

# The Economic Instruments for the Development of the Renewable Energy Sector in the EU and Ukraine\*

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The research reveals the theoretical and practical aspects of the green energy sector. The article compares the level of development of the green energy sector in the European Union and Ukraine. Different indicators, including the share of energy from renewable sources in Ukraine, the interaction between the level of GDP per capita and the share of renewable energy in the EU and Ukraine, and the structure of the renewable energy resources of Ukraine and the EU are taken into account. The article discussed the role of financial and non-financial tools for the development of the green energy sector in the EU countries. The research states that the countries can be divided into three groups, where group A involves countries with a highly developed green energy sector, group B – member-states with progress in the transition to alternative sources of energy, and group C – countries with weak or no progress in the development of renewable energy sector. The research explains the impact of economic prosperity in developed countries on the renewable energy sector. It investigates that there is a very small positive correlation between the independent variable and the dependent variable. In general, it demonstrates that there is no correlation between the economic condition of very developed countries and the level of their green energy efficiency. The article suggests policy-making changes for the stable development of green energy in both the EU and Ukraine. Revision of existing government's medium and long term plans and adapting them to current circumstances, the gradual reduction of subsidies and reform of energy pricing, the regulatory focus on energy efficiency, the attraction of private investments through the use of domestic and donor investments are determined as important actions for stable development of green energy sector.

*Keywords:* renewable energy, green economy, sustainable development, green energy, alternative sources of energy.

*УДК 332.146.2:620.9(4-6CC+477)*

*JEL Codes:* Q40, Q41, Q42

**Introduction.** The problems with the energy sector are one of the most urgent today. Traditional sources such as oil, gas and other minerals are gradually losing their relevance, becoming more expensive and, of course, causing great harm to the environment [6]. Sources such as solar energy, water or geothermal heat are used to generate energy and they are becoming so popular today. Renewable energy sources provide about 19 % of the world's final

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\*The publication contains the results of research of European Commission grants "Jean Monnet Chair in EU Economic Policies and Civil Society" (619878-EPP-1-2020-1-UA-EPPJMO-CHAIR) and EU legislative, economic and social transition to sustainable society within Industry 4.0 and 5.0 (619997-EPP-1-2020-1-UA-EPPJMO-CHAIR).



energy consumption, including biomass –9 %, and other renewable energy sources – more than 10 % (used in different industries, including heat and electricity production, transport sector, etc.).

The main advantage of all alternative energy sources is their environmental friendliness. In other words, during the operation of such stations, no harmful emissions into the surrounding atmosphere occur. Even an accident at wind, solar or any other alternative power plant will only lead to material losses for its owners, but will not cause a global environmental disaster, as it can happen, for example, with a nuclear power plant. Renewables have a special advantage over conventional sources to minimize reliance on limited fossil fuels and to shorten the emissions of greenhouse gas content [2]. Most studies have found that a reduction of greenhouse gases (GHGs) emissions can be achievable by replacing conventional sources of energy with alternative ones.

Many countries already have the strategy to expand the usage of alternative sources of energy and to decline the level of application of conventional resources. The role of the European Union in providing solutions for various global challenges is invaluable. Today, the European Union is seen as a powerful organization capable of determining the course of international economic affairs, sustainable development, migration, environmental policies and foreign and security policies. The EU is a key world organization, which aims to provide social, economic, environmental and energetic stability and prosperity. Many scientists consider the EU as the only organization capable to minimize the negative effects of humans' activity in different spheres and industries.

The integration of Ukraine to the European Union is a strategic direction of our foreign policy. According to the Association Agreement of Ukraine with the European Union, signed in 2014, energy and environmental issues are key points when evaluating the progress of reforming the state [10]. It states, «the fast transition of Ukraine's energy sector to the usage of renewable resources is a strong and significant step to energetic independence, ecological friendliness and economic prosperity [3]. The wide usage of alternative sources of energy are undeniable conditions for providing sustainable development».

**Literature review.** There are many scientific researchers concerning the theoretical and practical aspects of green energy. Böhringer, C., Hoffmann, Twidell, J. has developed the definition of the concept «green energy». In our research, we use their definition: green (renewable) energy is energy from different resources that are renewable, or inexhaustible, on a human scale. Bekun F., Alola A. and Sarkodie S. have studied the role of the European Union in green energy development. Their research is based on statistical data from 16 EU-countries about the impact of renewable energy on the environmental situation. Gökgöz, F., & Güvercin, M paid attention to the influence of the green energy sector on conventional energy. Authors stated that the energy safety and independence of the EU are directly connected with renewable energy development. Sagan, M., and Meeus, L. in their publication discussed the role of financial and non-financial tools for the development of the green energy sector in the EU countries. Kharlamova, G., Nate, S., & Chernyak O. has investigated Ukraine's energy structure. They stated that there is a stable and consistent development of the green energy sector. It is emphasized that Ukraine's energy security depends on the growth of the share of green energy sector.

**The purpose of the research** is to compare the level of development of the green energy sector in the European Union and Ukraine and to explain the impact of economic prosperity in developed countries on the renewable energy sector.

**The results of the research.** The level of the development of green energy sector in different countries (member states of the EU and Ukraine) will be evaluated according to different indicators, including the share of energy from renewable sources in Ukraine, the interaction between the level of GDP per capita and the share of the renewable energy in the EU and Ukraine and the structure of the renewable energy resources of Ukraine and the EU.

The energy sector in Ukraine is under a number of competing impacts, both positive and negative. On the one hand, the development of the sector was negatively affected by the instability of energy supply, the persistence of energy prices below market prices and instability in the eastern region of the country. On the other hand, the sector is stimulated by such positive influences as a long-term government strategy for the development of the sector, active involvement of a technically strong sector of non-governmental organizations and increased cooperation with the EU and International Financial Institutions.

As of the third quarter of 2019, the share of energy received from renewable sources in Ukraine was 8.6 %. This is not much, but given the rapid growth rates and plans set out in Ukraine's energy strategy, by 2020 this percentage of renewables in final consumption should be 11 % [9]. From Figure 1 it becomes understandable that there is a stable growth in the share of renewable energy in the energy sector of Ukraine: in 2014 this figure was 3.9 % and continued growing – up to 8.6 % in 2019. The development of the green energy sector is a part of Ukraine's commitments to the European Energy Society and is described in the National Renewable Energy Action Plan until 2020. According to the same strategy, in 2035 the share of green energy in the total primary energy supply should be 25 % [8].

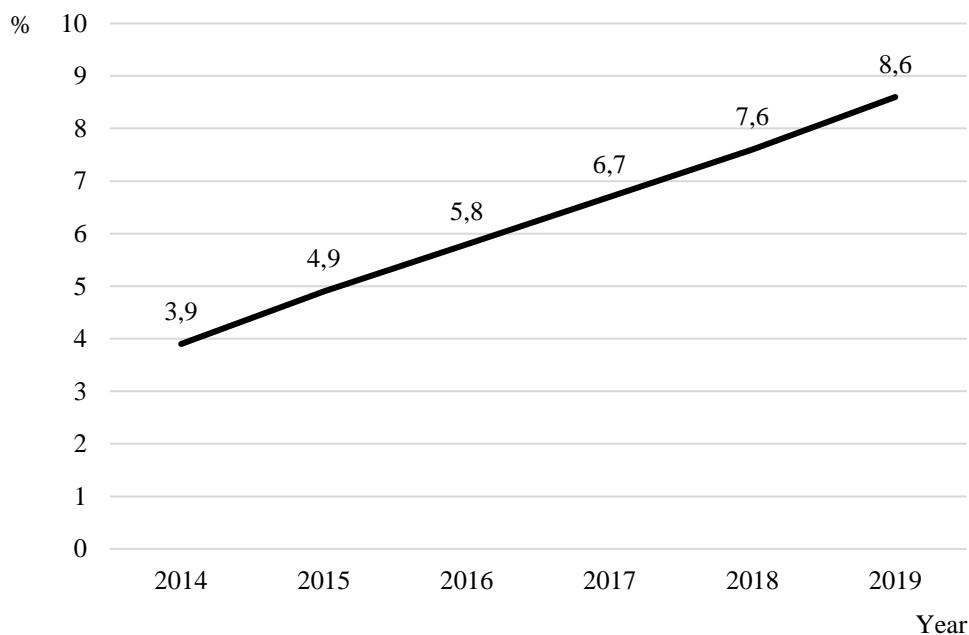


Figure 1. The share of energy from renewable sources in Ukraine in 2014–2019

The green energy market showed negative dynamics until 2015: hydro, wind and solar power plants reduced production. The situation began to change when the state revised the legislation on the so-called «green tariff» in 2015. The point is that the tariff for green energy is higher than the wholesale price of energy extracted from non-renewable sources. The state has deliberately created profitable and clear rules of the game in the green energy market for all who want to do it. This policy has contributed to the possibility of a sharp rise in the industry.

In the European Union, the state of development of renewable energy, in general, is close to world indicators. Sweden is an absolute leader in the list of the EU member states. Moreover, Sweden demonstrates the high pace of growing of the share of energy from renewable sources. Finland, Latvia, Austria, Portugal, Estonia are countries with high efficiency of the green energy sector. Most EU countries demonstrate good and stable development of the green energy. The Netherlands takes the last place in this rate. In our opinion, this fact can be explained by the wide usage and trade of the conventional sources of energy. Therefore, the countries can be divided into three groups, where group A involves countries with a highly developed green energy sector, group B – member-states with progress in the transition to alternative sources of energy, and group C – countries with weak or no progress in the development of renewable energy sector. The results of the division can be observed in Table 1.

*Table 1*

The results of the division of the EU member-states  
(by the share of energy from renewable sources)

<b>Groups</b>	<b>Countries</b>
Group A (>30 %)	Sweden, Finland, Latvia, Austria, Portugal, Estonia
Group B (15 %–30 %)	Bulgaria, Croatia, Cyprus, Czech Republik, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, Portugal, Romania, Slovenia
Group C (<15 %)	Ireland, Luxembourg, Malta, Netherlands, Poland, Slovakia

Built by authors, using [7]

Nevertheless, the overall share of renewable energy in the EU in 2018 is 18.9 %, therefore, it becomes obvious that the EU with a high probability will achieve 2020 target – 20 %. To achieve the 2020 target (20 % of RES in gross final energy consumption), EU countries must not only increase renewable energy capacity but also reduce primary energy consumption – overall for the EU-28 by about 5 % by 2020 compared to 2018.

To comply with the 2DS climate change scenario, in 2011 the European Union reaffirmed its official goal of reducing greenhouse gas emissions (decarbonization) in 2050 by 80–95 % compared to 1990 levels. Since the energy sector is one of the main sources of greenhouse gas emissions associated with human activities, then the main reserves for reducing these emissions should be found and implemented in it. With this in mind, the European Commission has developed an energy roadmap by 2050, in which it analyzed how the set targets for reducing greenhouse gas emissions can be achieved while ensuring the reliability and competitiveness of energy supply systems.

The next indicator is the interaction between the level of GDP per capita and the share of renewable energy in the EU and Ukraine. On Table 2 it is possible to observe the list of

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countries (members of the European Union and Ukraine) with the data about GDP per capita (in US dollars) and share of energy from renewable sources (in %).

Table 2

GDP per capita and share of energy from renewable sources

Country	GDP per capita, US dollars	Share of energy from renewable sources, %
Austria	50 022	33.4
Belgium	45 275	9.5
Bulgaria	9 563	20.3
Croatia	14 949	29.2
Cyprus	27 160	15.7
Czech Republic	23 213	16.5
Denmark	59 275	36.1
Estonia	23 523	29.8
Finland	48 222	41.2
France	41 260	17.6
Germany	46 554	17.1
Greece	19 974	19
Hungary	17 154	15.1
Ireland	77 771	12.8
Italy	32 568	18.5
Latvia	18 171	40.3
Lithuania	19 568	25.6
Luxembourg	113 196	9.1
Malta	30 650	8.0
Netherlands	52 367	7.4
Poland	14 890	11
Portugal	23 343	31.4
Romania	12 141	25.1
Slovakia	19 563	12.4
Slovenia	26 170	21
Spain	29 651	18.4
Sweden	51 241	54.6
Ukraine	3 592	8.6

Built by authors, using [4]

Independent variable ( $x$ ) is a value of GDP per capita (in US dollars), the dependent variable ( $y$ ) is a value of the share of energy from renewable sources (in %).

There are some potential challenges connected with the independent variable  $x$ . GDP per capita is optimal but not the most exact way to indicate economic prosperity and the general condition of the country's economy.

The linear dependence between variables  $x$  and  $y$  can be expressed by the equation:  $y = -0.00001x + 21.94$ .

The coefficient of correlation  $(-0,19)$  indicates that there is a small negative correlation between the independent variable and the dependent variable. In general, it demonstrates that there is no correlation between the economic condition of very developed countries and the level of their green energy efficiency. In our opinion, such correlation may exist when we compare developed and developing countries, paying attention to other important factors. According to Twidell, the square of the state, its climate and geographic position, international cooperation in this sphere are also important in the context of the development of the renewable energy sector [11]. There are other factors, which have an impact on the development of the green energy sector. Significance  $F(0.92)$  demonstrate that the results of the regression model need to be accurately analyzed, paying attention to other factors.

Such regressive-correlative statistics demonstrate that Ukraine's green energy sector can expand despite the problems with economic development. Moreover, such expansion can lead to economic growth and state's prosperity.

The third indicator for comparison is the structure of the renewable energy resources of Ukraine and the EU. It is optimal to compare the structures with the value of final consumption. Final consumption means the level of green energy application by households and enterprises.

On Figure 2 there are two diagrams, which characterize the structure of renewable energy both in the European Union and Ukraine. From the first diagram it becomes apparent that the major part among all renewable sources in Ukraine plays solar energy (64 %).

The second diagram characterizes the structure of energy sector in the European Union. From the diagram, it becomes obvious that biomass, biofuels and waste (15 %) are popular energy sources among European countries. Thermal energy (3 %) and HPS (10 %) are also important for Ukraine's energy sector. In the European Union thermal energy (3 %) are not so widely used as in Ukraine. Unfortunately, such popular in Europe energy sources as solar and wind energy are still weakly developed in Ukraine [1].

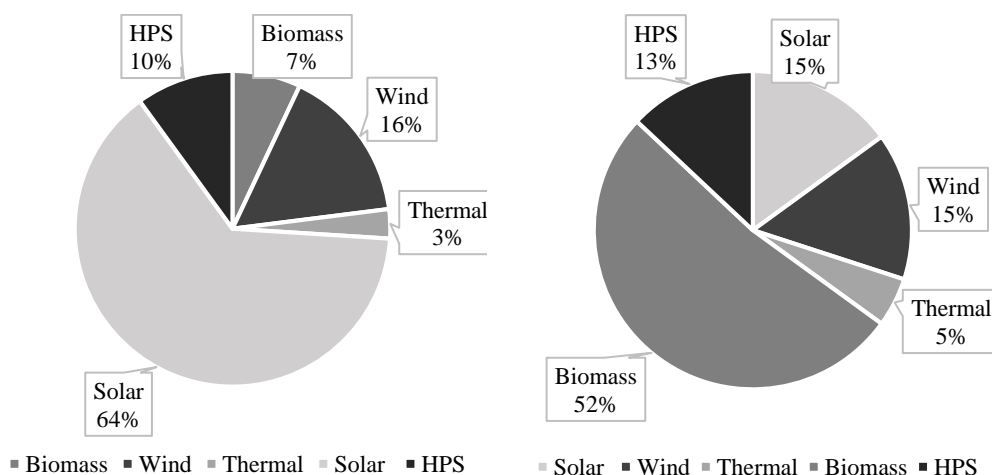


Figure 2. Structure of the renewable energy resources of Ukraine and the EU (by final consumption), %, (built by authors using [2])

Policy-making measures need to be adopted to provide the stable development of green energy in both the EU and Ukraine. They include:

- Revision of existing government's medium and long term plans and adapting them to current circumstances.
- The gradual reduction of subsidies and reform of energy pricing.
- Regulatory focus on energy efficiency.
- Development of local renewable energy sources.
- Attraction of private investments with domestic and donor ones.
- The encouragement of scientific institutions to research the possibilities to accumulate green energy effectively.

The fast growth and strong integration of green energy creates opportunities as well as challenges. The accumulation of alternative energy is a significant challenge, which needs to be solved. It is important for government and business to do research of creating stationary energy storage. It is necessary to use the experience of the EU's scientists to deal with the problem of accumulation.

**Conclusions.** The level of the development of green energy sector in different countries (member states of the EU and Ukraine) was evaluated according to different indicators, including the share of energy from renewable sources in Ukraine; the interaction between the level of GDP per capita and the share of the renewable energy in the EU and Ukraine, and the structure of the renewable energy resources of Ukraine and the EU.

As of the third quarter of 2019, the share of energy received from renewable sources in Ukraine was 8.6 %. There is a stable growth in the share of renewable energy in the energy sector of Ukraine: in 2014 this figure was 3.9% and continued growing up.

The countries can be divided into three groups, where group A involves countries with a highly developed green energy sector, group B – member-states with progress in the transition to alternative sources of energy, and group C – countries with weak or no progress in the development of renewable energy sector. The results of the division can be observed in Table 1.

The impact of economic prosperity in developed countries on the renewable energy sector was investigated. Regressive-correlative analysis has demonstrated that there is no correlation between the economic condition of very developed countries and the level of their green energy efficiency.

The major part among all renewable sources in Ukraine plays the solar energy – 64 %. Thermal energy (15 %) and HPS (28 %) are also important for Ukraine's energy sector. In the European Union thermal energy (3 %) are not so widely used as in Ukraine. Unfortunately, such popular in Europe energy sources as wind and biomass energy are still not enough developed in Ukraine.

Policy-making measures need to be adopted to provide the stable development of green energy in both the EU and Ukraine. Revision of existing government's medium and long term plans and adapting them to current circumstances, the gradual reduction of subsidies and reform of energy pricing, regulatory focus on energy efficiency, attraction of private investments through the use of domestic and donor investments are important actions for stable development of green energy sector.

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*Manuscript received 12 April 2020*

**Економические инструменты  
развития сектора возобновляемой энергетики в ЕС и Украине**

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Исследование раскрывает теоретические и практические аспекты сектора зеленой энергетики. В статье сравнивается уровень развития сектора зеленой энергетики в Европейском Союзе и Украине. Принимаются различные показатели, в том числе доля энергии из возобновляемых источников в Украине, взаимосвязь между уровнем ВВП на душу населения и долей возобновляемых источников энергии в ЕС и Украине, а также структура возобновляемых энергоресурсов Украины и ЕС. в учетную запись. В статье обсуждалась роль финансовых и нефинансовых инструментов для развития сектора зеленой энергетики в странах ЕС. В исследовании говорится, что страны можно разделить на три группы, где в группу А входят страны с высокоразвитым сектором зеленой энергетики, в группу В – страны-участницы с прогрессом в переходе на альтернативные источники энергии, а в группу С – страны со слабым или нет прогресса в развитии сектора возобновляемой энергетики. Исследование объясняет влияние экономического процветания в развитых странах на сектор возобновляемой энергетики. Он исследует наличие очень небольшой положительной корреляции между независимой переменной и зависимой переменной. В целом это демонстрирует отсутствие корреляции между экономическим состоянием очень развитых стран и уровнем их экологической эффективности. В статье предлагаются изменения в политике для стабильного развития зеленой энергетики как в ЕС, так и в Украине. Пересмотр существующих среднесрочных и долгосрочных планов



правительства и их адаптация к текущим обстоятельствам, постепенное сокращение субсидий и реформа ценообразования на энергию, регулятивная направленность на энергоэффективность, привлечение частных инвестиций за счет использования внутренних и донорских инвестиций определяются как важные действия для стабильного развития сектора зеленой энергетики.

*Ключевые слова:* возобновляемые источники энергии, зеленая экономика, устойчивое развитие, зеленая энергия, альтернативные источники энергии.

*Mechanism of Economic Regulation, 2020, No 2, 169-177*

*ISSN 1726-8699 (print)*

**Економічні інструменти розвитку  
сектору відновлюваної енергетики в ЄС та Україні**

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Дослідження розкриває теоретичні та практичні аспекти сектора зеленої енергетики. У статті порівнюються рівень розвитку сектора зеленої енергетики в Європейському Союзі та Україні. Приймаються різні показники, в тому числі частка енергії з відновлюваних джерел в Україні, взаємозв'язок між рівнем ВВП на душу населення і часткою відновлюваних джерел енергії в ЄС та Україні, а також структура поновлюваних енергоресурсів України та ЄС. в обліковий запис. У статті обговорювалася роль фінансових і нефінансових інструментів для розвитку сектора зеленої енергетики в країнах ЄС. У дослідженні говориться, що країни можна розділити на три групи, де в групу А входять країни з високорозвинутою сектором зеленої енергетики, до групи В – країни-учасниці з прогресом в переході на альтернативні джерела енергії, а в групу С – країни зі слабким чи ні прогресу в розвитку сектора відновлюваної енергетики. Дослідження пояснює вплив економічного процвітання в розвинених країнах на сектор відновлюваної енергетики. Він досліджує наявність дуже невеликої позитивної кореляції між незалежною змінною і залежною змінною. В цілому це демонструє відсутність кореляції між економічним станом дуже розвинених країн і рівнем їх екологічної ефективності. У статті пропонуються зміни в політиці для стабільного розвитку зеленої енергетики як в ЄС, так і в Україні. Перегляд існуючих середньострокових і довгострокових планів уряду і їх адаптація до поточних обставин, поступове скорочення субсидій і реформа ціноутворення на енергію, регулятивна спрямованість на енергоефективність, залучення приватних інвестицій за рахунок використання внутрішніх і донорських інвестицій визначаються як важливі дії для стабільного розвитку сектора зеленої енергетики.

*Ключові слова:* відновлювальні джерела енергії, зелена економіка, сталий розвиток, зелена енергія, альтернативні джерела енергії.

*JEL Codes:* Q40, Q41, Q42

*Tables:* 2; *Figure:* 2; *References:* 11

*Language of the article:* English