DOI: 10.31520/2616-7107/2023.7.1-8 *ISSN 2616-7107*

UDC 330.341.1
JEL: O33, Q40, Q55, H23

THE ECONOMICS OF TECHNOLOGY TRANSFER IN THE ENVIRONMENTAL SAFETY OF ENTERPRISES FOR THE ENERGY TRANSITION

Yevheniia Sribna
Candidate of Economics Sciences, Associate Professor,
National University of Water and Environmental Engineering,
Rivne, Ukraine
E-mail: e.v.sribna@nuwm.edu.ua
ORCID iD: 0000-0002-6676-0606

Svitlana Skakovska
Candidate of Economics Sciences, Associate Professor,
National University of Water and Environmental Engineering,
Rivne, Ukraine
E-mail: fotisssvit@gmail.com
ORCID iD: 000-0002-3415-9613

Tetiana Paniuk
Candidate of Economics Sciences, Associate Professor,
Rivne State University of Humanities,
Rivne, Ukraine
E-mail: panjuk@ukr.net
ORCID iD: 0000-0002-2494-6111

Iryna Hrytsiuk
Nadsluchansky Institute of National University of Water And Environmental Engineering,
Berezne, Ukraine
E-mail: i.i.hrytsiuk@nuwm.edu.ua
ORCID iD: 000-0003-4682-1106

Received: January 24, 2023
Accepted: March 27, 2023

DOI:10.31520/2616-7107/2023.7.1-8

Introduction. European countries are at different stages of transition to a new energy system due to different levels of energy dependence, geographical conditions, and priorities of national administration. The use of information technology and innovative developments in the energy field allows for reducing energy production costs, improving resource use efficiency, reducing environmental impact, and ensuring energy security. Modern energy is reaching a new qualitative level due to technology transfer and government policy. Such an energy transition in the industry requires time, unfolding globalization processes, implementing sustainable development strategy and solving greening problems.

Aim and tasks. The aim of the study is to assess the level of the economic base of technology transfer in the creation and functioning of a new energy system based on the principles of environmental safety of modern enterprises in EU countries.

Results. The theoretical model is considered, which explains the essence and factors in the implementation of the new energy system of production enterprises in the cross-section of the EU countries. The ranking of European countries is given based on the calculation of the use of final electricity consumption per dollar per capita and one percent of renewable energy consumption minus the tax burden. Thus, some countries already have significant indicators that indicate the effectiveness of the transition to a new energy structure of their national enterprises. And such results do not directly depend on the share of the use of renewable energy sources and the reduction of the use of coal. But the share of more than 60% of the use of renewable energy and the significant tax burden placed on the final household consumers of electricity are general signs of the implementation of such a transition. Enterprises use such a transition mechanism more effectively in EU countries, where more than 60%. In economic terms, such transitions of enterprises are carried out at the expense of the lion's share of the tax burden on electricity use by end consumers – households.

Conclusions. The study of the economic basis of technology transfer in the creation and functioning of a new energy system based on the principles of environmental safety of modern enterprises in EU countries is of great importance for improving energy efficiency and achieving environmental safety in the region as a whole. The research will be useful for government bodies that are engaged in shaping energy policy, regulating the energy sector, and ensuring environmental safety.

Keywords: energy system, technology transfer, electricity consumption, energy transition.

1. Introduction.

In connection with the growing global challenges related to climate change and exhaustible natural resources, more and more attention is being paid worldwide to the transition to a new energy system based on renewable energy sources and maximum energy efficiency. The transition to a new energy system is important for ensuring sustainable development and environmental safety. One of the key factors contributing to a successful transition to a new energy system is the transfer of technologies in the environmental safety system of enterprises. This means the transfer of technology, knowledge, and know-how in electricity generation and the use of renewable energy sources from advanced enterprises to less developed markets and countries. Technology transfer in the environmental security system is a complex and multifaceted process that requires interaction between states, the public, businesses, and research institutions. This process contributes to developing new technologies and markets, ensuring the economy's growth, and increasing the energy security of individual enterprises and the country.

One of the successful examples of technology transfer to ensure environmental safety at enterprises is the use of wind power plants for electricity production. The countries of the European Union, in particular Denmark, Germany, and Spain, have successfully implemented projects for the construction of wind power plants, which allowed them to reduce their dependence on fossil fuels and reduce the level of carbon emissions into the atmosphere (CREA, 2021).

Another successful example is the use of solar panels to generate electricity. For example, in Germany, companies install solar panels on the roofs of buildings and plots of land. Norway has ensured an almost complete replacement of traditional energy with alternative energy. Such solutions allow not only for reducing the environmental impact but also for reducing electricity costs. In addition, technology transfer in the environmental safety system can be successfully implemented using energy-efficient technologies and materials. For example, enterprises replace outdated equipment with new ones that meet energy efficiency requirements.

This makes it possible to reduce energy consumption and reduce costs for its provision. All these examples show that technology transfer has become an effective tool for ensuring environmental safety at enterprises during the transition to a new energy system.

In this study, there is an assessment of the level of the economic basis of technology transfer in the creation and functioning of a new energy system based on the principles of environmental safety of modern enterprises of EU countries.

According to the goal, the proposed hypotheses are:

1. Analysis of renewable energy as an effective direction for the development of a new energy system.

2. Justification of the basic models of energy support for the functioning of the future enterprise, which is based on the principles of environmental safety, which is the result of the new energy transition.

2. Literature review.

The transfer of technologies in the environmental safety system of enterprises is an important aspect of the transition to a new energy system. New technologies allow enterprises to use more ecological and efficient production methods, which has a positive effect on the environment and reduces the negative impact on the climate (Peng & Zhou, 2017). However, the transition to new technologies can be difficult for many businesses, especially those that do not have the necessary experience or financial resources to implement them. In this situation, technology transfer may prove to be a necessary tool for ensuring the environmental safety of enterprises.

Technology transfer can take many forms, including licensing, joint ventures, and collaboration between academic researchers and professionals (Xu et al., 2020). For example, an enterprise can purchase a license to use technology from another enterprise or organization to implement it in its production. A joint venture can be created for the development and production of new environmentally friendly technologies. One of the examples of successful technology transfer in the environmental security system is the transition to the use of renewable energy sources.

For example, in the USA and China, joint research centers were established where scientists shared experience and knowledge about solar cells and wind generators, which allowed to accelerate the development and commercialization of these technologies (Urban, 2018; Zhou et al., 2021). This has led to a significant reduction in the cost of production and an increase in the efficiency of solar and wind installations, making them more affordable for commercial and household use (Franza et al., 2012).

However, it must be taken into account that technology transfer can carry risks and cause problems. For example, new technologies may not match local conditions and requirements, which may lead to low efficiency and underutilization (Kulkarni et al., 2022). In addition, there is a risk of loss of privacy and intellectual property, which can affect the business models and revenues of organizations (Liu & Liang, 2011).

In general, technology transfer is an important tool for ensuring the environmental safety of enterprises during the transition to a new energy system. It allows the use of more environmentally friendly and efficient production methods, positively affecting the environment and reducing the negative impact on the climate (Yan, 2022). However, for technology transfer to be successful, local conditions and requirements must be considered, and intellectual property and privacy must be protected.

The problems of technology transfer in the environmental security system are studied in the works of scientists from various fields, such as ecology, technology, economics, management (Andersson and Stone, 2017; Peng & Zhou, 2017; Zhou et al., 2021).

The urgency of the problem of technology transfer in the environmental sphere is increasing. Thus, the main content of the study by Schmid et al. (2016) is an empirical analysis of the decarbonization strategies of large German enterprises in the context of the transition to a new energy system in the context of the study of approaches to decarbonization, their effectiveness and the relationship with business strategies.

Key in the analysis is large enterprises in Germany implementing decarbonization strategies according to different business models such as innovation, energy efficiency, and emission reduction to ensure energy stability and security in the future.

Scmid et al. (2016) analyze various aspects of the energy transition, including renewable energy generation, energy conservation, energy efficiency, electromobility, modern energy generation and storage technologies, and others. In the context of the study, socio-economic and political aspects of the energy transition and its impact on ecology and human health are also considered.

Galan (2020) explores how managing the transition to a low-carbon economy can be implemented in developing countries using solar panels in Kenya as an example. The study analyzes various management strategies, including government regulation, policy agendas, and network effects, and discusses how these strategies can best be applied in specific contexts. The results of the research can be useful for the formation of a more effective policy to support the use of renewable energy sources in developing countries.

A study by Lund et al. (2019) presents an overview of energy system flexibility measures that can ensure high levels of use of variable renewable energy sources such as wind and solar energy. In addition, different methods such as energy storage, off-season storage, and demand management technologies are considered and their advantages and disadvantages are analyzed. The main output is the scenarios in which these flexibility measures can be most effectively used depending on the characteristics of local energy markets and user requirements.

Bhattarai et al. (2022) examine the relationship between energy transition and green finance based on a review of research on green finance and its impact on energy transition and explore different approaches to green finance such as green bonds and green lending. The study provides examples of successful green finance projects and the potential of green finance to support the energy transition in various sectors of the economy, such as industry, construction, and transport.

Xian et al. al. (2022) analyze the influence of public policy on the energy transition of industrial enterprises in China using the example of the production of new energy-efficient cars. The research was conducted using both quantitative and qualitative methods, including analysis of legislation and interviews with representatives of car manufacturers. Xian et al. (2022) argue that public policies, particularly financial incentives, and regulations, have a significant impact on stimulating transitions to new, more environmentally friendly production technologies. Problems that may arise in connection with the implementation of state policy, such as a large volume of involved investments and uneven development of various industries, are also substantiated.

Peel et al. (2020) argue that corporate governance is important in shaping companies' strategies for reducing emissions and ensuring energy efficiency. The study examines how corporate boards deal with energy transition issues and how they help ensure the long-term sustainability of enterprises.

Višković et al. (2022) investigate the transition to a low-carbon economy through corporate energy management based on a survey of 184 large European companies to find out which corporate energy management practices are applied in the context of the transition to a low-carbon economy and what obstacles stand in the way of the transition. In addition, it was found that most companies are already taking concrete steps to reduce their carbon footprint, including using renewable energy sources, increasing energy efficiency, and improving energy management processes. However, Višković et al. (2022) also point to some obstacles such as a lack of resources, limited availability of clean technologies, high investment costs in new technologies, and weak political leadership.

The transition to a new energy system is a critical and relevant topic for modern global management because energy technologies must become cheap and environmentally sustainable. In turn,the infrastructural component of energy must ensure a reliable supply of an insurance system for obtaining electricity independent of any factors such as political, economic and natural and climatic nature.

Research in this area can help determine the economic basis of technology transfer, which will facilitate the transition of enterprises to a new energy system with minimal losses and damages. Also, these studies can help identify innovative technologies that can be implemented in enterprises with minimal costs and great efficiency.

Thus, although there is a sufficient amount of scientific research on technology transfer issues in the system of environmental security, the problems of transition to a new energy system are considered superficially and insufficiently.

3. Methodology.

The methodology of the conducted research is based on the analysis of literary and statistical sources, which note the changes in the energy sector of the EU. In particular, indicators were used that reflect indicators of the use of traditional and renewable energy sources.

The transition to a new energy system was calculated using an economic approach that reflects the share of electricity use (traditional and renewable) per capita. At the same time, the efficiency of individual countries of the new energy system in the consumption of electricity by industrial and household consumers was determined, applying the ranking of countries. However, the costs of construction and operation of new energy systems were not taken into account.

The methodology for rating countries during the transition to the new system was based on calculations. First, the average share of the tax burden on industrial and household consumers in the use of electricity was determined. Second, the ranking was based on the calculation of the use of final electricity consumption per dollar per capita and one percent of renewable energy consumption, minus the tax burden. The economic costs of the environmental friendliness of energy and the attraction of innovations and developments were taken into account through the tax burden.

The study determined the number of indicators that were used from the official data of the EEC EAEC Word Energy (2023), namely:

1. Macroeconomic indicators: GDP per capita in nominal prices; gross electricity consumption per capita, kWh.

2. Average electricity prices: industrial electricity consumption without taxes and with taxes; household consumption of electricity without taxes and including taxes,

3. Indicator reflecting the share of renewable energy sources in electricity production.

Such an analysis will help determine the main problems and weak points of the energy market, as well as the potential for the introduction of new technologies.

4. Results.

The new energy system is a process of transition to a more stable, sustainable, and environmentally friendly energy system based on the use of renewable energy sources and the reduction of greenhouse gas emissions (Ciuła et et al., 2019). Its manifestations are quite diverse in different countries and regions. However, it is worth noting the main characteristics of the energy transition:

1. Growth in the production and consumption of renewable energy, which includes wind and solar energy.

2. Reduction of emissions of greenhouse gases and pollutants.

3. Development of energy-efficient technologies and industry.

4. Raising awareness and involving the public in issues of energy efficiency and the use of renewable sources.

The use of renewable energy sources is becoming a key factor in the development of a new energy paradigm. Thus, solar panels become an additional source of electricity for industrial enterprises and households, which allows them to reduce energy costs and ensure their energy independence. At present, wind energy does not have such a wide application for industrial and household use. It is included in a single energy system, thereby allowing to reduce of the tax pressure on the production of products. Thus, there was evaluating the capabilities of European countries in the transition to a new energy system through the noted indicators.

The transfer of renewable energy technologies stands out as a feature of such a transition to the energy system. This is the transfer of knowledge, experience, and technologies from countries that have developed renewable energy to countries that do not yet have such a level of development in this field. At the same time, its nature varies depending on the specific available technologies and the context of EU energy policy. There are several main characteristics of the new energy transition, which is based on the growth of renewable energy:

1. Cooperation between countries and organizations for the development and transfer of technologies to support the energy transition.

2. Investing in scientific research and development in the creation of new renewable technologies and their improvement.

3. Observance of intellectual property rights to protect the interests of individual European countries.

4. Financial support to promote technology transfer at the level of EU energy packages.

5. Programs for the purchase of electricity from developing countries.

6. Knowledge exchange and training programs to ensure effective transfer and implementation of energy technologies.

7. Legal improvement regarding standards of environmental protection, safety, promotion of transparency, and accountability.

In modern conditions, such a transfer has a positive effect on the energy sector of the EU countries. After all, it makes it possible to reduce dependence on fossil fuels, reduce emissions of carbon and other pollutants into air and water, as well as reduce the cost of electricity and ensure the stability of the country's energy sector.

The reduction in the cost of electricity is estimated due to the tax burden on electricity consumption by both industrial enterprises and household consumers (Table 1).

The calculation made it possible to identify ten groups of countries that are implementing measures in the new energy system (Table 2). The only leader was Norway, which has an efficiency index of 0.33 for the transition to a new energy system. This is due to the average tax burden (35%) and the share (99%) of renewable energy.

The second and third groups of countries (the apparent leader - Austria and the leader - Denmark) have indicators ten orders of magnitude lower than Norway.

Table. 1 Source data for calculating the level of transition to the new energy system of the EU countries as of 2020.

Countries	Household consumers without taxes, USD	Industrial consumers without taxes, USD	Household consumers, including taxes, USD	Industrial consumers, including taxes, USD	Share of renewable energy, %	GDP consumption per capita, USD (nominal prices)	Consumption (gross) GDP per capita, kWh.
Norway	9,11	5,69	13,15	7,11	99	65830	21584
Austria	11,76	7,84	18,57	10,24	76,19	58680	7169
Denmark	11,85	8,94	24,74	9,32	62,65	59833	5372
Ireland	18,99	12,61	21,55	12,61	36,4	90405	5742
Sweden	6,89	4,87	13,57	4,91	75,7	55656	12060
England	19,3	13,05	20,28	13,66	40,7	49576	4422
Portugal	9,87	7,08	18,31	9,68	58,43	36466	4655
Spain	18,51	10,24	22,68	10,6	47,1	42600	4979
Germany	13,58	7,01	27,63	13,51	41,5	56526	6012
Turkey	5,67	5,86	7,02	7,02	35,2	29719	3045
Switzerland	14	8,21	17,05	10,04	22,8	74756	6694
Italy	14,57	8,99	22,67	14,5	36	44703	4880
Luxemburg	11,92	7,29	16,34	8,1	14,22	123205	10418
The Netherlands	13,4	6,87	19,58	9,02	30,39	59675	6339
Poland	11,09	8,62	18,31	8,71	17,17	34689	3698
Greece	12,63	10,14	16,49	11,74	35,93	30888	4680
France	11,05	8,03	16,62	9,89	25,02	49769	6635
Belgium	16,34	8,64	24,59	11,59	23,8	54488	7155
Hungary	6,76	6,54	8,58	6,83	13,66	34344	4125
Slovakia	12,03	11,41	14,43	11,52	22,37	34203	4622
Czech Republic	12,69	8,82	15,01	8,91	14,54	42963	5487
Finland	11,31	6,02	16,42	6,08	39,53	50676	14797

Source: calculated by the author based on EEC EAEC Word Energy (2023).

At the same time, the share of renewable energy is from 63% to 76%, and the tax burden is from 43% to 57%. It should be noted that in Denmark, the household tax burden exceeds the industrial one by almost 25 times. The potential leader is Ireland with an efficiency index of the transition to a new energy system 4.04. At the same time, the share of renewable energy is 36.4%, and the average tax burden is 6.7%. The tax burden on industry is zero. The leaders with average indicators include Sweden, England, and Portugal.

In these countries, the share of renewable energy is more than 40.1%, and the tax burden on industry is quite low. Portugal entered this group due to its high share of renewable energy (over 58%). The largest group is a group of stable leaders with potential for development, which includes five countries (Spain, Germany, Turkey, Switzerland, and Italy) with an efficiency indicator of the transition to a new energy system from 6 to 7. The lowest level of the tax burden in this group belongs to Spain (13%), and the highest (98%) in Germany. The share of renewable energy in these countries is between 23% and 47%. Countries with average indicators are represented by Luxembourg and the Netherlands, where the share of renewable energy is from 14% to 30%, and the tax burden is from 24% to 39%.

Poland and Greece stand out as separate groups. Poland has a small share of renewable energy (17%), but the industrial tax burden is only 1%. The share of renewable energy in Greece is 35%, but the tax burden on industry is almost 16%. Countries such as France, Belgium, Hungary, Slovakia, and the Czech Republic are among the weak participants with limited room for improvement.

Table 2. Rating by the level of transition to the new energy system of EU countries as of 2020.

The country's rank in the energy transition	European countries	Share of taxes in industrial electricity consumption, %	The average share of taxes on electricity consumption, %	Consumption (gross) per capita of electricity consumption, kWh	The share of electricity consumption per 1 billion US dollars from traditional energy sources, %
In the new energy system	**Norway**	25,0	34,7	32,79	0,33
Obvious leader	**Austria**	30,6	44,3	12,22	2,91
Leader	**Denmark**	4,3	56,5	8,98	3,35
A potential leader	**Ireland**	0,0	6,7	6,35	4,04
Leaders with average indicators	**Sweden**	0,8	48,9	21,67	5,27
	England	4,7	4,9	8,92	5,29
	Portugal	36,7	61,1	12,77	5,31
Stable leaders with potential for development	**Spain**	3,5	13,0	11,69	6,18
	Germany	92,7	98,1	10,64	6,22
	Turkey	19,8	21,8	10,25	6,64
	Switzerland	22,3	22,0	8,95	6,91
	Italy	61,3	58,4	10,92	6,99
Countries with average indicators	**Luxemburg**	11,1	24,1	8,46	7,25
	The Netherlands	31,3	38,7	10,62	7,39
The country needs an average effort to improve	**Poland**	1,0	33,1	10,66	8,83
The country needs significant improvement efforts	**Greece**	23,2	36,8	13,33	10,00
Weak countries with limited opportunity for improvement	**France**	34,1	42,3	13,13	10,01
	Belgium	4,4	15,7	12,01	10,37
	Hungary	1,0	10,5	13,51	10,49
	Slovakia	1,0	9,7	12,77	10,91
	Czech Republic	1,0	23,1	29,20	17,66
Outsider	**Finland**				

Source: calculated by the author based on EEC EAEC Word Energy (2023).

This is due to the small share of renewable energy (14% to 25%) and the tax burden (10% to 37%). Finland is an outsider in terms of the efficiency of the transition to a new energy system. At the same time, the share of renewable energy is quite high (40%), and the average tax burden is 23%. At the same time, in Slovakia, Hungary, and Finland, the industrial tax burden is only 1%. However, given that Finland has a low electricity consumption per capita compared to other countries, the country ended up on the last step of the rating. Such calculations marked the distribution of countries in the energy transition process, focusing on the growth of production and consumption of renewable energy. This distribution of countries is not traditional in terms of their economic potential. After all, it considers electricity consumption per capita, the share of renewable energy, and the taxation of electricity consumption.

The general trend is that the higher the share of renewable energy, the closer the country is to the new energy system. That is why Norway dominates this list.

Thus, the conditions and regularities of the transition to a new energy system that we have determined reflect the general economic situation of the country and its energy policy. Therefore, the regularities and the need to transition economic entities (manufacturing firms, enterprises) to a new energy system are important.

The activity of enterprises is based on the full use of electricity. All means of production, from basic to software, are electricity consumers. Therefore, taxes on electricity use have been introduced in various European countries. This is mainly done for consumers (households with a high tax burden on electricity consumption) (Table 1).

It should be noted that there is no tax on electricity consumption by industrial enterprises in Ireland. In Sweden, the tax pressure is 0.8%. For such countries as Poland, Slovakia, the Czech Republic, and Finland, taxation is 1%. The highest taxation of manufacturing enterprises in Germany is 92.7%. For other countries, the average tax burden on electricity consumption varies between 25-30%. Thus, modern enterprises bear additional costs for the use of electricity, which automatically leads to an increase in the cost of production. At the same time, electricity acts as an external resource support for the company's activities. According to the requirements of the current global concept of sustainable development and environmental sustainability, electricity is changing. For the enterprise itself, such changes are not critical, because they concern only the reorientation of electricity production from thermal plants (CHP, TPP), which cause the most environmental pollution due to emissions, to renewable sources (mainly solar and wind energy). Therefore, the cost of purchasing electricity increases, and the government introduces a tax burden on electricity consumption (Fig. 1).

.

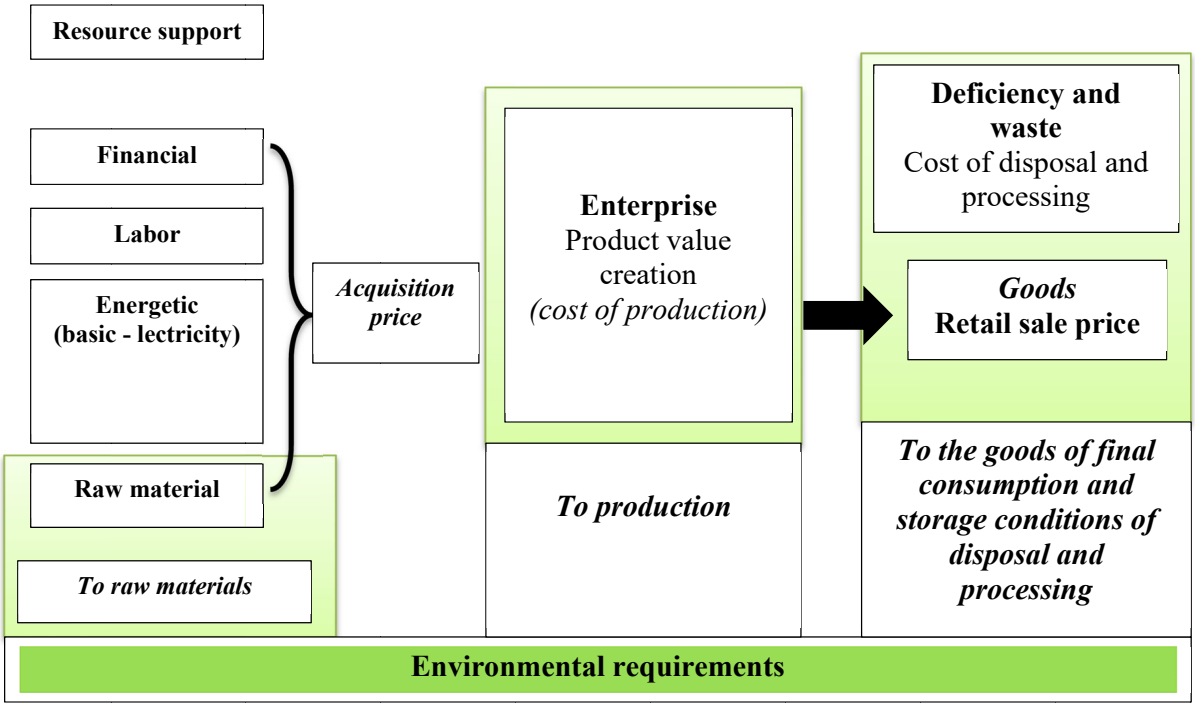

Fig. 1. The current model of energy supply of the production enterprise according to environmental requirements.

Taking into account the increased global competition, enterprises are forced to implement a policy of reducing the cost of production of global products. One of the directions for cost reduction is the reduction of expenses for electricity consumption and the reduction of defects and waste in the production process. Therefore, due to the developed transfer of energy technologies, enterprises have the opportunity to obtain their electricity without external involvement due to the introduction of their own solar generation and wind generation (Fig. 2).

According to the European Commission (2023), at the beginning of 2021, more than 2.5 million enterprises in the EU have already established their renewable energy solutions. This means that more than 17% of all businesses in the EU use renewable energy sources for their needs. The most popular sources of renewable energy for businesses are solar and wind energy.

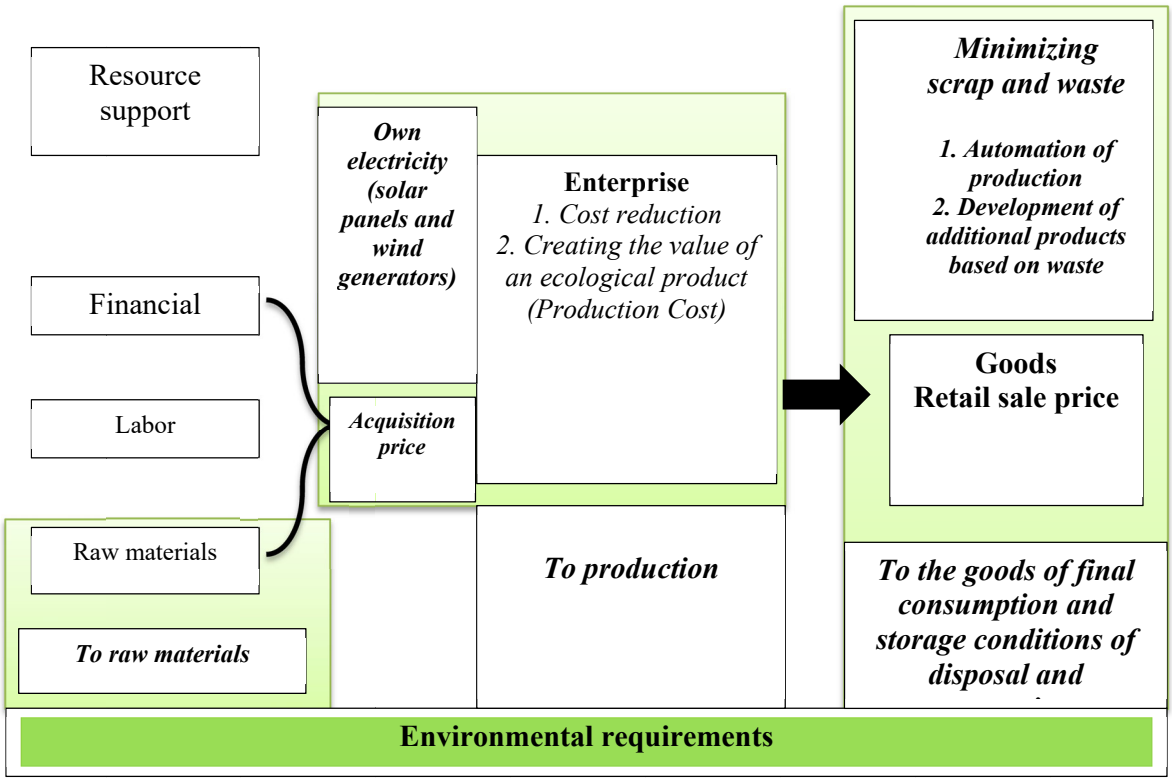

Fig. 2. Energy security of production of enterprises in the new energy system.

According to data from the European Climate Change Agency (European Environment Agency, 2023), in 2020 solar energy accounted for more than 40% of the total number of renewable energy sources installed by enterprises, and wind energy for more than 25%.

The total number of installed volumes of renewable energy at enterprises in the EU is increasing every year. For example, from 2019 to 2020, the total installed capacity of solar energy at enterprises in the EU increased by 40%, and the installed capacity of wind energy - by 11% (European Commission, 2023).

Installation of own renewable energy at enterprises is part of a wider trend of transition to sustainable development and reduction of dependence on traditional energy sources. According to the European Green Deal, the EU must achieve carbon neutrality by 2050. According to this plan, the EU commits to reducing carbon emissions by 55% by 2030 compared to 1990 levels. Installation of renewable energy at enterprises is an important element in achieving this goal, as well as in ensuring sustainable economic development and reducing dependence on energy imports.

Renewable energy has become one of the key energy sectors in Europe, and most enterprises in the region are actively working on the development of their renewable energy infrastructure. According to the European Energy Agency (EEA), the development of RE in Europe has increased by more than 60% over the past 10 years (European Energy Agency, 2023). There are cite several examples of successful implementation of RE-infrastructure projects by enterprises in Europe:

1. The Swedish furniture company IKEA has built more than 500 wind farms and installed more than 1 million solar panels worldwide (IKEA, 2023). Thanks to this, the company provides more than 90% of its own electricity needs from renewable sources.

2. The Siemens company has installed more than 500 wind generators in Europe and provides an energy capacity of 7.5 GW from wind energy (Siemens Gamesa Renewable Energy, 2022).

3. Google signed an agreement with renewable energy producers in Europe to purchase 2.5 GW of electricity from5 renewable sources (Global Energy Management & Sales, 2019).

4. German car manufacturer BMW Group (2021) has installed solar panels on the roof of its factory in Spain, enabling it to meet 51% of its energy needs from renewable sources.

5. Heineken has installed more than 170,000 solar panels at its breweries in Europe and America (Brewing4.Eu, 2020).

Thus, large enterprises are actively applying the transition to renewable energy. Accordingly, we will form a model of energy support for the operation of the enterprise based on the principles of environmental safety of the new energy system. The transition to such a model involves the following stages:

1. Analysis of energy needs of the enterprise. For this, the amount of energy that allows all systems and devices at the enterprise to function is determined.

2. Selection of energy sources. Analysis of energy types is provided, which is an effective tool for replacing traditional energy supply. These can be renewable energy sources, such as solar panels, wind generators, geothermal systems, etc., or combined partly include the use of traditional energy sources based on the latest traditional solutions.

3. Development of an energy supply plan, which includes the calculation of the amount of energy required for the operation of the enterprise, as well as the distribution of the use of energy sources between various processes and systems at the enterprise.

4. Installation of appropriate infrastructure to ensure uninterrupted and efficient use of energy sources. This stage includes the installation of appropriate power generation equipment and software for controlling the receipt and use of electricity.

5. Monitoring and support of the energy supply system to ensure its uninterrupted and efficient operation. This includes regular testing of equipment, software maintenance, provision of a backup power source, and other measures.

6. Development and improvement of the enterprise's energy supply system, which includes the installation of new technologies, increasing the number of used renewable energy sources, increasing the efficiency of energy use, and other measures to ensure maximum economic and environmental efficiency of the enterprise's energy supply system.

All these stages are carried out taking into account the principles of environmental safety, ensuring the uninterrupted and efficient functioning of the enterprise, as well as minimizing the impact on the environment and human health. One of the key principles of environmental safety should be the principle of "ensuring environmental compatibility", which involves taking into account the impact of any activity on the environment and avoiding negative impact on it.

Thus, when installing renewable energy in enterprises, it is important to consider such aspects as:

– impact on natural resources (water, soil, air, plants, and animals);

– impact on people's health, related to the reduction of emissions of harmful substances;

– efficiency and uninterrupted operation of the renewable energy system;

– the financial efficiency of establishing a renewable energy system.

When installing renewable energy in enterprises, it is necessary to use innovative technologies and developments that allow for more efficient and uninterrupted functioning of the system, as well as to reduce the impact on the environment.

Such processes are actively used by European enterprises due to the transfer of technologies to increase their energy security and ensure sustainable development. However, statistical data on the use of technology transfer for the implementation of energy security are limited, because it depends on many factors, such as the size of the enterprise, the industry in which it operates the level of technological readiness of the partner countries. However, it should be noted that there is a small number of reports and studies that provide an overall picture of the state of use.

In addition, in Europe, there is a fairly significant number of programs and projects that focus on the application of technology transfer to implement energy efficiency in enterprises. So, the largest European program is Horizon 2020. Its goal is to support innovation and technological development in the field of energy to ensure sustainable development and energy security.

One example of a project that received funding under the Horizon 2020 program is the EASE-R3 project, which aims to create new energy storage resources that allow for storing large amounts of renewable energy. The project uses technologies that have been developed in Europe to expand existing energy storage resources and ensure energy security. Another example is the SUNRISE project (2022) (Sustainable energy and nutrient recovery from wastewater by the means of innovative technologies), aimed at the development of new technologies for the collection and use of energy and resources from wastewater waste. This project uses technologies that have been developed in Europe to create new resources and reduce dependence on energy imports.

Thus, as a result of the Horizon 2020 program, significant positive changes were registered in the energy sector in Europe, in particular, an increase in the volume of electricity production using renewable energy sources and a decrease in the amount of greenhouse gas emissions into the atmosphere. In addition, the Horizon 2020 program promotes investment in the energy sector, which contributes to the development of innovation and ensures energy security in the region. All this allowed EU enterprises to adapt and make a quick and efficient transition to the new energy system.

The further development of green energy and, accordingly, the transfer of technology will ensure the development of the enterprise entirely based on its renewable sources of electricity generation, which will not depend on natural and climatic conditions and factors. Accordingly, this requires further fundamental research of physical phenomena of an electromagnetic nature and the formation of relevant modern technologies based on them.

5. Discussion.

The energy sphere and the problems of its greening and sustainable development are analyzed in a wide spectrum and explain the energy transition on the example of enterprises due to the implementation of the decarbonization strategy (Schmid et al., 2016). Since decarbonization forms a new energy system, however, the direct impact of technology transfer is not considered.

However, the energy transition in terms of countries that have already made the transition (Denmark, Germany) and countries that have begun to effectively implement it (India, China) is determined by the role of technological aspects of energy conservation, energy efficiency, electromobility, and modern technologies of energy production and storage (Zhang et al., 2021). This is the basis for implementing the transfer of energy transition technologies, where the level and depth of the transition in European countries were clarified within the framework of this study, clarifying that Norway and Austria provided the deepest transition. The role of state policy in promoting the energy transition remains important (Galan, 2020). However, the conducted research generally indicates significant state regulation during the energy transition, but this role is marked by the tax burden on industrial and household electricity consumers. In addition, it was also noted that, that the energy transition of enterprises depends to a large extent on state support for the implementation of the policy of transition of enterprises to renewable sources of energy.

The role of technologies in energy storage, off-season storage, and demand management technologies, which are directly the object of technology transfer in modern energy, is no less important. However, the research does not concern enterprises but the energy system of an individual country as a whole (Lund et al., 2015). Therefore, in this study, the energy systems of countries were studied for the EU to form a ranking of countries in the level of implementation of the energy transition.

The main role in the energy transition is green innovation and cooperation with similar institutions and enterprises. Therefore, the transfer of technologies is the basis of the energy transition. It should be noted that the conducted research deeply evaluates the transition to a new energy system through the use of basic energy efficiency indicators. An innovative calculation of an individual country's transition level to a new energy system is proposed. At the same time, a model of the energy transition for a particular enterprise based on a sustainable development strategy is presented.

6. Conclusions.

Manufacturers actively support the concept of sustainable development and greening in European countries. This ensures that enterprises, due to the transfer of technologies in renewable energy, switch to an alternative power supply and form their high energy security.

It was also noted that the EU countries are fully transitioning to a new energy system model. In different countries, enterprises implement energy transition policies in different ways, focusing on economic factors, among which the tax burden on electricity consumption stands out. Further trends in the development of the new energy system indicate the improvement of the company's energy supply policy with an orientation towards the complete transition of power supply from its alternative sources of electricity.

Currently, such trends are at the initial stage of development, indicating a large discrepancy in the EU countries regarding the efficiency of the transition to a new energy system. Enterprises use such a transition mechanism more effectively in EU countries, where the share of renewable energy is quite high, over 60%. In economic terms, such transitions of enterprises are carried out at the expense of the lion's share of the tax burden on electricity use by end consumers - households. The average tax burden on consumers reaches more than 46%, while a similar burden on industrial enterprises is only 19%. Further areas of research will focus on the quantitative assessment of the impact of the tax burden in the EU countries on the speed and nature of the transition of enterprises to a new energy system. In addition, it is advisable to investigate state support programs for industrial enterprises in the process of transition to a new energy system.

REFERENCES

Andersson, M., & Stone, T.-A. (2017). Global sourcing and technical efficiency – a firm-level study on the ICT industry in Sweden. Journal of Business Economics and Management, 18(5), 877–896. https://doi.org/10.3846/16111699.2017.1356367

Bhattarai, U., Maraseni, T. & Apan, A. (2022). Assay of renewable energy transition: A systematic literature review. Science of the Total Environment. 833, 155159. https://doi.org/10.1016/j.scitotenv.2022.155159

BMWGroup (2021). Every Gramm, Every Watt, Every Liter Counts. https://www.bmwgroup.com/en/news/general/2021/sustainable-production.html

Brewing4.EU. (2020). Heineken's Sol Now Brewed With Solar Energy. https://brewing4.eu/sustainability-initiatives/heinekens-sol-now-brewed-with-solar-energy/

Ciuła, J., Gaska, K., Iljuczonek Ł., Generowicz, A., & Koval, V. (2019). Energy efficiency economics of conversion of biogas from the fermentation of sewage sludge to biomethane as a fuel for automotive vehicles. Architecture Civil Engineering Environment, 12(2), 131-140. https://doi.org/10.21307/ACEE-2019-029

CREA. (2021). https://energyandcleanair.org/ua/product/eu-co2-emission-tracker

EASE-R3. (2023). Integrated framework for a cost-effective and easy Repair, Renovation, and Re-use of machine tools within modern factory. https://portal.effra.eu/project/1047

EEC EAEC Word Energy. (2023). https://www.eeseaec.org/energeticeskaa-statistika

European Energy Agency. (2023). https://www.eea.europa.eu

European Environment Agency. (2023). https://www.eea.europa.eu/themes/energy

European Commission. (2023). https://energy.ec.europa.eu/topics

Franza, R. M., Grant, K. P., & Spivey, W. A. (2012). Technology transfer contracts between R&D labs and commercial partners: choose your words wisely. The Journal of Technology Transfer, 37(4), 577–587. https://doi.org/10.1007/s10961-010-9191-6

Galan, M. (2022). Governing the scalar politics of solar energy: Global production and national regulation in Kenyan and Indian off-grid solar markets. Energy Research & Social Science, 90, 102607. https://doi.org/10.1016/j.erss.2022.102607

Global Energy Management & Sales. (2019). https://gems.engie.com

IKEA. (2022). Renewable electricity for IKEA suppliers. https://about.ikea.com/en/sustainability/becoming-climate-positive/renewable-electricity

Kulkarni, S.S., Wang, L. & Venetsanos, D. (2022). Managing Technology Transfer Challenges in the Renewable Energy Sector within the European Union. Wind, 2(1), 150-174. https://doi.org/10.3390/wind2010009

Liu, H. & Liang, X. (2011). Strategy for promoting low-carbon technology transfer to developing countries: The case of CCS. Energy Policy, 39(6), 3106–3116. https://doi.org/10.1016/j.enpol.2011.02.051

Lund, P. D., Lindgren, J., Mikkola, J. & Salpakari, J. (2015). Review of energy system flexibility measures to enable high levels of variable renewable electricity. Renewable and Sustainable Energy Reviews, 109, 157-169. https://doi.org/10.1016/j.rser.2015.01.057

Peel, J.,Foerster, A., McDonnell, B. & Osofsky, H. (2019). Governing the Energy Transition: The Role of Corporate Law Tools. Environmental and Planning Law Journal, 5, 459-476. http://dx.doi.org/10.2139/ssrn.3439212

Peng, F.,& Zhou, S. Z. (2017). Local Technology Transfer and Innovation Efficiency of High-Tech Industry under Environment Regulation. Scientific Technology Progress and Policy, 34 (22), 115–119. http://dx.doi.org/10.6049/kjjbydc.2017080387

Project SunRise. (2022). https://www.project-sunrise.eu

Ramazanov, S., & Petrova, M. (2020). Development, management and forecasting in a green innovative economy, based on the integral dynamics model in the conditions of "Industry - 4.0." ACCESS: Access to Science, Business, Innovation in Digital Economy, 1(1), 9–30. https://doi.org/10.46656/access.2020.1.1(1)

Schmid, E., Knopf, B. & Pechan, A. (2016). Putting an energy system transformation into practice: The case of the German Energiewende. Energy Research & Social Science, 11, 263-275. https://doi.org/10.1016/j.erss.2015.11.002

Siemens Gamesa Renewable Energy. (2022). https://www.siemensgamesa.com

Urban, F. (2018). China's Rise: Challenging the North–South Technology Transfer Paradigm for Climate Change Mitigation and Low Carbon Energy. Energy Policy, 113, 320–330. https://doi.org/10.1016/j.enpol.2017.11.007

Višković, A., Franki, V. & Bašić-Šiško, A. (2022). City-Level Transition to Low-Carbon Economy. Energies, 15, 1737. https://doi.org/10.3390/en15051737

Xian, Y., Wang, Q., Fan, W., Da, & Fan, J.L. (2022). The impact of different incentive policies on new energy vehicle demand in China's gigantic cities. Energy Policy, 168, 113137. https://doi.org/10.1016/j.enpol.2022.113137

Xu, Q. R., Li, Y. & Wu, H. B. (2020). Market Mechanism or Non-market Mechanism, Which Kind of Technology Transfer Is Benefit to Innovation Capability? Journal of Management Engineering, 34 (4), 196–206. https://doi.org/10.13587/j.cnki.jieem.2020.04.021

Yan, L. (2022). Technology Transfer Initiatives. Nature Climate Change. 12, 884. https://doi.org/10.1038/s41558-022-01496-1

Zhang, W., Li B., Xue, R., Wang, C. & Cao, W (2021). A systematic bibliometric review of clean energy transition: Implications for low-carbon development. PLoS ONE, 16(12). https://doi.org/10.1371/journal.pone.0261091

Zhou, S., Deng, Q., Peng, F. & Alexandridis, A. (2021). Effect of International Technology Transfer on the Technical Efficiency of High-Tech Manufacturing in China: A Raga-PP-SFA Analysis. Complexity, 1–12. https://doi.org/10.1155/2021/6633484