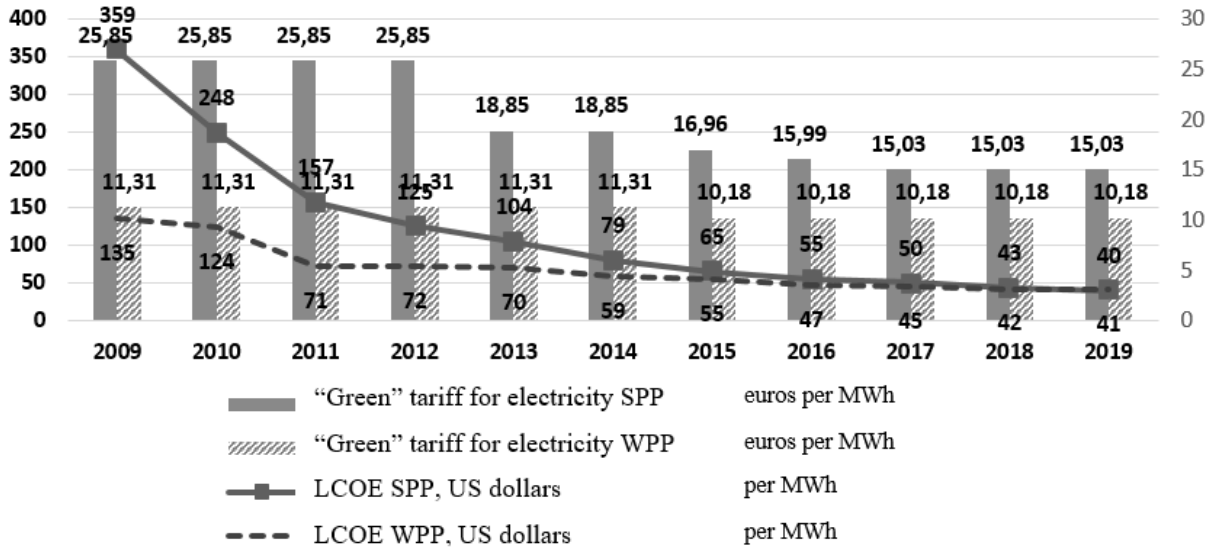

Figure 2. Dynamics of Levelized cost of electricity (LCOE) and "green" tariff for electricity from SPP and WPP.

Compiled by the authors based on: [19].

World experience shows that with the help of "green" tariffs it is possible to develop related branches – such as industry and mechanical engineering. In particular, in Germany and Denmark, the development of wind turbines ensures the development of mechanical engineering. China has used similar mechanisms. This indicates that the development of renewable energy technologies is a priority. As an alternative to the "green" tariff, there may be contracts for difference, corporate PPAs as additional tools to auctions.

Conclusions

he study identifies the main areas of economic incentives in leading countries, which should be used in Ukraine for the development of entrepreneurship in the field of renewable energy. Economic incentives for the development of renewable energy will achieve global environmental goals and should be provided by political factors. Renewable energy development in Ukraine should be a priority in the short and long term, given the current energy crisis, the rapid rise in coal prices ($ 220 per tonne in October 2021), and natural gas (over $ 2,000 per 1,000 m3 in October 2021), Ukraine's high energy dependence on energy imports. The key elements of most of the world's policy planning documents in the field of energy are energy transition, innovation, decarbonisation, circular economy, digitalization, which proves the importance of renewable energy. These key elements and the basic principles of renewable energy entrepreneurship stimulating should be

taken into account and on this basis, it is recommended to develop a new comprehensive strategy for the functioning of the RES sector until 2030. In Ukraine, it is important to start the implementing process of the new Renewable Energy Directive (Directive (EU) 2018/2001) and the financing mechanism for RES within the framework of Implementing Regulation (EU) 2020/1294 of the European Commission. It is advisable to initiate participation as a host country within the functioning of the new EU mechanism of the financing RES. Namely, within the framework of the 17 Sustainable Development Goals, in support of the Sustainable Development Goal 7, intensify the search for EU partner countries to provide a new funding mechanism – Ukraine is the host country for investment in RES projects, and the EU Member State contributing to the development of RES projects in Ukraine will receive a "statistical transfer" to achieve the Sustainable Development Goals (Luxembourg-Lithuania experience).

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