

A background image of several green leaves with water droplets on them, arranged vertically on the right side of the page.

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**Environmental Taxes:  
Balancing Fiscal and  
Environmental Policy  
on the Way to  
Sustainable Development  
and National Security**

**MONOGRAPH**

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## INTRODUCTION

Environmental taxation is a complex and diverse tool of state environmental policy. The regulatory functions of environmental taxation are related to the regulation of both environmental and economic aspects. This determines the diversity of environmental taxes in different countries. At the present stage, the most common is the application of a wide range of environmental taxes, rather than the choice of a universal environmental tax instrument. The existence of combinations of environmental taxes can simultaneously provide a positive impact on reducing the various manifestations of environmental damage caused by the activities of economic entities. At the same time, the optimal set of environmental taxes can not only minimize the destructive impact on the environment, but also accumulate additional financial resources that can be used to restore nature and achieve other goals of state environmental policy.

At the same time, it is important to find the most successful environmental tax instruments, as well as their combinations, the results of which are most consistent with the objectives of state environmental and economic policy. To this end, it is necessary to study the economic relations that arise from the interaction of environmental taxes with other manifestations of environmental and economic activities and other regulatory instruments. International experience shows that the process of forming environmental taxation systems is not yet complete. The current stage of development is characterized by both comprehensive environmental tax reforms and specific measures to improve environmental taxation. That is why it is important to study the modern features of the functioning of environmental taxes, their interaction with environmental, economic and financial policies, as well as their environmental and economic consequences.

The study provides an in-depth analysis of the theoretical aspects of environmental taxation, their evolutionary development in different countries, as well as the study of theoretical relationships that arise between environmental taxes and other economic concepts. The authors study the current state of development of environmental taxation in different countries, in particular, the level of environmental taxation, the structure of revenues from environmental taxes. It was found that at the present stage the state policy should be comprehensive, which includes not only the application of environmental taxes, but also their combination with monitoring and control tools, including environmental audit and environmental reporting. It is determined that environmental audit is in its infancy, especially in countries with economies in transition. At the same time, environmental audits and environmental reporting are tools that enhance the effectiveness of environmental taxation.

The study of the consequences of the application of environmental taxation was conducted in terms of its fiscal and budgetary manifestations, as well as the relationship with national security, which is the end result of the application of all instruments of state regulation of the economy. The authors prove that today the impact of environmental taxation extends from the achievement of exclusively environmental impacts to a comprehensive balanced impact on the national economy.

The monograph was performed within the framework of the research «De-shadowing and regulatory efficiency of environmental taxation: optimization modeling to ensure national security and rational use of nature» (registration number 0122U000777) and «Socio-economic recovery after COVID-19: modelling the implications for macroeconomic stability, national security and local community resilience» (registration number 0122U000778) which are financed by the State budget of Ukraine.

# **1. THEORETICAL ASPECTS OF ENVIRONMENTAL TAXATION: DOMESTIC AND FOREIGN EXPERIENCE**

## **1.1 Conceptual background of environmental taxes**

Climate change is seen as the greatest threat for nature and humanity in the XXI century. International organizations and leading countries of the world have joined forces to oppose climate change and mitigate its negative consequences, therefore, the focus of their joint work has been directed to the prevention of the effects of environmental disasters, which is primarily aimed at supporting the development of renewable energy and increasing the energy efficiency of economic sectors.

The large number of international treaties and conventions of an environmental nature is an indication of the increasing scale and intensity of human activities on the environment.

The first international agreement to deal with global warming was the United Nations Framework Convention of Climate Change (the Convention) in 1992 (a document ratified by 195 nations of the world, containing the shared goals and principles of the world community). The scientists realized that solving current environmental problems requires considering not only technological but also economic and legal aspects. That is why the Convention was legally prolonged by the 1997 Kyoto Protocol. The main objective of the protocol and the Convention is to stabilize the level of toxic substances of anthropogenic origin in order to prevent a negative impact on the environment (Melnyk, 2013)

The document contains limits on emissions of the main direct greenhouse gases that have the most adverse impact on atmospheric properties - carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride. A



special feature of the protocol is a set of strict control mechanisms known as market mechanisms:

- emissions trading, the essence of which is that each participating country, according to the number of inhabitants, their occupation and access to natural resources, acquires the right to carry out a clearly defined number of emissions. If a country manages to reduce the number of emissions, part of the quota can be sold on the market, so that greenhouse gas emissions are reduced at the expense of those participating countries that can do so at the lowest cost;

- joint implementation mechanism - countries can join together to implement a project related to the reduction of greenhouse gas emissions. If a country accepts the project, it becomes a seller of emission reduction units, and the participating countries invest in the project and in addition receive extra emission allowances;

- clean development mechanism - allows countries to implement projects aiming to reduce emissions in "exclusionary" countries, as specified in the Kyoto Protocol.

Thus, if the protocol is followed, the environment can be improved by reducing emissions to the atmosphere and the emissions can be reduced in those countries and sectors of the economy where the most cost-effective measures can be taken.

As for the theoretical basis of the ecological tax, it was formulated by the English economist A.S. Pigou (2005) in 1920. His first studies were aimed at identifying the differences between social costs of economic activity and individual costs of the enterprise, which are reported in the Statement of Profits and Losses. He claimed that the actual social costs of economic activities are much higher than the costs of production expressed in monetary units. This distinction is due to the external effects of economic activity, such as the contamination of water resources, soil, air, etc. These consequences were considered by

A. S. Pigou as a cost of environmental factor by producers of goods and services.

Over time, the attempt to directly implement the tax requested by A. Pigou into the taxation system has encountered serious problems, where one of the main ones is the difficulty in determining the correct amount of the tax. This means that scientists could not adequately estimate the level and cost of the damage caused by the producers of goods and services in terms of the types of pollution. This situation is mainly due to technical limitations that make it impossible to accurately assess the external costs, which additionally have to be expressed in monetary units. In practice, the amount of taxes related to A. S. Pigou's concept is sometimes determined by trial and error until the optimal solution is found (Santra, 2004).

Researchers who followed A.S. Pigu's research found that for the implementation of the proposed tax it's necessary to put it on a practical basis (Bovenberg, 1994). Therefore, in order to implement it, the state must define an environmental objective, specifically an appropriate environmental standard (e.g. by setting permissible levels of permissible emission levels in line with environmental policy requirements). Then the appropriate tax bases should be converted, and a surcharge imposed from them, which should lead to achieving the envisaged standard. After a certain period, the tax is checked whether the objective is achieved and depending on this the tax is increased or decreased in order to find the optimal rate. Therefore, we first recommend analysing the contextual link between the environmental tax and other sectors of research and knowledge based on articles indexed by the Scopus database. The tool for this analysis was an interactive visualization software VOSviewer, which allowed to reveal the presence of six clusters, in particular, they are divided by such areas as: 1) greenhouse gases, costs, natural gas, cost industry, carbon dioxide etc (red cluster); 2) tax, environmental protection, economics,











manufacturing, sustainable development, planning, competition, trade-environment relate, efficiency etc. These articles can be linked to environmental taxation at the enterprise level and also assess its necessity for expanding markets and finding international investors. The environmentally responsible business is currently growing and environmental policy is one of the most important ways of gaining international allies and increasing the level of trust among consumers of goods or services. The results of this analysis are shown in Figure 1.5.

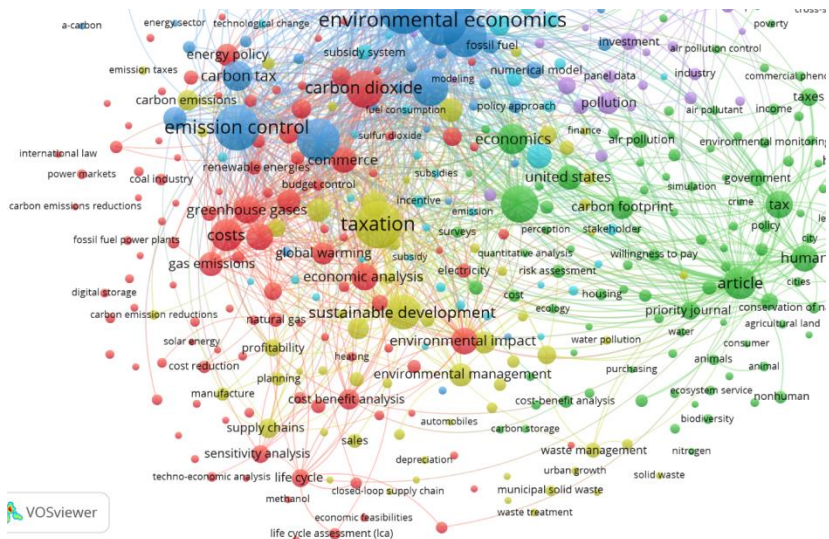


Figure 1.5. Results of bibliometric analysis of keywords co-occurrence on the request «environmental tax» (yellow cluster)  
Source: VOSviewer 1.6.1 results

The purple cluster is characterized by the following areas: capital, investment, economic development, economic growth, energy use fiscal policy, environmental pollution, energy consumption etc. This cluster consists of 40 keywords and establishes an interconnection between environmental taxation and the environmental policy of the enterprise, the development











research analyses all the advantages and disadvantages of specific environmental taxation provisions that have been adopted.

Thus, the analysis has shown which areas of research can correlate with environmental taxation. This research will help to develop such environmental measures that would satisfy the needs of society and minimize the level of pollution of the natural environment.

It should be noted that in national and international literature the following term "ecological tax" is used in common with "pollution tax", "green tax", "environmental fee", "environmental tax", etc.

Since there is no single universally accepted definition of environmental tax, and individual authors propose different, often distant propositions. Some domestic scientific approaches to the interpretation of the concept of "environmental tax" are presented in Table 1.1.

Some foreign scientists define environmental taxes as a financial burden on various economic entities as a result of the direct introduction of pollutants into the environment; They relate indirectly to products that cause pollution of the environment in the process of their production and use or are the result of the use of environmental resources and services.

According to the definition provided by a foreign scientist, ecological taxes are payments for each unit of waste products released into the environment or for each unit of pollution of the environment, in other words, for the use of environmental resources (Ekins, 2021). Another definition is proposed by the Statistical Office of the European Partnerships, which defines the environmental surcharge as a monetary payment based on the natural unit (or its equivalent) of an activity which has a significant and particularly negative impact on the environment (Arese,2002).

In accordance with the diversity of scientists' approaches to interpreting the concept of "environmental tax", it should be stated that this term should be understood as a mandatory and irrevocable payment to the state, which is imposed on the taxation base (defined by a legislative act) and is levied on the producer of goods and services or a natural resource user, which has a particularly significant impact on the taxpayer.

Table 1.1. Approaches of scientists to interpreting the concept of "ecological tax"

Source	Peculiarities of interpretation
Tax Code of Ukraine (Chapter VII)	Environmental surcharge is a mandatory payment determined by the state and collected from polluters in accordance with the actual volume of discharges into the atmosphere, water bodies, the size of disposed wastes, etc.
Nikola (2020)	The environmental surcharge is the amount paid by legal entities in proportion to the negative impact on the environment, expressed in monetary equivalent
Musienko (2007)	The environmental tax is a general local payment represented by a fee for special use of natural resources and a fee for the pollution of the natural environment
Shako O. (2015)	The environmental surcharge is an inherent incentive for innovation, for the rational use of natural resources by producers of goods and services, as well as by the users of natural resources
Novytska N. V. (2016)	The environmental surcharge is a tool to maximize the public good by establishing a socially efficient level of pollution of the natural environment
Naydenko O. Ye. (2017)	The environmental tax is a direct reflection of the cost and the amount of damage caused to the natural environment

Source: developed by the authors

The research also revealed that there is a long-standing debate among scientists on the use of environmental revenues for environmental protection purposes or budgetary replenishment.

Thus, revenues from environmental taxes can be used in two ways. First, they can increase the total amount of budget revenues, and then they can be directed towards different goals, such as reducing budget deficit in the social sphere or repaying external debt. Alternatively, they can be distinguished for specific purposes, in this case for the protection of the environment, e.g. by financing environmental programs (Bovenberg, 1994).

Thus, if there is a mechanism for the collection of environmental tax from users of natural resources or polluters of natural resources, it's likely that there is a few functions that an environmental tax can perform. The main functions of the environmental tax and ways to assess its efficiency are shown in Figure 1.10.

According to the figure above, the ecological tax must perform three functions (Shevchenko, 2014):

- fiscal - which consists in replenishing the budgets of different levels and redistribution of such expenditures for priority purposes, for the state to fulfil the basic functions assigned to it;
- stimulating - which is characterized by the level of compensation for the costs incurred in paying the tax by its payers (in the form of subventions, subsidies for modernization, tax allowances, etc.);
- compensatory - which means purposeful use of funds received from polluters of environment, for renewal of the state of the environment by carrying out environmental protection measures.

It should be noted that in post-industrial countries, the environmental tax mainly serves only a fiscal function, which means that receipts from the environmental tax are used to cover

budget deficits. Thus, there are no state incentives for enterprises in these countries to pursue environmentally friendly activities, and the latter are mainly driven by those with foreign capital or their products and services are oriented towards the international market.

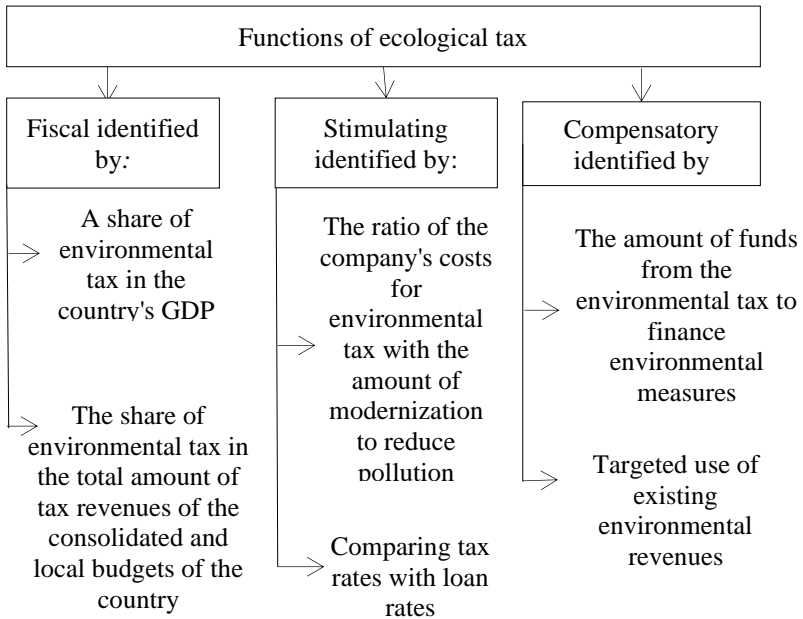


Figure 1.10. Functions of the environmental tax and methods for determining its efficiency

Source: developed by the authors on the basis, created by Fanglu & Junfeng (2000), Schofield (2017), Kashenko (1999), Novytska (2016)

It is also worth noting the views of scholars on the functions of the ecological tax. Some believe that the compensatory function is the main one and that its implementation must be clearly regulated and monitored.

This position is taken, for example, by Grodalskyi (2011) who points out that the main purpose of any environmental tax is the implementation of environmental plans and not covering the fiscal needs of the state. This means that the fiscal effect is a "by-product" of achieving environmental goals. This view is also supported by another scholar who argues that the environmental surcharge must not only provide funds but also encourage or obstruct specific economic activities. Other authors point out that the fiscal function of taxes is now considered to be the main one. After all, budget replenishment is one of the main tasks performed through taxes and is to provide the budget with the funds that are used to cover state expenditures, while other functions of environmental taxation that are performed by taxes are additional.

Thus, today, the ecological tax does not play an additional role, in this case ecological (that is, encouraging action for the protection of the environment), and its main task remains to provide the state with financial resources.

We believe that this situation is a consequence of the lack of relevance of environmental management, as before the end of the twentieth century the environment was used as a common good, which was freely available and free of charge (Matuszak-Fleijnsman, 2009). Before that time there were no market operations and nobody could be excluded from the use of this commodity (e.g. breathing clean air, using water from a river, etc.). However, today it is very difficult to assess the damage to the environment, and there is still a stereotypical perception among the population about the unlimited access to the ecosystem's resources.

However, an economic assessment of the level of environmental pollution is necessary because it performs many important functions, such as (Porfyriev, 2016, OECD 2014):

- informs users that the natural environment is not free of charge, despite the absence of a traditional resource market;



- allows setting the pace of resource use and warns users of the consequences of their depletion;
- validates or verifies economic development indicators;
- supports administrative activities aimed at the protection of the environment,
- encourages the implementation of economic instruments for the management of the environment (fees, taxes, penalties, etc.).

The environmental taxation system combines the limitation of negative impacts on the environment with the application of different tax rates, by type of pollution (a system of differentiated rates, which are applied separately by each country), which contributes to progressive environmental policy. Thus, the Organisation for Economic Cooperation and Development has identified four main groups of environmental taxes, including (Danish Tax Reform, 2010):

- energy taxes - this group includes taxes on energy products, which are used both for mobile and stationary purposes. Gasoline and diesel fuel are the most important energy products for mobility, while oil, coal, natural gas and electricity are intended for stationary use. Since the CO<sub>2</sub> tax is integrated with the energy tax, it is very important or simply impossible to introduce the CO<sub>2</sub> tax separately, so the CO<sub>2</sub> tax is included in the energy tax group and not in the pollution tax group;
- transport taxes - the group of transport taxes includes taxes associated with vehicles and other transport vehicles (e.g., aircraft). This group also includes one-time charges related to the import or sale of equipment or lump-sum charges such as the annual fee for the use of a vehicle;
- pollution fees - this group mainly includes taxes related to the discharge of pollutants into water bodies, air, and soil, which can be identified and calculated. This also includes taxes on different types of waste and a tax on noise;

– resource taxes - this group includes taxation of natural resources, as their extraction causes erosion and increases pollution.

Taking into consideration above mentioned division, we consider it necessary to analyze the environmental payments that function on the territory of certain countries (Table 1.2).

Table 1.2. Types of environmental taxes enforced in some countries of the world

Tax name	Country													
	GB	EE	SE	FI	DE	NL	DK	IE	CZ	PL	FR	LV	SI	UA
Energy tax		+	+	+	+	+	+	+						
Carbon tax				+			+	+			+		+	
Water pollution tax					+	+	+	+	+	+	+	+	+	+
Air transportation tax	+							+			+			
Air pollution tax								+	+	+	+			+
Vehicle emissions tax			+		+			+						
Waste tax	+		+	+	+	+		+		+	+			+
Packaging tax			+		+						+			
Tax on pesticides, fertilizers, chemicals			+		+			+		+		+		
Collection for environmental protection	+	+	+		+			+						

Source: developed by the authors on the basis Danish Tax Reform (2010), Ekins (2014), Hanemann (2013), Shofield (2014), Sheate (2014)

The table shows that environmental taxation is present in every analyzed country. This is the result of the situation that almost all of the surveyed countries are members of the European Union (EU) and the European Council has adopted the "polluter pays" program. Under the program, every natural person and/or legal entity that causes an indirect or intermediate impact on the natural environment (in particular, atmospheric pollution, the weather, water, land, natural resources and the lack of environmental management) will bear full financial responsibility equivalent to the environmental damage caused. It should also be noted that in the EU countries such funds are mainly used for programs to reduce pollution, construction of treatment plants, etc.

An analysis of functional taxes in selected countries has shown that the countries with the highest amount of environmental taxes are Denmark, Sweden and Ireland. These countries are leaders in innovative environmental protection technologies and have minimal anthropogenic impact on the environment. The authorities of the designated countries regularly approve the environmental development programs, and report to the public on the accomplished and planned tasks. It should also be noted that all Scandinavian countries have the highest environmental taxes in volume terms. Special attention should be paid to the transport tax because it is the highest in these countries. Thus, the government encouraged the population to ride bicycles or invest in electric cars, which had an impact on the reduction of emissions into the atmosphere by diesel and other fuel-powered vehicles.

Thus, effective functioning of environmental taxes can help achieve structural changes, positively influencing the level of pollution and the natural environment in general.

It should be noted that environmental taxes significantly contribute to solving not only environmental but also demographic, social and economic problems of humanity.

Environmental taxes are considered an effective tool of environmental policy and are used to combat the pollution of the natural environment. In terms of the concept of sustainable development, the use of economic mechanisms in environmental activities contributes to the development of innovative technologies, encourages polluters to use more environmentally friendly or create new technologies.

## **1.2 Current trends in environmental taxes in European countries**

Human beings, like any other living organism, are an intrinsic part of nature. In this sense, the human community is entirely dependent on the laws of nature, but in comparison with any other biological species, its intelligence and intensive activity has the greatest impact on nature and the environment. Over time, the public has come to understand that their activities must be based on the protection and creation of a healthy environment, which is a guarantee of survival and one of the most important objectives of EU environmental policy.

An analysis of historical literature shows that since ancient times, people have understood their dependence on nature. Thus, ancestors believed that the natural environment was the basis for all human activity and, ultimately, the health of the population. Unfortunately, for centuries, people have viewed nature as a mere object and have sought to change and control it in order to build their own civilizations (Garkushenko, 2013).

Among historians and ecologists, the emergence of agriculture and animal husbandry is considered as such a start, but the real pressure of anthropogenic unreasonable actions began in the XVIII century, during the industrial revolution and the intensive use of speculative fuel. Consequently, at the end of the XX century the effects of industrialization became visible,

and the impact of economic activity on the global level of pollution of docklands has already exceeded acceptable limits.

Thus, because of industrial development and careless human activity towards nature, today there are several environmental problems, among the main ones are climate change (global warming), depletion of the ozone layer, catastrophic forest viruses and biodiversity. Most importantly, most of these problems are not human made.

Although environmental problems had been known since the tenth century, it was only in the post-war period (1950) that discussions began on reuniting Western Europe to counter the aggressive policy of the Radical Union. Thus, the French Minister of Foreign Affairs Robert Schuman (2011) presented a declaration on the European integration and a concept of actions in the post-war period. However, at that time Europeans were concerned with the problems of overcoming the consequences of the world war, the expansion of markets, and the integration of the Western European lands, rather than with a joint European environmental policy.

In 1957, the Treaty of Rome was signed, which scholars consider a manifesto for economic renewal through the creation of a single market. According to the provisions of the treaty the Confederation was not responsible for the environmental policy (Bovenberg, 1994). Thus, the member states were able to respond independently to the increasing pollution of the environment and to develop individually measures to reduce it. Given the fact that geographically the European lands had shared river basins and used shared waters, politicians have called for supranational regulation of environmental issues. They believed that such regulation would enable the creation of uniform environmental practices and standards for environmentally friendly products. This in turn would have a positive impact on trade.

Thus, in 1972, a conference of the United Nations Organization laid the foundation for a single European environmental policy. Not long ago, the principles of the EU environmental policy were adopted in Paris. And already in 1973, the First Program of Environmental Action was adopted (Ekins, 2021). Since the end of the twentieth century, a tangible change has begun in the field of environmental protection as Europe has become more aware of the environmental value of a growing economy and the importance of preventing the degradation of the natural environment.

Global warming has become one of the biggest environmental problems. This is often due to excess carbon dioxide from the massive use of fossil fuels and the unsustainable destruction of forests. Problems of regional importance include the contamination of the Baltic, Mediterranean and Eastern Seas, acid rain, and the discharge of chemical waste into major European rivers and the contamination of radioactive nuclides from the Chernobyl nuclear power plant accident. All of these reasons made it clear that major environmental disasters do not respect established national boundaries and that Europe must take steps to counteract them in the wider interests of the planet.

The implementation of the Treaty of Amsterdam, which stipulated the obligation to apply the principles of subsidiarity and proportionality, is the next stage in the development of environmental protection (Mandryk, 2016). Thus, the subsidiarity principle helps to delimit the competences of the EC and member states. Therefore, the objectives of EU environmental policy will be better achieved by joint efforts rather than by individual member states. At the same time, the principle of proportionality is one of the general principles of EU law, according to which all regulatory assets and court decisions of the Member States must correspond with the objectives pursued by the EU.

Today, more than 350 directives, resolutions, decisions and recommendations regulating the protection of the natural environment have been registered and are operational in the EU (Arifin & Jahi, 2013). These documents essentially set standards for the quality of water and limit values of emissions of pollutants from various sources. The EU Convention requires the establishment of procedures for issuing discharge permits, implementation of abatement programs, establishment of an emission monitoring system, provision of information on emission and measures to combat emission to the public and EU institutions.

One of the aspects that confirms that the EU understands the importance of protecting the environment is the signing of the Lisbon Treaty in 2009. The Treaty states that the natural environment is one of the key areas of joint competence between the EU and its Member States (2011). Since reducing the level of pollution in the natural environment is becoming more and more urgent every year, it's worth analyzing the income of the EU countries due to environmental taxation (Figure 1.11).

The figure confirms that the level of pollution of the environment has increased, with a proportional impact on the environmental costs. The total environmental costs in 2018 were 325.2 billion euros when in 2008 the environmental costs were 70.2 billion euros less. It should be noted that the largest share of EU environmental revenues is represented by energy taxes, estimated at around 77.7% of the total amount in 2018. In 2017, the share of such revenues was 77.4%, although in value terms the amount of revenues from energy tax decreased by 7 billion euros compared to 2018. This state of affairs is an indication that the number of industrial enterprises and power plants on the territory of the EU is increasing.

As for transport tax, its increase is not significant in dynamics, and the share of this tax in the total amount of environmental payments for 2002-2018 fluctuates between

18.9-22.1%. The pollution tax is represented in the total amount of environmental payments at the lowest rate. Thus, its revenues are close to 10 billion euros every year, and this indicator is expected to grow due to the development of the agricultural sector, which is the largest contributor to this tax.

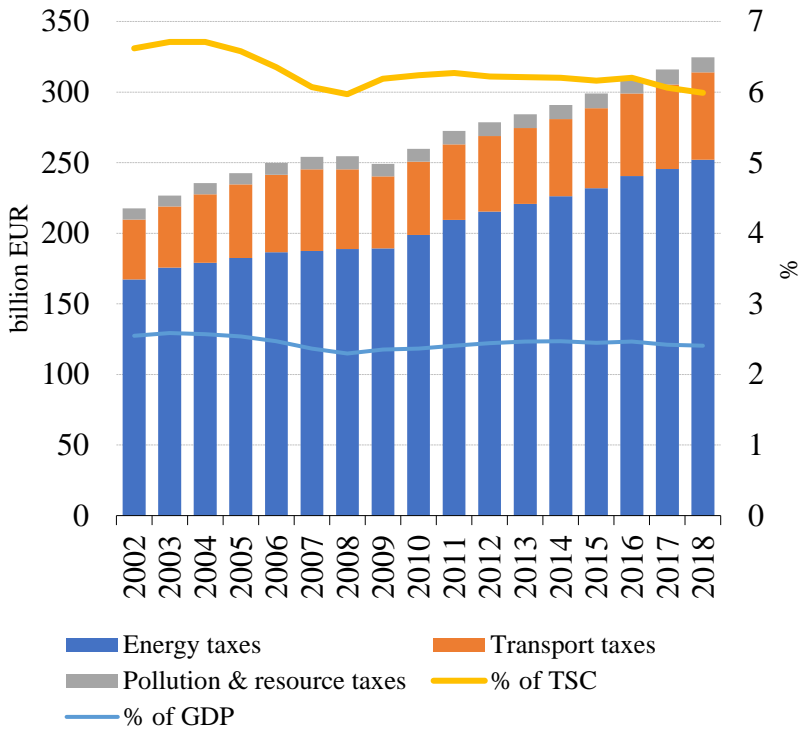


Figure 1.11. Environmental tax revenue by type and total environmental taxes as share of TSC and GDP, EU-27, 2002-2018 (billion EUR, %)

Source: Eurostat



To summarize, special attention should also be paid to the indicator of the share of environmental revenues in the GDP of the EU countries, which demonstrates in the most substantive way the extent to which environmental revenues contribute to the GDP of the EU countries. Thus, the share of environmental revenues in GDP has fluctuated between 2.3-2.6% over the 2002-2018 period.

A detailed analysis is also required to compare the change in the share of environmental taxes in GDP and the total amount of taxes and social contributions accrued by the EU countries (Figure 1.12). Thus, the overall dynamics for EU countries shows that the amount of environmental payments in 2017 was higher than in 2018, although in percentage terms this difference does not amount to even 1%, this fact may indicate either a lack of efficiency of the administrative mechanism or a decrease in the anthropogenic impact on the environment. This situation occurs in countries such as Greece, Ireland, Slovenia, Estonia, Latvia, Austria, Ugricia, Cyprus, Malta, Slovakia, Germany, Belgium, Italy, Sweden, the United Kingdom and Norway.

Among such countries as Romania, Czech Republic, France, Lithuania and Czech Republic, environmental expenditure increased in 2018 compared with 2017. Particular attention also needs to be paid to those EU countries that have reduced the share of environmental revenues in GDP but increased it in total taxes and social contributions. These include Denmark and Finland. These countries are leaders in the recycling of waste and recycling of raw materials. There are also those EU countries that have reduced the level of environmental payments in the total amount of tax revenues but increased their share in the country's GDP, among them: Portugal, Poland, Spain, Luxembourg, Croatia, the Netherlands and Bulgaria.

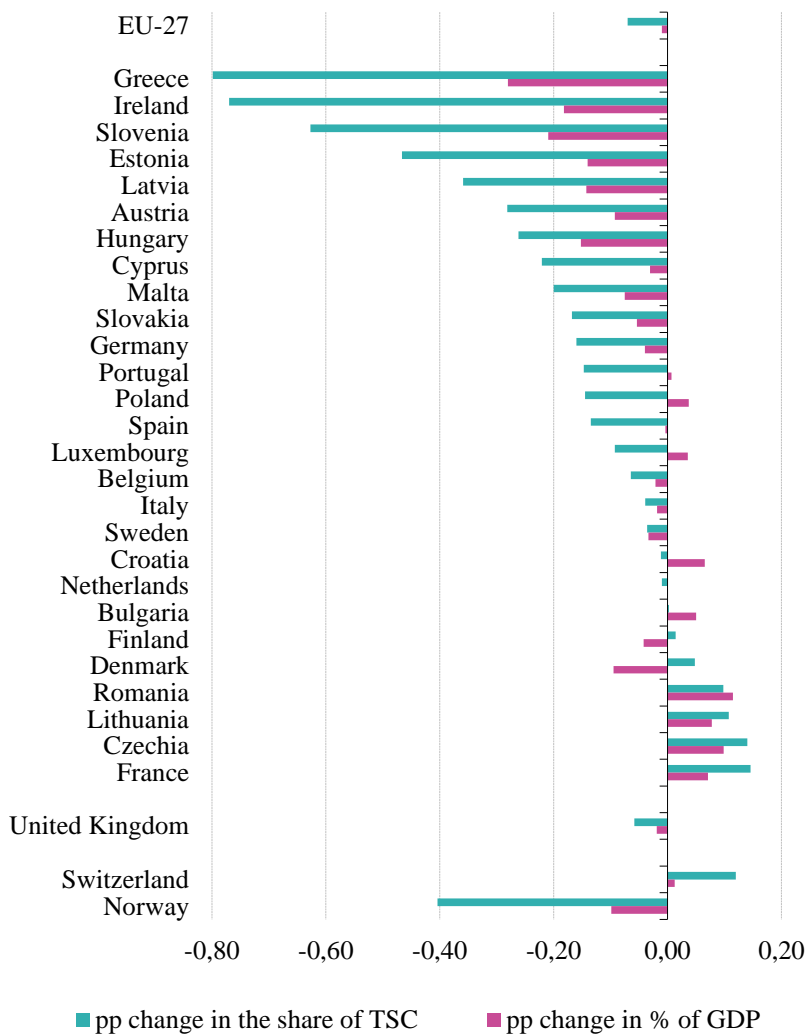


Figure 1.12. Environmental tax revenue – change between 2017 and 2018 (percentage points)

Source: Eurostat

Since environmental tax revenues have a tendency to increase, we suggest that a range of EU countries be identified and conduct a detailed analysis of the specifics of environmental payments, their types and categories of payers, in line with the peculiarities of the legal regulation of the countries where they operate.

A detailed analysis will be conducted on the application of three countries, such as Switzerland, Sweden and Finland. These countries are leaders in the implementation of eco-innovations in production and development of effective environmental protection measures.

For example, based on Europe's long experience in the fight against environmental pollution, the European community has responded well to the environmental charges which have been increasing over time, depending on the type of emissions and the regulatory regime in force in each country. The Swiss population pays environmental taxes, environmental charges and voluntary payments, as shown in Figure 1.13.

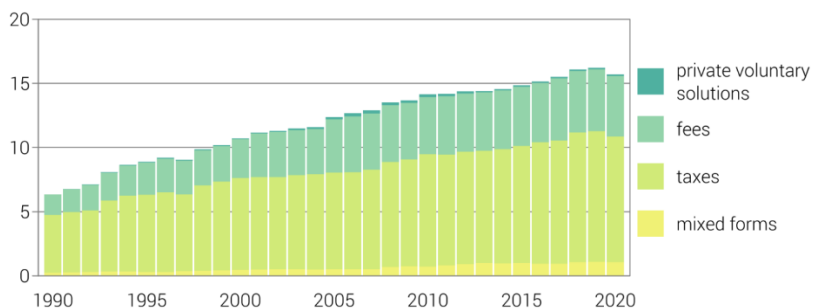


Figure 1.13. Dynamics of income from ecological payments by type in Switzerland, 1990-2020, %

Source: FSO – Environmental accounting

According to the figure above, the amount of revenues from ecological taxes has been increasing during the analyzed three-decade period. The smallest share is made up of mixed forms of

ecological taxes, so in the period 2018-2020 their highest share is observed, which varies between 0.8% and 1%. The largest share of environmental revenues, in total environmental income, consists of environmental taxes levied on polluters under general conditions and aimed at financing anti-environmental behavior that affects the health of the Swiss population and the planet in general. For example, the environment tax rate in 2020 is 11.2%, compared to 7.8% for the same period in 2000. This difference is an indication that the amount of anthropogenic pressure on the population is increasing all the time and is a factor of budgetary replenishment. But we should not forget about the fact that tax rates are regularly reviewed at the EU level, resulting in an increase in the cost of pollution of the environment.

Another important part of the environmental revenues is the environmental charges. The main peculiarity of environmental charges is that they are intended to cover environmental costs (e.g. charges for the disposal of waste, hazardous materials, etc.). From 2006 to 2020 the share of environmental charges remains approximately the same in total environmental revenues and varies between 4.7% and 5.1%. Although at the end of the twentieth century these charges did not even reach a fraction of 1.5%.

Another very important environmental fee paid to the Switzerland budget is the voluntary payments for the conservation of the planet. These payments started to be collected from economic entities in 2002, but at that time they were not very popular. One of the reasons could be considered the low environmental awareness of the population. But since 2006 the amounts of these payments have been increasing, a trend that lasted until 2012, when the average share of these payments was close to 0.3%. Today, the share of such payments varies between 0.1%.

Thus, there are various types of environmental payments in Switzerland, with most of them being environmental taxes and

charges, but it should be noted that there are also environmental payments of mixed form, which are also paid for the purpose of preserving the natural environment.

Given the diversity of environmental payments, it is worth noting that Switzerland also has certain categories of environmental taxes, such as:

- energy taxes - taxes on energy used for production and consumption;
- transport taxes - taxes on carbon dioxide emissions, annual taxes on traffic, fees for the borrows, etc.;
- resource taxes - taxes and charges for extraction or use of natural resources, such as: soft diggings, water resources, soil, etc.;
- taxes on pollution - taxes on discharges of pollutants into the atmosphere, on discharges to water bodies, etc.

In consideration of this classification, it's necessary to analyze environmental revenues from environmental taxes by their main categories (Figure 1.14).

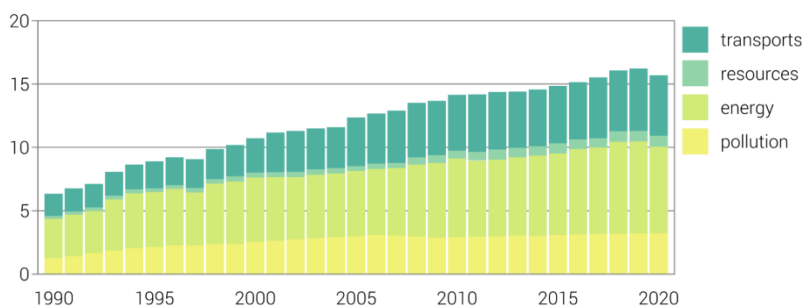


Figure 1.14. Dynamics of income from ecological taxes by their categories in Switzerland, 1990-2020, %

Source: FSO – Environmental accounting

The figure shows that the largest share of environmental revenues comes from energy taxes. Thus, from 1990 to 1993 these revenues fluctuated between 2.9% and 3.2%, and even with the development of industry, energy taxes began to increase

steadily. Since 2008, their amount has remained roughly the same, varying only under the influence of internal factors (such as access to licences, additional permits for production, etc.). Today, energy taxes, among others, are budget-financed and account for 7%.

The next most important tax for the budget is transport tax, which up to 2000 remained between 1.7% and 2%. Bearing in mind that with time, new types of transport taxes began to function in the EU countries that required the owners of transport vehicles to pay not only for carbon dioxide emissions (Estonia, Denmark) but also pay an annual surcharge on consumption (Spain) and pay for the bollards (UK). The introduction of new types of transport tax influenced increased consumption of electric vehicles and bicycles in EU countries although most Europeans continue to use petrol cars as the cost of electric vehicles is not reduced. This situation has also increased revenues to the Swiss budget from vehicle users, increasing revenues to 5% in 2017.

The tax on littering is effective throughout the EU, although it can be changed depending on the country in terms of its type, the availability of such a resource in the country and the volume of its consumption. In Switzerland, for example, the total amount of tax revenues from pollution in the environment has been 2.8-3% since 2013. There is a steady increase/decrease in the range of 0.1-0.2% depending on the year.

The last category of environmental tax is the resource tax. This figure confirms the fact that their share is the smallest in Swiss environmental revenues. In the total amount of environmental revenues, and the highest share of revenues was in the period from 2018 to 2020. We believe that this situation is the result of the fact that each EU country independently selects the tax attribution to each of the categories. For example, in Denmark there is a tax on water supply, which is included in the category of resource taxes, while, for example, in the Czech

Republic there is a tax on water bodies and their pollution, which is included in the tax on pollution, although the use of water resources in this case should not be distinguished.

Taking into consideration the previously studied stability of environmental revenues from the energy tax, the dynamics of revenues from environmental taxes by categories of tax should be considered, whereas a special attention should be paid to the analysis of energy tax in the context of stationary and secondary sources of pollution in Switzerland (Figure 1.15). The EU energy surcharge directive stipulates that the use of diesel fuel is economically more viable than the use of gasoline. From 2009 to 2020, the highest energy tax values were found in Germany, Poland, Sweden, Denmark and Finland, while the lowest energy tax values were in Estonia, Latvia and Lithuania.

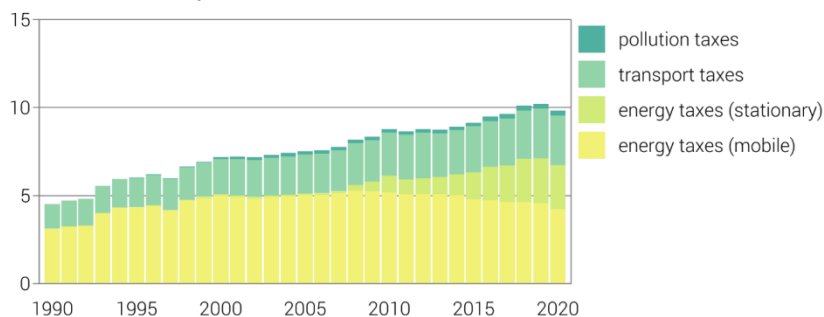


Figure 1.15. Dynamics of income from environmental taxes by tax category in Switzerland, 1990-2020, %

Source: FSO – Environmental accounting

The results of the study presented in the figure confirm that in Switzerland the natural environment is much more polluted by stationary sources than by secondary sources. Before 2008, however, pollution from non-nuclear sources was minimal, whereas in 2009 revenues from the stationary source category began to rise rapidly. Thus, the difference between income levels in 2020 and 2009 is approaching 2.9%. Factors in this growth

are the increasing number of mobile sources of pollution such as cars, planes, tractors and vans. As for stationary sources of pollution, this figure may change due to the opening of new power plants, oil refineries, industrial facilities, etc., as well as an increase in national electricity tariffs. Germany, for example, has the highest tax rates in 2018: €58/t CO<sub>2</sub> for electricity and €27.4/t CO<sub>2</sub> for natural gas (Environmental Reporting, 2021).

It should be noted that a number of economic instruments, such as energy taxation and environmentally motivated energy taxation schemes, exist in the Nordic countries to address environmental issues. According to the European Commission, in general, significant progress has yet to be made in introducing feed-in tariffs for diesel, especially in Belgium, Greece, Portugal, Slovenia and Slovakia.

Thus, the analysis shows that all categories of ecological tax cover the Swiss budget, but the most important issue is the intended use of these cash flows.

Thus, the next issue to be analyzed is the use of eco-tax revenues in Switzerland (Figure 1.16).

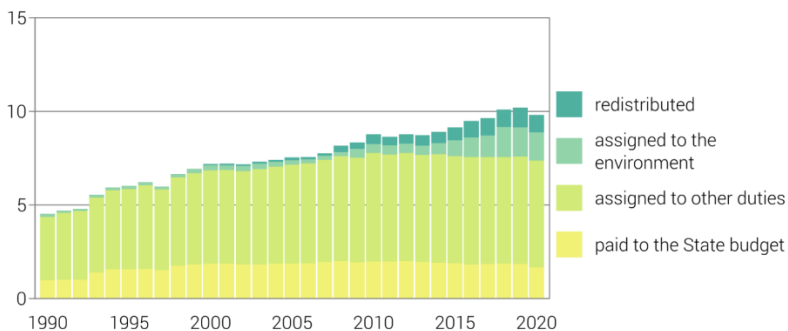


Figure 1.16. Dynamics of ecological tax revenues, 1990-2020, %

Source: FSO – Environmental accounting

The figure shows that the distribution of environmental tax revenues in Switzerland is not evenly distributed. Most of the



ecological tax is spent on other (non-environmental) duties. Thus, in the past 20 years between 6.3% and 7.8% of revenues generated by environmental fees have been used to perform the core public functions of Switzerland. At a time when the level of pollution in the environment is rising steadily, urgent efforts are required to maintain the ecosystem, but only around 3% of the Swiss budget is allocated for this purpose. Importantly, from 2008 until 2017, the share of spending on the environment varied between 0.8% and 2.3%, whereas since 1990 it has not exceeded 0.5%. This situation influences Switzerland's non-compliance with EU development priorities in areas such as: halting climate change and global warming; natural resource protection and biodiversity conservation; and sustainable use of natural resources and adequate waste management.

It should be noted that a large part of the environmental tax revenue is also used for the Swiss State Budget. This situation is caused by the deficit in certain budget lines. Although since 2016, the share of environmental tax revenues accruing to the State Budget has been steadily decreasing. Thus, in 2020 such revenues decreased by 0.1%, though in percentage terms this decrease is not significant, but in terms of value it amounts to millions of dollars.

Apart from the categories that generate environmental revenues, an important question is who in Switzerland pays the environmental charges to the budget. The answer to this question is shown in Figure 1.17.

According to the figure, the categories of environmental taxpayers in Switzerland are divided into 5 types, in particular:

- non-residents - foreign natural persons and legal entities, enterprises, organizations that carry out their business activities and have to pay taxes according to the requirements and laws of the country they live in temporarily or permanently;
- households - understood as citizens of the country;

- primary sector - represented by the agricultural industry, and related services (characterized by the supply of raw materials for production of goods and services);
- secondary sector - represented by manufacturing (converts one good into another, thus increasing its value);
- tertiary sector - represented by the service sector (characterized by the provision of services to the primary and secondary sector).

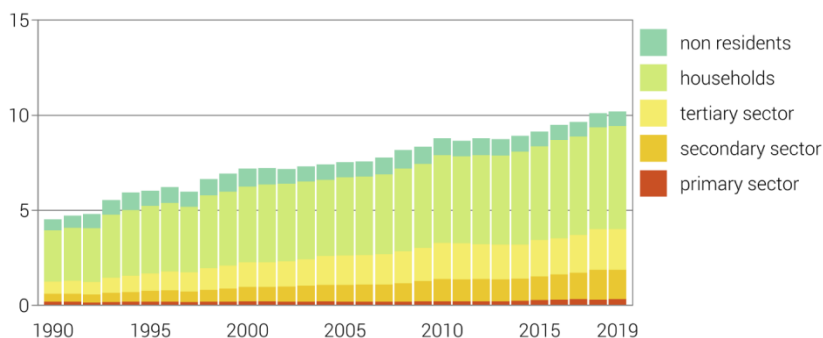


Figure 1.17: Dynamics of income from ecological taxes by taxpayer category in Switzerland, 1990-2019, %

Source: FSO – Environmental accounting

Thus, the largest part of environmental revenues is generated by the household sector. In 2019, they accounted for 6.3%, which is 3.9% more than in 1990. This situation is due to the fact that a large part of the environmental revenue structure is composed of transport taxes and Europeans often own a few cars, each of which is subject to a tax at some point.

Income from the primary sector is the least represented among those shown in the figure, which is a consequence of the fact that in Switzerland the agricultural industry and related services are not the most dominant among all the companies represented. For example, revenues from the primary sector for the whole survey period remained around 0.7%, while the

secondary sector is the biggest environmental polluter and the number of such enterprises is significantly higher compared to the primary sector. Also, the secondary sector generates revenues at 0.3-2.1%, depending on the period. But the tertiary sector takes the leading position and increases the level of environmental payments every year. Compared to 2000, the environmental payments have increased by 2.5%, a consequence of the development of the service sector in Switzerland.

The analysis of the preceding figure gives only a general idea of the environmental fee payers and does not identify the types of taxes paid by each of them. Therefore, the next step is to analyze the revenues from environmentally related taxes by type of economic activity in Switzerland (Figure 1. 18).

Thus, the biggest contributors to the environmental payments in Switzerland are the manufacturing industry, which pays 13.9% of energy taxes to the budget, 2.3% are transport taxes, and the rest comes from pollution taxes. This confirms the fact that these organizations consume the most energy through the functioning of industrial facilities, power plants, etc., among other types of economic activity.

The next most important economic activities in terms of environmental payments are the construction industry, trade and transport. Among others, the transport industry generates the largest amount of tax on energy, while the transport tax is about 2.0%, and the trade industry generates 2.5% more transport tax than the transport industry. Also, the trading industry is a payer of the pollution tax, of course, this portion is not significant, but amounts to 0.07%.

As for the construction industry, it pays a tax on the pollution due to the specifics of its activity. Thus, the tax on pollution constitutes 1.7%, energy - 7.9%, and the rest falls on transport taxes.

Representatives of the agricultural sector, forestry and fishery pay transport tax and energy tax roughly in equal proportions,

whereas the situation of the extractive industry representatives is more likely to pay transport tax, while in our opinion they must pay a significant part of the tax on natural resources.

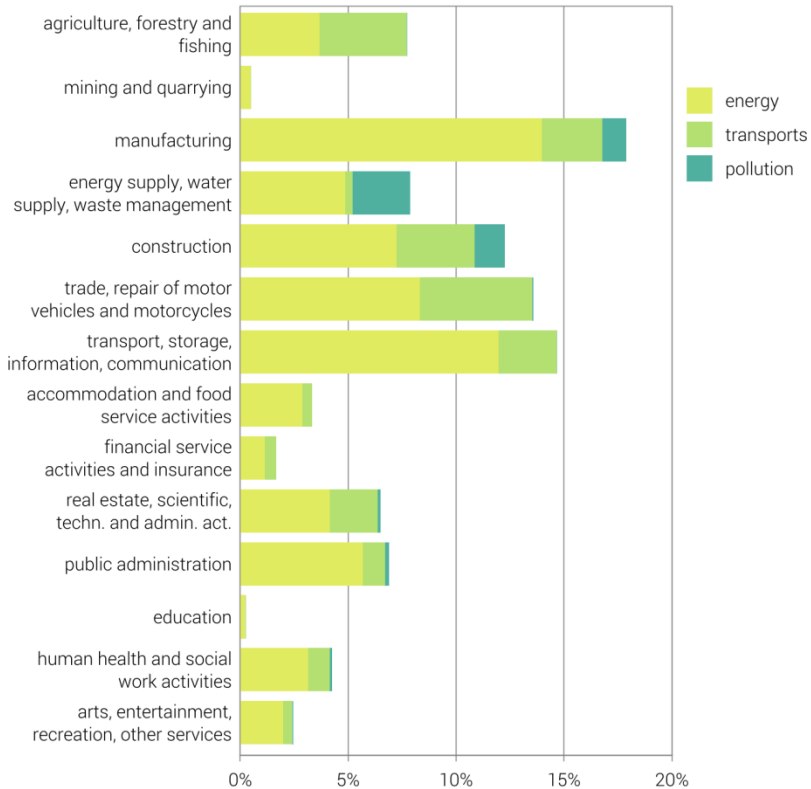


Figure 1.18. Revenues of environmental taxes from different types of economic activities in Switzerland in 2019, %

Source: FSO – Environmental accounting

The activities related to energy supply, water supply and waste management are subject to 2.7% pollution tax, 4.9% energy tax, as well as transport tax, but at a much lower percentage point.

Other represented types of economic activities are mainly energy taxpayers. Thus, each of the presenters most of the costs is directed precisely to the repayment of financial obligations from the tax on energy, also relevant to them is the payment of transport tax, while the tax on the pollution is paid only by the sectors of public administration and real estate.

Thus, the examined aspects confirm the fact that the Swiss legal framework is based on the "polluter pays" principle, according to which the economic entity must pay to the budget such a sum of money that is proportional to the value of the caused damage to the property.

This analysis enabled a very detailed assessment of the level of environmental taxation in Switzerland, in terms of types of tax, categories of taxpayers, etc. However, there is a need for an analysis of the environmental tax in macroeconomic indicators of Swiss operations. Thus, to begin with, we suggest analyzing the value added of the environmental sector relative to GDP (Fig. 1.19).

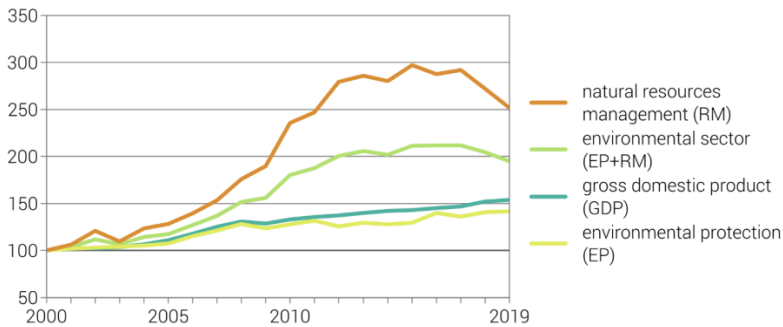


Figure 1.19. Dynamics of the value added of the environmental sector compared with GDP in Switzerland, 2000-2019

Source: FSO – Environmental accounting

The environmental sector in Switzerland produces products and services that aim to reduce or avoid pollution. It also helps

to conserve natural resources. The figure shows that natural resource management (which is at a very high level and is characterized by the protection of land, soil, plants and animals) is a very important part of the management of natural resources, the environment sector (characterized by the implementation of nature protection measures by removing or minimizing the impact of natural resources) benefits the environment sector by around 40 percentage points higher than GDP.

Another equally important issue is an analysis of the added value of the environmental sector by area (Figure 1.20).

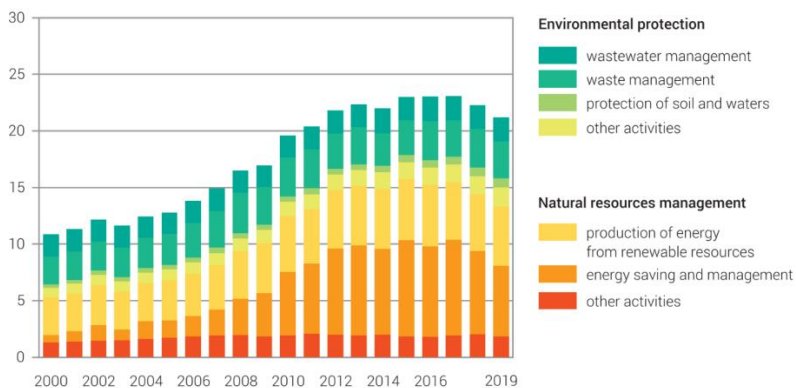


Figure 1.20. Dynamics of gross value added of the ecological sector, by regions in Switzerland, 2000-2019

Source: FSO – Environmental accounting

Considering the fact that the environmental sector in Switzerland is represented by organizations and institutions that are engaged in activities to prevent, limit or correct environmental damage that has occurred in water bodies, In order to prevent, reduce or correct environmental damage caused by water, atmosphere, soil, etc., it is necessary to consider which part of the organization in the area reduces the

environmental risk and minimizes the level of pollution of the natural environment.

Thus, the data in Figure 1.20 show that in Switzerland the management of natural resources is represented by such areas as: wastewater management, waste management, ground and water conservation and other activities, while the protection of the natural environment is represented by such areas as: energy extraction from renewable resources, energy conservation and management, etc.

The largest share in the management of natural resources is the area of waste management, which during 2005-2019 remains at a stable level, and the least developed is the area of soil and water protection. The fact that the field of waste management is functioning effectively in Europe is due to the existence of incentives for alternative and more sustainable ways of waste disposal. The field of natural resources management is especially developing in the field of management and energy saving. Thus, such measures have increased significantly since 2010, and in 2019 amounted to 5.3 billion in total management and environmental expenditures.

To summarize, it is fashionable to state that the system of environmental taxation in Switzerland ensures an increase in the level of environmental safety of the country. The current system of mandatory environmental payments takes into account the interdependence of the negative impact on the natural environment and tax rates, which contributes to the efficiency of environmental taxation in general. And the significant variety of types of environmental taxes ensures the achievement of different effects of changing the state of the environment, which could be the basis for a new concept of environmental taxation in Ukraine.

The next EU country, which during the long period of its development demonstrates the development and implementation of effective environmental protection measures, is Sweden.

Thus, according to the statistics service of Sweden (Figure 1.21), it is clear that revenues from environmental payments as of 2020 decreased in comparison with the same figure in 2019.

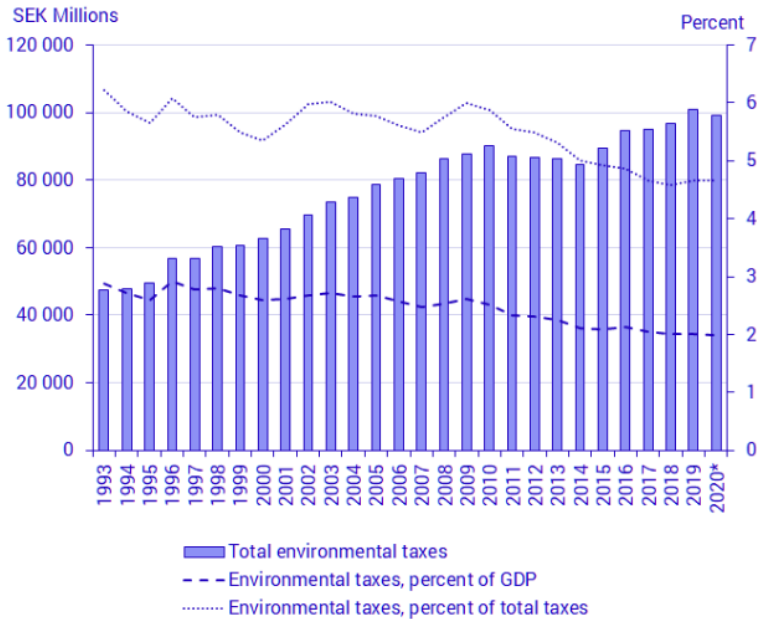


Figure 1.21. Environmental taxes, total, as a percentage of GDP, and as a percentage of total taxes 1993–2020

Source: Statistics Sweden

In value terms, this difference is close to 2 billion crowns. Although, the analysis of total environmental revenues for 1993 and 2020 shows that these revenues have doubled. However, if we compare the share of environmental tax revenues in GDP and the total sum of the sub-actual revenues, we can see that these indicators are increasing in dynamism from 1993 to 2020. This means that the sums accumulated from taxes on energy, transport, pollution, etc. are not increasing at the same rate as



other parts of the economy of Sweden and the total sums of tax revenues of the country.

It should also be noted that from the beginning of 2020 new types of taxes were introduced in the country (tax on burning waste and tax on plastic bags). Throughout the year, the functioning of such taxes, accumulated to the budget 0.2 billion crowns, while the tax on air transportation decreased as a result of the COVID-19 pandemic.

It was found that previously the energy tax has been the largest part in the total amount of environmental expenditures in the EU countries. Thus, Sweden is not an exception, as Figure 1.22 shows. As in Switzerland, environmental taxes in Sweden are divided into four types: energy tax, transport tax, pollution tax and natural resources tax. The share of the energy tax is close to 75% in the total amount of environmental revenues, while the transport tax accumulates about 22%.

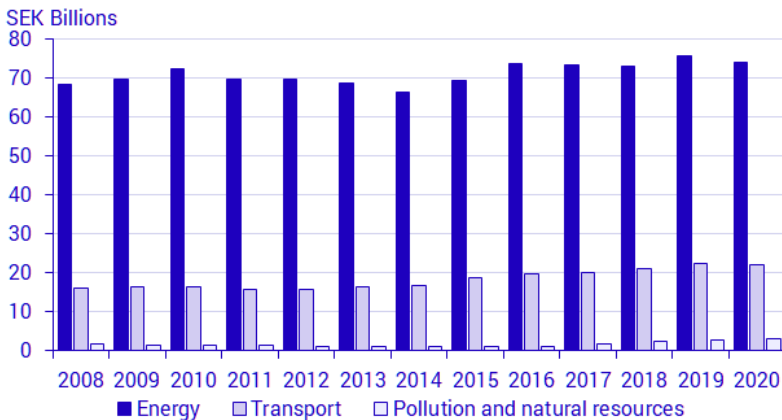


Figure 1.22. Environmental tax revenue by environmental taxation category, 2008-2020, SEK billions

Source: Statistics Sweden

Analyzing the dynamics of environmental revenues, there is no single trend of increasing or decreasing. The amounts of

energy taxes vary depending on the rates of the fuel tax, carbon dioxide gas tax, electric power tax, etc. The review of tax rates in the country takes place on a regular basis. Such fluctuations are also possible through the granting of certain permits for industrial enterprises, etc. The share of taxes on pollution and natural resources is insignificant and fluctuates within 1-3% depending on the year.

The next point that requires our attention is the main payers of environmental payments (Fig. 1.23). Thus, the payers of environmental taxes in Sweden are: households, business entities and the public sector. As of 2019, environmental revenues from households increased by 10%, and from the state sector by 2%, as compared to the same figure of the previous year. The share of business entities also increased by 6%. One of the factors of such an increase is the increase in income from the issuance of permits for whales (in value terms it is a difference of 0.9 billion crowns).

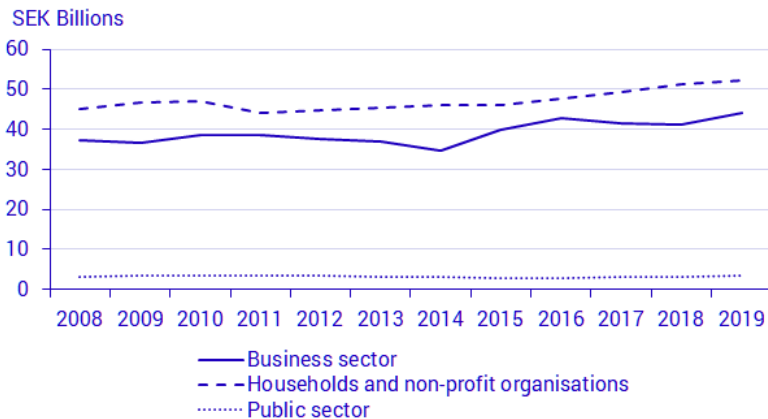


Figure 1.23. Environmental tax revenue, from households, business sector, and public sector, 2008-2019, SEK billions

Source: Statistics Sweden

Considering the fact that in Sweden the largest amount of taxes is generated by taxes on energy, coal and total greenhouse gas emissions, we consider it necessary to investigate those sectors that pay the highest taxes and also have the greatest impact on the natural environment in comparison with others. The results of such analysis are reflected in Figure 1.24.

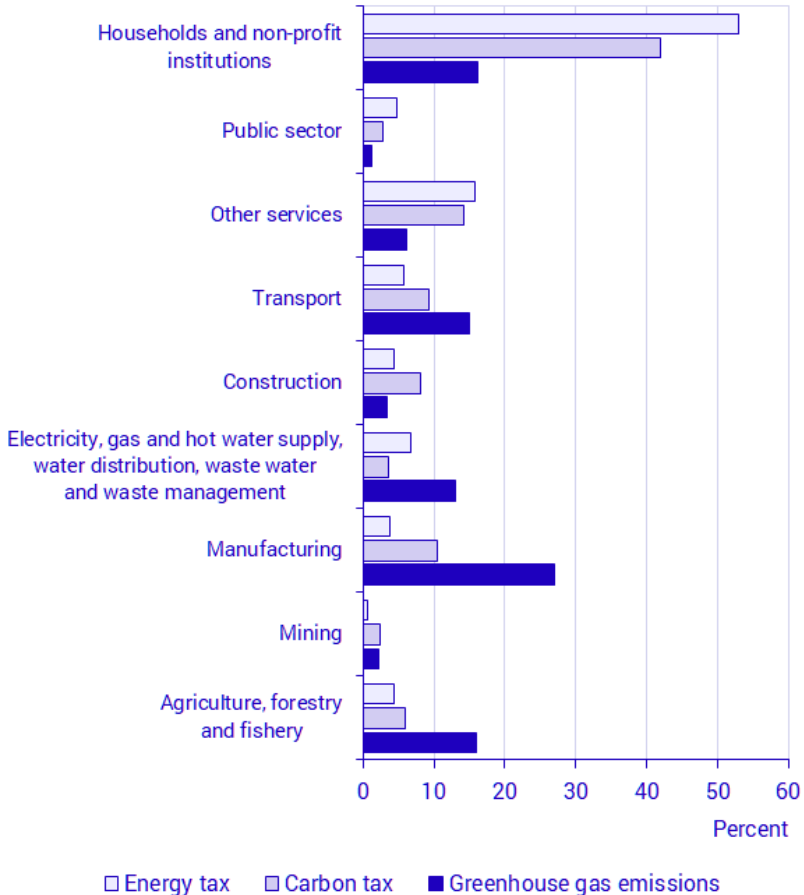


Figure 1.24. Energy, carbon tax, and total greenhouse gas emissions by industry (NACE rev. 2) in 2019, %  
 Source: Statistics Sweden

Thus, households in Sweden are those that pay the most tax on coal and energy, 42% and 53% respectively, as of 2019. Although in 2018 the number of households generated only 16% of such payments. As for the manufacturing sector, the number of environmental payments significantly decreased in 2019 as compared with 2018 due to taxes on energy, coal and greenhouse gases. Since 2019, the government of Sweden decided to exempt certain enterprises of the manufacturing sector from taxation. Other types of activities also act as polluters of natural environment, but their share of environmental revenues from energy taxes, The environmental payments from taxes on energy, coal and total greenhouse gas emissions are not as significant as in the domestic sector, the manufacturing sector and the agro-industrial complex.

Thus, the experience of environmental taxation in Sweden shows that environmental legislation is changing based on the level of development of economic sectors, the need for additional incentives for certain sectors of the economy, the level of pollution of docklands by their types, etc. Such a flexible system ensures that the budget is funded by environmental payments. In general, the environmental policy of Sweden differs from that of other EU countries, the system of environmentally responsible business is effectively implemented here, and at the legislative level is functioning on the observance of laws and regulations on waste sorting and recycling, and there are a lot of such examples of environmental activities in Sweden.

The next country studied is Finland, which is at the first place in the index of environmental indicators and has a rating of 90.68. The peculiarity of environmental activity of the country is that more than 38% of the energy is derived from renewable sources. Also, on the territory of Finland there are no industrial waste, this situation was the result of limiting the operation of

such coal-fired power plants, the ban on virgin forests, the total control over the burning of waste through the introduction of a ban on such activities. Also, the experience of Finland differs from others in its environmental achievements.

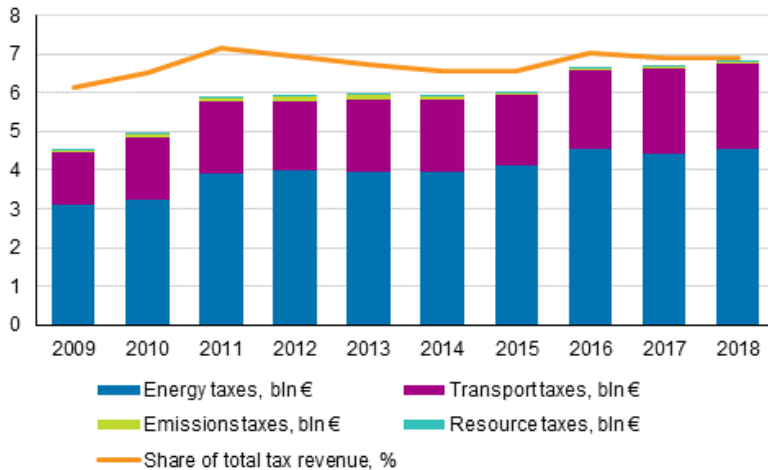


Figure 1.25. Environmental taxes by tax category and share of total tax revenue in 2009 to 2018

Source: Statistics Finland

Thus, the data shown in Figure 1.25 indicate that in the total amount of environmental expenditures the largest share is represented by payments for energy. In terms of dynamics, the amount of such payments varies between 3.2-4.6 billion euros. This is a result of the fact that the government of Finland has taken a decision that the taxation of energy in the country is the highest, compared to other EU countries, and the tax amounts are progressive. As for the tax on transport, the income from this type of tax is mostly stable. Although there are some fluctuations, but this is due to the introduction of electric transport vehicles. It should also be noted that in comparison

with other EU countries, the transport tax in wartime amounts to a maximum of 2.2 billion euros, while in Sweden this tax is close to 12 billion euros. This situation is caused by the fact that the population of Finland is very small, and most people prefer bicycles to vehicles, which is why one of the costly budget items in this country is the construction of bicycle paths.

Other types of taxes indicated in the figure are not significant, because in Finland the use of agricultural waste, biomass and biogas has increased, construction of new hydroelectric power plants has been increased, bioenergy in forests is used, forest residues are used, heat pumps are installed, etc.

The analysis showed that environmental taxation is one of the most effective tools of environmental policy, the purposeful use of which leads to the functioning of environmental protection measures, which increase the level of innovative technologies and induce the polluters to use more environmentally friendly production methods. Such a detailed analysis of peculiarities of environmental taxation can become a stimulus for the development of effective Green Reform in Ukraine for the expansion of environmentally friendly use of nature.

### **1.3 Ukrainian experience of collecting environmental taxes**

In recent years, issues of sustainable development and environmental protection have been central among the problems of national development of Ukraine's economy due to the growing level of air and water pollution, lack of effective waste management practices and more. There are different types of tools for achieving the goals of environmental protection and sustainable development. At the same time, despite the wide list of these instruments, international experience shows the greatest effectiveness of economic instruments. Environmental taxes are becoming increasingly important among economic instruments

due to their high effectiveness in achieving economic and environmental policy goals. The spread of environmental taxes at the state level reflects the level of income they provide. There are many environmental barriers and counterarguments about the need to reform this type of tax, set higher rates or change the object of taxation, and therefore becomes relevant to study the evolution of environmental tax to determine the strengths and weaknesses of its effectiveness in Ukraine.

Ukraine ratified the Kyoto Protocol in 2004, and the government has committed itself not to exceed the 1990 greenhouse gas emissions for 2008-2012 (Mandryk, 2016). However, since 2000, total greenhouse gas emissions have been steadily increasing. Therefore, the government has introduced mandatory environmental taxation. It is important that the problem of greening and determining the responsibility for violating regulations that occurs in today's Ukraine did not arise in the early XX century but began in the days of Kievan Rus and modernized under the influence of different countries, as shown in Figure 1.26.

According to Figure 1.26, the system of environmental taxation began to function on the territory of modern Ukraine in the times of the Kievan Rus. The current tax system differed by the fact that the payers of the ecological tax were men (heads of families), and their children and wives did not pay it. If the wife was engaged in activities that required taxation according to Russian Pravda, the husband had to pay the financial obligation for her, and in case of nonpayment the head of the family was liable to the law. The current ecological tax was paid for fishing and slaughtering animals, thus the state tried to control the level of fish and animals on their territory.

Taxes at that time were high and only the villagers and townspeople paid them. Thus, the period of the Kiev Rus had a high tax pressure on the population, and the taxation (including ecological) was a primitive and harsh nature.

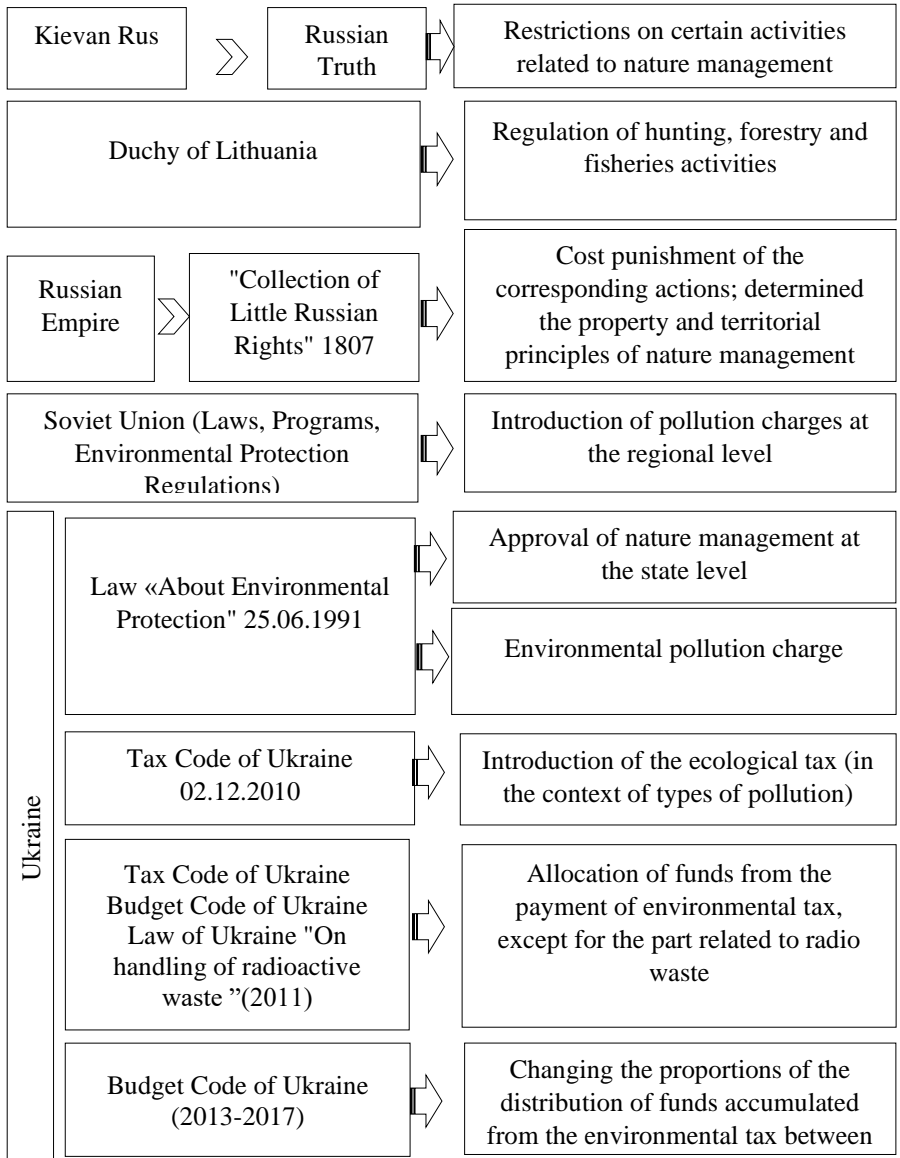


Figure 1.26. Evolution of environmental taxation in Ukraine

Source: Created by the authors on the basis of [62, 96]



The next historical period in which ecological taxation functioned is the Duchy of Lithuania. Thus, at that time taxation was carried out in cash and in kind, and the objects of taxation were activities related to farming, forestry and fish farming. In the times of the Kievan Rus, taxpayers were only villagers, which contributed to the emergence of tax chaos, because for the nobility there were shares. This situation influenced the increased migration of villagers to free land.

The next stage in the development of environmental taxation was the period of the Russian Empire. However, before that time the system of taxation also existed, but the sphere of environmental protection was not reflected in any legal act. During the Russian Empire several changes took place in the tax system, which had a corresponding impact on environmental taxation, among the main ones (Kanonishena-Kovalenko, 2017):

- legislative formalization of the taxation system;
- functioning of a large number of taxes with a constant introduction of new ones;
- the in-kind form of payment for taxes.

These changes had an indirect effect on the environmental taxation, because the variety of taxes increased. For example, the ecological tax was paid for such activities as: pollution of rivers and soil. Also, the current legislation defined natural resources and territorial resources of environmental management, and problems with the natural environment were solved by prohibiting certain types of activities and fines for violation of the legal requirements.

Analyzing the next stage, it is worth to mention that in 1917 the Decree "About the Land" was adopted, which became the fundamental document that regulated the essential nationalization of land together with natural resources (Goncharenko, 2021). During this period, the state acts as a mediator between the natural environment and economic entities. Also at the beginning of the twentieth century there was

an attempt to introduce a fee for pollution, in particular for the discharge of untreated wastewater into water bodies. Since such a fee was imposed on enterprises owned by the state, the functioning of this type of environmental tax was unreasonable, since the state acted as a taxpayer of such a fee. Already in the middle of the XX century, after the adoption of the Law on the Protection of Nature, the protection of the natural environment is becoming more and more important, both among the government and the public in general. Thus, some fifty legislative documents were developed and adopted to regulate the specifics of tax collection and regulate environmental protection. The next important issue in the development of environmental taxation in the period of the Soviet Union was the adoption of the Resolution of the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR "About enhancing the protection of nature and improving the use of natural resources". Such normative document became the beginning of consideration of the problem of rational environmental management and the search for new technological processes, the implementation of which is likely to reduce the level of impact on the natural environment. Adoption of such a document seemed to have little positive impact on the environment, but such a document has become only a tool, which was not supported by any mechanisms that could improve the environmental situation. Thus, the Soviet period was marked by several adopted laws, decrees and decisions in the field of environmental protection, but they did not provide an opportunity to strengthen the protection of the natural environment.

Since the independence of Ukraine, there has been a significant demand for the implementation of mechanisms for the protection of the environment. Thus in 1991 the Law of Ukraine "About the protection of the natural environment" was adopted. During the following year the law received some

comments and recommendations from the scientists and a resolution was passed that determined: peculiarities of the collection of environmental taxes at the national level, tax rates, types of fees for pollution of water bodies (discharges into the atmosphere, discounts to water bodies, placement of waste). Adoption of the Decree of the Cabinet of Ministers "About approval of the Procedure for determining payment and collection of payments for pollution of natural environment", First time in history, the basic limits of emissions and discounts of polluting substances were determined according to which the coefficients and norms of environmental charges were determined.

The final stage in the establishment of the environmental tax on the territory of current Ukraine was the adoption of the Tax Code of Ukraine in 2010. It accumulated information about types of taxes, mandatory payers of ecological tax, taxation bases, system of limits, correlation coefficients, peculiarities of calculation and payment. The main features of the management of environmental tax, which are specified in the Tax Code, is shown in Figure 1.27.

According to the figure, it is seen that the information presented in the designated regulatory document fully reflects the essence of environmental tax and features of its collection from the subjects of economic activity.

Typically, since the adoption of the Tax Code, the environmental tax was covered in several regulations. Most of these innovations concerned the distribution of environmental tax between budgets. Today, according to the Budget Code of Ukraine, the environmental tax is distributed in the ratio of 45% and 55% (Nikola & Gusev, 2020). The 45% of the tax falls on the General Fund of the State Budget (apart from the tax on the disposal of double carbon and the tax on the establishment and temporary storage of radioactive waste), and 55% of environmental tax revenues belong to the local budget fund

(apart from the tax on dioxide emissions and the tax on the establishment and temporary storage of radioactive waste). Other taxes are paid and used at the place of actual residence of the taxpayer.

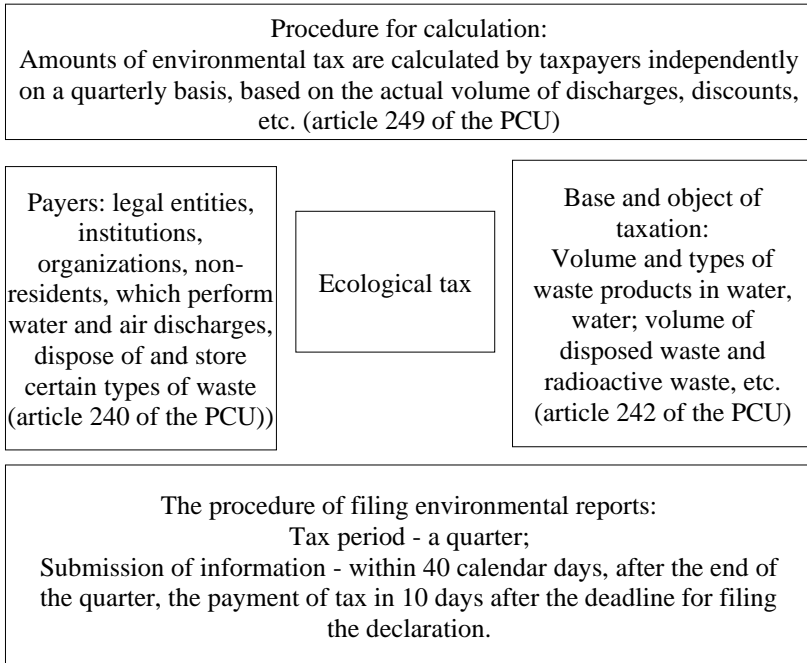


Figure 1.27. Peculiarities of environmental taxation in accordance with the Tax Code of Ukraine

Source: created by the authors on the basis of the Tax Code of Ukraine

As for the rates of environmental tax, the specified regulatory document has a separate article for each type of pollution, as follows:

- tax rates for emissions of pollutants into the atmosphere by stationary sources of pollution - specified in Article 243 of the PCU;

- tax rates for discharges of pollutants to water bodies - specified in article 245 of the TCU;
- tax rates for the placement of waste in specially designated areas or objects - specified in article 246 of the TCU;
- tax rates for the establishment of radioactive waste (including those already accumulated) - as specified in article 247 of the TCU;
- tax rates for hourly storage of radioactive waste by their producers over the period established by special conditions of the license - specified in article 248 of the TCU.

It should also be noted that the rates of environmental tax are increasing all the time. However, such an increase is the result of not analyzing the value of the damage caused to the environment, in practice, it depends on macro indicators, in particular the index of sales prices.







Since the domestic environmental situation requires negative efforts to improve the quality of atmospheric air, rivers and lakes, the Azov and Black Seas, reducing the amount of all types of waste, the environmental taxation is the key tool for the transition to environmental sustainability of Ukraine as a whole, which in the future will contribute to the development.






Thus, we investigated the environmental situation in each region of Ukraine in 2019 (Table 1.3).

According to the table, the most environmentally friendly areas are Chernivtsi, Zhytomyr, Zakarpattia, Volyn and Rivne regions, which are included in the top five of the Eco-Rating. In these regions, the discharge of polluting substances into the atmospheric air is decreasing, as well as the number of created and disseminated wastes and the volume of discharges of polluted wastewater, which influenced the reduction of the number of diseases in the regions. At the initiative of the community of Chernivtsi region in 2019 began the implementation of the plan for the renewal of the forest. For example, during the year, nearly a thousand trees were planted,

while the planned planting figures amount to ten thousand plants.

Table 1.3 - Level of environmental pollution in Ukraine (by region) in 2019

Region	Rating						
Chernivtsi	1	0,3 ↓	-4,0 ↓	12,3 ↓	39,3 ↓	123,5 ↓	2,5 ↓
Zhytomyr	2	0,1 ↓	16,5 ↓	40,2 ↓	15,9 ↓	67,0 ↓	3,1 ↓
Transcarpathian	3	0,3 ↓	-5,1 ↓	54,7 ↓	11,9 ↓	235,2 ↓	2,5 ↓
Volyn	4	0,3 ↓	23,2 ↓	44,6 ↓	33,1 ↓	23,4 ↓	3,0 ↓
Evenly	5	0,5 ↓	-14,6 ↓	34,9 ↓	25,9 ↓	249,3 ↓	2,7 ↓
Khmelnysky	6	1,0 ↓	18,7 ↓	67,8 ↓	43,6 ↓	48,4 ↓	3,8 ↑
Luhansk	7	1,3 ↓	-81,0 ○	217,3 ↓	16,6 ↓	599,6 ↓	2,0 ↓
Kyiv	8	3,0 ↓	-12,2 ↓	67,5 ↓	50,2 ↓	71,1 ↓	3,6 ○
Chernihiv	9	0,9 ↓	-34,5 ○	21,9 ↓	21,8 ↓	438,8 ↓	4,1 ↑
Vinnysia	10	3,7 ↓	-19,9 ↓	37,7 ↓	102,2 ↓	37,7 ↓	3,7 ↑
Cherkasy	11	2,5 ↓	-22,3 ↓	38,7 ↓	60,2 ↓	143,4 ↓	4,0 ↑
Odessa	12	0,9 ↓	42,6 ↓	6,0 ↓	19,1 ↓	1080,6 ↓	2,9 ↓
Kherson	13	0,6 ↓	147,2 ↓	748,3 ↓	13,2 ↓	35,1 ↓	4,2 ↑
Kirovograd	14	0,5 ↓	8,4 ↓	150,4 ↓	1521,4 ↑	122 ↓	4,7 ↑
Ternopil	15	0,7 ↓	14,63 ↓	933,2 ↓	76,8 ↓	144,6 ↓	3,3 ↓
Mykolayivska	16	0,5 ↓	-23,9 ↓	764,2 ↓	94,6 ↓	813,5 ↓	3,9 ↑
Lviv	17	4,0 ○	-11,2 ↓	187,7 ↓	93,7 ↓	2061,2 ↓	3,5 ↓
Ivano-Frankivsk	18	14,7 ↑	-10,4 ↓	417,2 ↓	215,2 ↓	71,8 ↓	3,0 ↓
Sumy	19	0,9 ↓	-19,6 ↓	5857,1 ↓	36,2 ↓	881,1 ↓	4,2 ↑
Poltava	20	1,8 ↓	-18,9 ↓	2779,3 ↓	3389,5 ↑	69,5 ↓	3,9 ↑
Kharkiv	21	3,3 ↓	-29,2 ↓	1575,6 ↓	55,7 ↓	477,4 ↓	3,8 ↑
Zaporozhye	22	6,3 ↑	-16,1 ↓	603,3 ↓	198,7 ↓	404,6 ↓	3,7 ↑
Donetsk	23	29,1 ↑	-25,8 ↓	5554,9 ↓	995,8 ↑	1697,0 ↓	2,6 ↓
Dnepropetrovsk	24	18,1 ↑	-32,5 ↓	999,5 ↓	7903,5 ↑	6265,0 ↓	3,8 ↑
m. Kyiv	25	26,6 ↑	-29,0 ↓	5502,3 ↓	1195,0 ↑	343301 ↓	4,0 ↑

Note:  - emissions of pollutants into the atmosphere (2019);  - Increase / decrease in pollutant emissions into the atmosphere (2014); - creation of hazardous waste of I-III hazard classes;  - waste generation in general (I-IV hazard classes);  - volumes of wastewater discharges;  - incidence of malignant neoplasms.

Source: Baturyn & Bondar, 2021

In the same year, the number of business entities decreased by 228 registered persons who had permits to release pollutants into the atmosphere.

As for the Zakarpattia region, there are problems with the protection of forests from viruses, as the forests are an important part of the ecosystem, while for the residents of the region, the forests act as a commodity for sale or as a material for the heating of residential buildings. The protected area of the region does not allow deforestation, and for violation of legislative requirements the subject of management can be brought to criminal or administrative responsibility.

Particular attention should also be paid to the Odessa region, the human negligence most affected the seashore, as the flow of petroleum products is spreading. Not bad is the condition of waters, which suffer as a result of pouring into them sewage, which affects the release of toxins, which are not safe for society.

Ternopil region is very ecologically safe, because there are no large industrial enterprises in this region, but the unauthorized fishing remains open, due to bureaucratic processes it is impossible to bring poaching, as the number of fish in the waters of the region decreases. Illegal logging of forests also remains an open issue of the day order.

The Lviv region occupies the 16th position in the ranking, and the main problem of the region is the fight against debris. Thus, the problem of Lviv waste has become known to residents of all regions of Ukraine, as waste was transported to the north and south of the country. Today, the problem of landfills is gradually being solved. Thus, one of the most dangerous waste dumps in the region will be reclaimed by 2025.

Among the regions that are the least environmentally friendly are the Kharkiv, Zaporizhzhia, Donetsk, Dnipropetrovsk regions and Kyiv. This situation is a consequence of the fact that the eastern-northern regions are among the most highly enslaved areas of Ukraine. These areas have the highest concentration

level of industrial production, including coal, chemical, petrochemical, petrochemical, ferrous metallurgy and machine-building.

The main problem of the Kharkiv region is industrial discharges, as the territory of the region has a coke plant and other plants that have a significant impact on the environment. And dioxin and hydrocyanic acid discharges by such plants are more than the norm, which endangers the health of people who are in the order.

Dnipropetrovsk region is characterized by such environmental problems as: lack of treatment facilities and quality of atmospheric air. These problems arose as a result of the functioning on the territory of the region of industrial giants.

Particular attention should be paid to the Sumy region, which is the leader in the intensive creation and accumulation of waste, including hazardous waste. According to the data of interactive data of landfills and the State Ecological Inspection in the Sumy region as of 2021 there are 19 landfills of solid domestic waste, most of them do not meet the sanitary and technical standards and, in fact, are landfills, and about 178 waste dumps, it should be noted that this figure does not include the number of accidental waste dumps.

The largest part of the Ukrainian waste is spent on the landfills, especially being buried, and in turn, increases the risk of impact on the natural environment and disrupts the functioning of the ecosystem. Also, exhaust gas emissions have a negative impact on climate change. If we continue using outdated methods of combating waste, it will eventually lead to serious environmental consequences that are not safe for the life and health of the population.

Taking into consideration the fact that all the listed taxes, discounts, waste, etc. are an inseparable part of the process of consumption and functioning, the policy of the government should be focused not only on preventing their creation, but on



ensuring the most efficient and safe system of their management. As noted, one of the effective mechanisms of saving the environment is ecological taxes. Under ideal conditions, such taxes have several advantages, including the following:

- internalization of negative external effects;
- use of alternative sources of energy;
- creation of eco-innovative business;
- increase of budget revenues and corresponding increase in environmental projects;
- protection of the natural environment through the purposeful use of revenues;
- dissemination of environmental behavior of the population.

Toto, environmental taxes have a goal, not only correct the external effects, but they also bring income, which can be used to achieve the goals of sustainable development. So, to analyze the structure of environmental tax and study the share of each of it's types in the overall structure of environmental revenues, the reporting of the State Treasury Service of Ukraine in dynamics for 2019-2020 years was analyzed, the relevant data is presented in Figure 1.28.

The data presented in the figure show that the largest share in the total amount of environmental revenues to the budget are payments for discharges of pollutants into the atmosphere by stationary sources of pollution and for disposal of wastes in specially designated areas. Thus, environmental charges for air pollution in 2020 increased by 12.7%, while the amount of environmental charges for waste disposal increased by 1.4%.

In general, all structural elements of the environmental tax have been increasing environmental charges for a long time. Regarding such type of environmental tax as a tax for the generation of radioactive waste, it is more stable in comparison, for example, with the tax for the importation of vehicles to the customs territory of Ukraine, because it increased by 1.2% for

the analyzed periods, while the other tax in 2020 decreased by almost 15% compared to 2019.

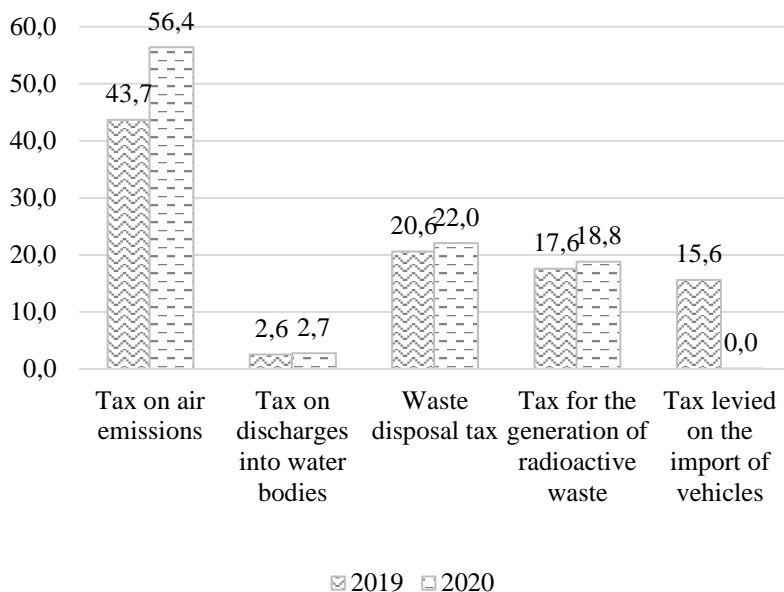


Figure 1.28. Structure of the environmental tax and it`s share in the total amount of environmental revenues in 2019-2020

Source: Created by the author on the basis of data from the State Treasury Service of Ukraine

This situation was caused by an increase in demand for imported cars. This was caused by limited financial capacity of Ukrainians and availability of a car from Lithuania, Poland or other countries.

The remaining analyzed environmental tax, which for the entire history of independent Ukraine remains at the lowest level compared to other environmental taxes, is the tax on discharges into water bodies. Thus, the amount of income from this tax is the lowest, one of the reasons for this, we believe, is the lack of

control over the subjects of state management, activities related to water resources, or those enterprises that are located near water bodies and are likely to use these resources illegally. Another problem, which concerns not only water bodies, but all kinds of resources, is the lack of measuring tools for the size of the assigned school of ecology.

In general, there is a tendency to increase tax payments, the reason for which is an increase in tax rates, as well as the deterioration of the environmental situation in the country. The largest share in the structure of the ecological tax is income from tax on air emissions, which is constantly increasing, and the smallest part - income from tax on discharges into water bodies. Therefore, we believe it is necessary to analyze the dynamics of environmental taxes in GDP for the period of 2017-2020 (Fig. 1.29).

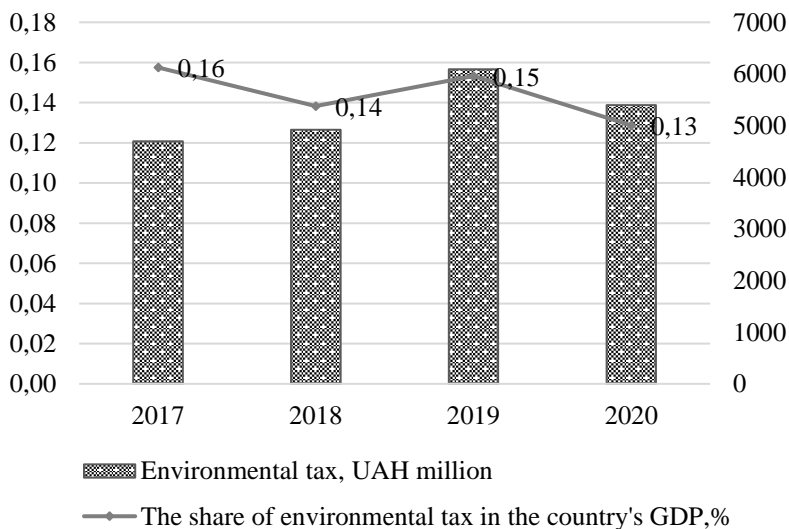


Figure 1.29. Dynamics of the share of revenues from environmental taxes in GDP 2017 - 2020.

Source: Created by the author on the basis of data from the State Treasury Service of Ukraine

Throughout the analyzed period, the share of environmental payments in GDP is characterized by instability, and in 2017-2019 the share of charges for environmental pollution in GDP fluctuates between 0.14 and 0.16%. And in 2020 there will be a significant decrease in environmental costs and, accordingly, their share in the country's GDP will decrease.

If we analyze each year separately, the actual environmental expenditures exceed the planned ones. On the one hand, this is a positive factor, because the accumulated funds are used to repay external debts or cover deficit budget items, but on the environmental side it means that the natural environment is subjected to excessive pressure from economic entities. Such pressure is not foreseen, and therefore existing environmental measures are not able to renew natural resources, atmospheric air and water.

It should also be noted that only in 2020 the actual figures did not exceed the plans. Thus, the budget did not receive certain environmental benefits. This situation, we believe, was the result of the COVID-19 pandemic, which disrupted the work of many domestic enterprises, institutions and organizations. Of course, the consequences of the pandemic are not significant, but during this period the environment was able to renew its resources.

Ecologists noted that during this period there were significant changes in the ecosystem. Thus, the research showed that in 2019-2021 the amount of greenhouse gas emissions decreased, the quality of water in lakes, rivers, seas and oceans improved, the level of noise pollution decreased and the quality of atmospheric air improved.

Turning back to the share of environmental revenues in the GDP of the country it should be noted that the mandatory environmental payment is far from being a budgetary tax and its share fluctuates within 0.2% of GDP for the last ten years. We believe that apart from external factors that have influenced the decrease in environmental costs, there are also attempts to avoid

paying the environmental tax, this has a negative impact not only on the reduction of the revenue part of the budget of the country, but also on the state of the natural environment and the level of health of the citizens.

Environmental taxes are divided between the state and local budgets, according to the proportions specified by the TCU, where the state budget accounts for 55% and the local one for 45%. Thus, it is necessary to analyze the dynamics of environmental revenues in the total amount of budget revenues and in the total amount of tax revenues. This will also allow us to investigate whether the environmental tax fulfills its fiscal function. To begin with we will analyze the environmental tax in the designated parts of the budget (Fig. 1.30).

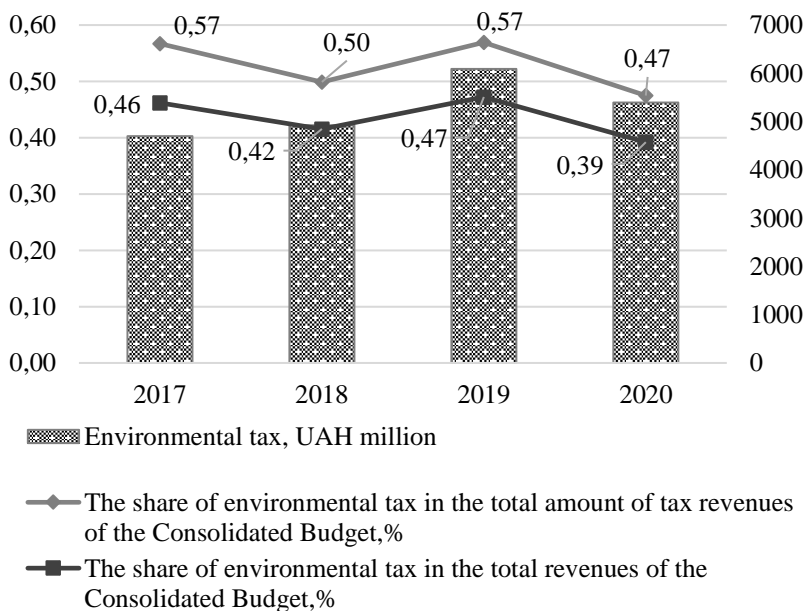


Figure 1.30. The share of environmental taxes in the total amount of income and tax revenues of the Consolidated Budget, 2017-2020

Source: Created by the author according to the data of the State Treasury Service of Ukraine

Thus, the presented results indicate that there is a tendency to increase the amount of environmental tax both in the total amount of tax revenues and in the total amount of revenues of the State Budget. In 2019 the amount of environmental payments amounted to 6092.57 million UAH, which proportionally influenced the increase of the share of environmental tax in the total amount of tax revenues and in the amount of environmental revenues by 0.07% and 0.05% respectively, compared to the same indicators of the previous year. It should be noted that the information from the shows that the environmental funds are used to cover the debt for social payments, but not for environmental security of the state. In terms of the local budget, the situation with environmental expenditures and its share in the total and tax revenues is not very problematic, as shown in Figure 1.31.

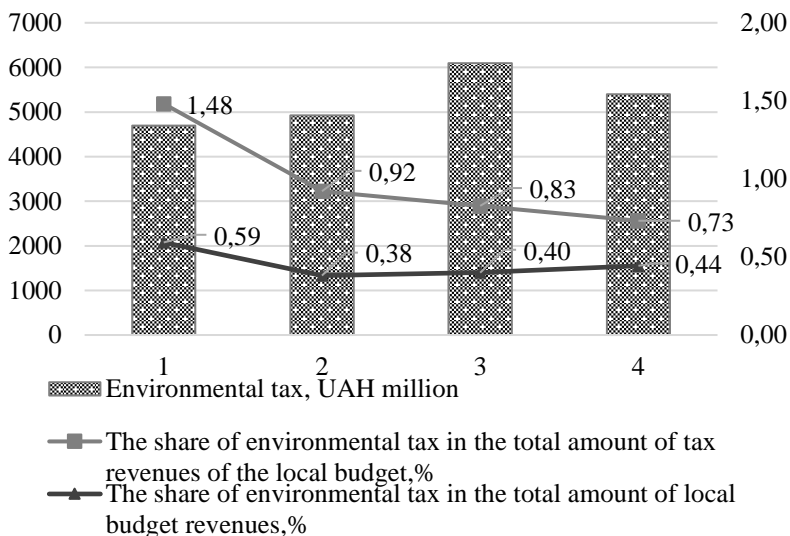


Figure 1.31. The share of environmental taxes in the total amount of tax revenues and revenues of the local budget, for 2017-2020 years

Source: Created by the author according to the data of the State Treasury Service of Ukraine

So, the amounts of environmental revenues were at their highest level in 2019 and reached the level of 6092.57 million UAH, which is by 1171.07 million UAH less than the analogous indicator of 2018, and by 1394.13 million UAH in 2017. Although, the share of environmental tax in the total amount of revenues of the local budget in 2017 was 1.48%, and in three years has decreased by more than twice. One of the reasons for such a decrease may be that environmental revenues do not increase in proportion to the total revenues of the local budget. Also, this could be the result of the closure of large enterprises, which paid environmental tax and got bankrupted as a result of the pandemic. It should also be noted that only 2019 plans were over fulfilled by 4.2% of the Consolidated Budget, The situation with the non-compliance of the planned estimates of the government with the actual results of tax payments by entities of the state for the incurred damage to the income is observed for the same period.

Thus, the analysis of the domestic experience of ecological taxation confirmed the fact that on the territory of present-day Ukraine ecological taxes (in various manifestations and types) functioned since the times of Kiev Rus. Of course, at that time their necessity consisted in controlling fishery, fishing, fishing (in quantitative terms), deforestation, which were carried out by villagers and townspeople, for the subsidization of their work. Only now the environmental taxation has become widespread due to the understanding of the approaching environmental catastrophe, as a result of the excessive anthropogenic impact on the natural environment. This was the reason for the development and implementation of a single regulatory document, which regulates the specifics of payment of environmental tax by domestic enterprises, institutions and organizations according to the amount of damage caused to the environment. Adoption of the Tax Code in 2010 contributed to the definition of types of pollution in the air, water bodies,

wastes, radioactive wastes, etc. The work also presented the rates of environmental tax, and it was found that the rates are increasing every year, considering macroeconomic indicators of activity of the country. But the number of environmental protection measures to protect the environment has not increased, as evidenced by the results of the statistical study of the pollution of 24 regions of Ukraine and the city of Kiev separately. According to it, only Chernivtsi, Zhytomyr, Zakarpattia, Volyn and Rivne regions are ecologically safe for living.

Therefore, the ecological situation in Ukraine is not very favorable and it is impossible to effectively influence the level of pollution of the natural environment under the conditions when the environmental subsidy performs only the fiscal function. Potential directions for the use of environmental revenues can be: creation of new resource-conserving and ecological technologies; development and production of high efficiency and resource-conserving machines and equipment; creation of powerful environmental protection facilities and devices; development and production of advanced technical methods and devices for environment control; re-equipment of environment control systems and development of environmental monitoring system; implementation of measures to ensure recycling of wastes; implementation of local social and environmental programs; subsidies to companies to reduce the resource intensity of production; implementation new standards of product quality, which will allow to increase the level of exports of the country to improve its position on the world market.



## **2. ENVIRONMENTAL REPORTING AND AUDIT: RELATIONSHIP WITH ENVIRONMENTAL TAXES**

### **2.1 Features of the ecological audit**

Today, the world is struggling with the degradation of the environment, where, without doubt, business entities are intensely involved in the problem. Due to the increasing importance of environmental protection, the business entities that operate in it must pay attention to the environmental aspect of their activities. Accounting plays a fundamental role in obtaining and transmitting reliable information, which shows the impact of the functioning of economic entities on the economic environment, and at the same time is focused on environmental management of the company.

Environmental aspects of the company's activities increasingly correlate with the main goals of doing business, such as maximizing profits or maintaining financial liquidity. The combination of these areas makes it possible to achieve a higher level of efficiency in the long term. Environmental protection can have a positive impact on economic results, by reducing costs associated with production, for example, the use of energy, power, materials, which in turn has a significant impact on the profitability of the company. However, between these two categories there may also be a negative correlation, which occurs when the activity of the subject of management is reduced as a result of stringent government regulations, which interfere with the negative impact of the company on the environment. The latter possibility lies in the lack of a link between economic and environmental goals, i.e. neutrality of the goals. In this case, the environmental protection becomes only an instrumental element, directed to the creation of financial effects outside the enterprise.







creation and presentation of which contributes not only to the development of the environment, but also has a significant impact on reducing the incidence of disease in men, women and children.

According to the blue cluster, it consists of 114 key words, but the main attention is focused on the following: animal, water pollution, non-human, environmental monitoring, river, fish, risk assessment, ecotoxicology, environmental pollutants. These research, in our opinion, were focused on the intensive anthropogenic impact that harmed nature and biodiversity. In particular, environmental reporting can act as one of the mechanisms implementations of which in the activity of each entity of business activity, in the future prospect, positively influence the renewal of the natural environment as a whole. The results of the research are shown in Figure 2.4.

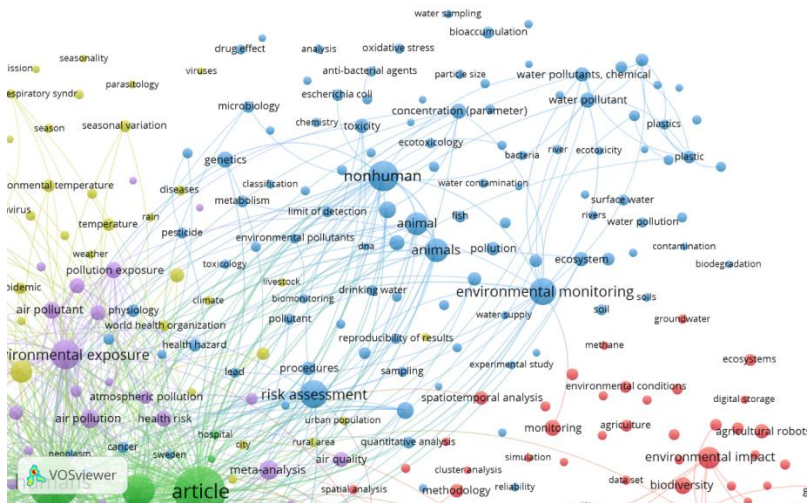


Figure 2.4. Results of bibliometric analysis of keywords co-occurrence on the request «environmental reporting» (blue cluster)

Source: VOSviewer 1.6.1 results

Another cluster (yellow) has 63 key words, including: epidemic, covid-19, pandemic, disease transmission, and coronavirus. This topic was developed as a result of the COVID-19 pandemic, which occurred in 2019. Thus, environmental reporting could function as a tool for measuring the reduction of environmental damage as a result of the global pandemic. After all, it was found that due to the total closure of industrial enterprises, which influenced the reduction of discharges of pollutants into the atmosphere and water bodies, the environmental situation has significantly improved.

During the two years of the epidemic, viruses in forests decreased, the ecosystem was balanced, and biodiversity has gradually resumed as compared to 2017. The results of the research are shown in Figure 2.5.

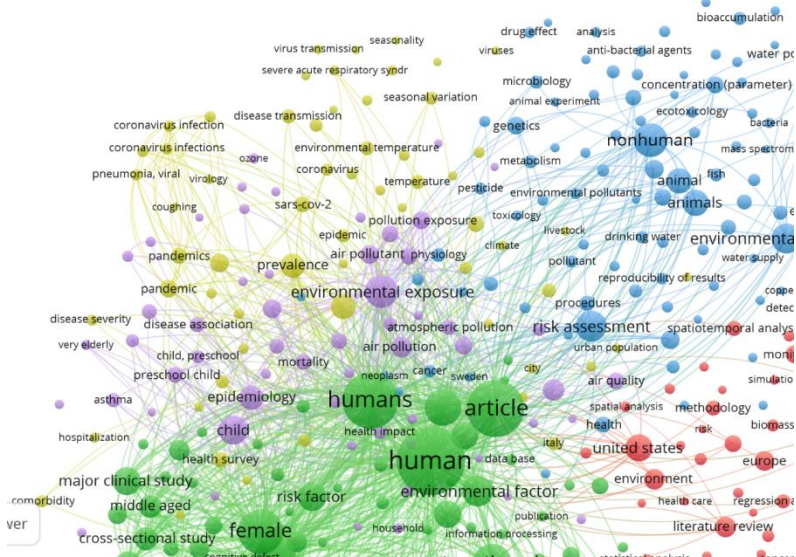


Figure 2.5. Results of bibliometric analysis of keywords co-occurrence on the request «environmental reporting» (yellow cluster)

Source: VOSviewer 1.6.1 results











among men and women. These studies show that the biggest problems are faced by the governments of all countries because the entire planet suffers as a result of an unquantified anthropogenic impact, and environmental reporting, in turn, can act as an effective mechanism of the obligation to hold all entities of the economy accountable for their activities.

Generally, business entities carrying out their activities on the territory of the European Union must comply with certain obligations, among the main ones: Comply with the conditions of the protection of natural resources; provide reliable and comprehensive information about the environment and its protection; have a permit for the release of certain substances into the environment or for the use of energy, use the best available production technologies; To give a permit for environmental audits and inspections; to pay environmental taxes and fees; to provide renewal (in particular, secondary processing of packaging and waste after use); to prevent the creation of waste or reduce their quantity, etc.

Compliance with the above requirements leads to the need for the functioning of environmental accounting, which is functioning in the enterprises, to receive complete and reliable information about the impact of activities on the natural environment and the results of their activities in the field of environmental protection. Introduction of environmental accounting into the accounting systems of modern companies is specified by the EU Directive. Thus, business entities are required to comply with interim environmental standards applicable to their products and production process.

In the opinion of foreign scientists, environmental accounting is a part of accounting that deals with environmental costs that arise as a result of past events, and is aimed at reducing these costs. This reduction should be ensured by a system of continuous collection of information about environmental

aspects of the functioning of enterprises, aimed at identifying, measuring, analyzing and interpreting this information.

It should be noted that the approaches of scientists concerning the interpretation of the essence of the concept of "environmental audit" have a common context, but some of them focus on specific words, as shown in Table 2.1.

Table 2.1. Approaches of scientists to the interpretation of the concept of "environmental accounting"

Author	Approach to the interpretation of the concept of "environmental accounting"
Voronovska (2011)	Environmental accounting functions on the basis of management and financial accounting methods in order to provide external information to interested parties about environmental aspects of the company's activities for the reporting period
Kirsanova et al. (2004)	System of detection, measurement, registration, volume, aggregation, storage, processing and preparation of relevant information about the activities of the company in the environmental sector for the transfer of its internal and external stakeholders to make optimal decisions
Kozhukhova (2012)	Independent branch of accounting, which activates practical environmental protection activities and provides information support for environmental controlling
Shmygal (2018)	Environmental accounting consists of accounting of environmental costs and accounting of environmental revenues incurred/received as a result of environmental activities
Murueva (2007)	A separate area of accounting of the economic entity, which provides accounting with appropriate environmental information and is not systematic in nature.
Chhutiashvili (2011)	The process of reflecting environmental costs and obligations of the organization in the accounting system, as well as the social and environmental and economic results of the activities of economic entities for business management and achievement of optimal environmental and economic marketplace for goods and services.

Looking at the approaches of scientists to the interpretation of the concept of "environmental accounting", it should be noted that it is part of the accounting system of the subject of management. The main objectives are firstly, to provide reliable and accurate information about the environmental activities of the company and its compliance with normatively defined standards; Secondly, the formulation and presentation of recommendations for the reorganization of environmental management, environmental control, etc., as well as improving the efficiency of environmental protection measures that are carried out by the company.

Thus, the environmental objectives set for the company must meet several functions, the analysis of which is presented in Figure 2.9.

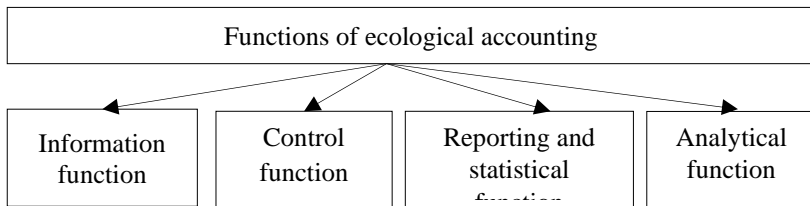


Figure 2.9. The main functions of environmental accounting  
Source: Murueva (2007)

The specificity of the informational function consists of providing environmental information by various divisions of the company, which is necessary to assess the impact of its activities on the natural environment, as well as the information that is necessary for all interested parties. The function of control is reflected in the provision of useful information, which allows the rational management of natural resources, prevents the creation of excessive amounts of waste, as well as controls the negative impact of enterprises on the environment. In addition, as part of the control function, the environmental accounting provides information that allows us to identify the compliance

of the registered phenomena with environmental standards, as well as to identify the damage to the environment, which does not meet these standards.

The informative and statistical function is performed by providing information on the company's impact on the natural environment and the effectiveness of measures taken for its protection, which is necessary to prepare reports in accordance with the legislative norms in the field of environmental protection. When the analytical function is expressed by the provision of quantitative environmental data, which are used to assess the impact of activities of the subject of management on the natural environment, determining the efficiency of resource use as well as determining the level of costs incurred in implementing environmental projects and making decisions that allow achieving environmental objectives. It should be noted that the environmental accounting also plays a stimulating role, as the environmental information provided by it stimulates and encourages the subject of economic activity to initiatives, aimed at limiting its negative impact on the natural environment and increasing the efficiency of use of natural resources.

It should be noted that the concept of environmental costs is indirectly related to environmental accounting. In the literature on this subject, they are defined as the total consumption of material resources, labor and external services, expressed in monetary terms, result of which is the maintenance or renewal of the natural balance, as well as functioning of the subject of management in a certain environment in accordance with the current legal order and the conditions of the market economy. One researcher identifies two main categories of environmental costs (Karlin, 2018):

- costs of environmental protection (including capital expenditures and flow costs) - characterized by the consumption of resources expressed in units of money to achieve the planned effects in the field of environmental protection (costs for the

creation and maintenance of environmental information systems; Registration and certification of environmental management systems; research and development in the field of environmental protection; neutralization of contamination and prevention of its creation, etc.);

- costs for the work of the division in a particular environment
- is characterized by the cost of resources to be used and implemented in support of the process of dock protection before its actual use (fees for trading quotas for whales; fees related to obtaining permits for introduction of goods or energy into the environment).

This division enables the management entity to control environmental costs and analyze their efficiency. Such a tool allows the company to increase its environmental potential.

It should be noted that the current costs include environmental payments, which are paid quarterly by the polluters of the natural environment. The state allocates funds for the financing of those areas of environmental protection that require urgent solution.

Thus, the statistics service regularly publishes data on the number of expenditures and investments aimed at reducing the level of pollution. Dynamics of such costs and investments is shown in Figures 2.10 - 2.11.

Thus, the largest part of the budgetary funds of business entities that pay environmental payments to the budget is spent on purification of return waters. And the amount of such costs varies in the range 1.2-1.4%. Depending on the number of registered accidents that occur on the territory of Ukraine as a result of poor use of water bodies. The next significant part of the environmental payments is expenditures on damage with waste. Thus, it's not a secret that a Ukrainian generates about 500 kilograms of waste per year, and the total amount of solid household waste (according to environmentalists) is about 11 million tons per year.

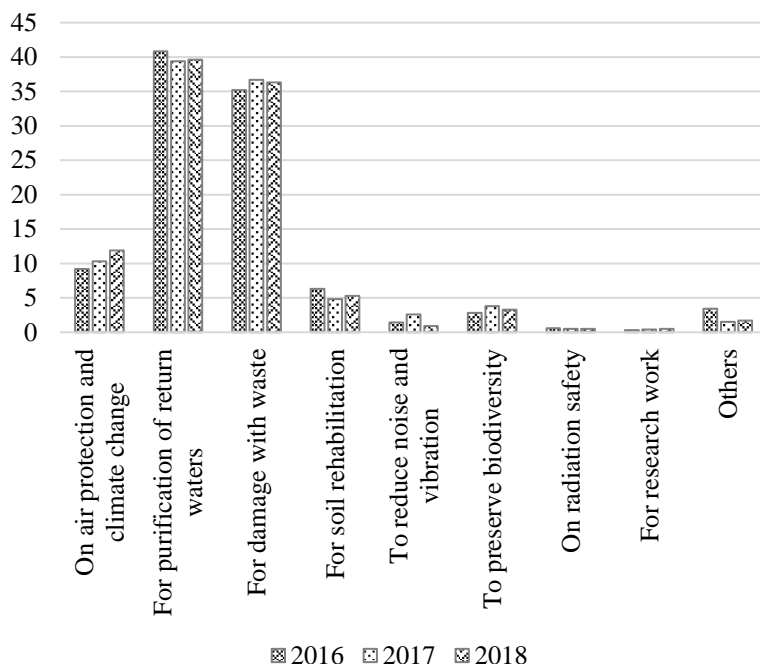


Figure 2.10. The share of current expenditures in the total expenditures for environmental protection by types of environmental protection measures, 2016-2018, %

Source: compiled by the author in accordance with the data of the State Statistics Service of Ukraine

We believe that the cost of waste management will increase, as the number of waste dumps is increasing, which has a proportional impact on the increase in the expenditure portion of the budgets of regional administrations for the cleanup of natural waste dumps. Our assumption is also confirmed by the data shown in Figure 1.19, so in 2018 the amount of expenditures amounted to 8830.20 million UAH (36.3%), which is 2110.60 million UAH more than in 2016.

The next step, which increases in value every year, is the flow of costs for air protection and climate change problems. So, while in 2016 the share of costs amounted to 9.2%, in 2018 it increased by 2.7%, which confirms the increase in excessive releases of pollutants into the atmosphere, which makes it necessary to take measures to neutralize certain chemical spills from the air.

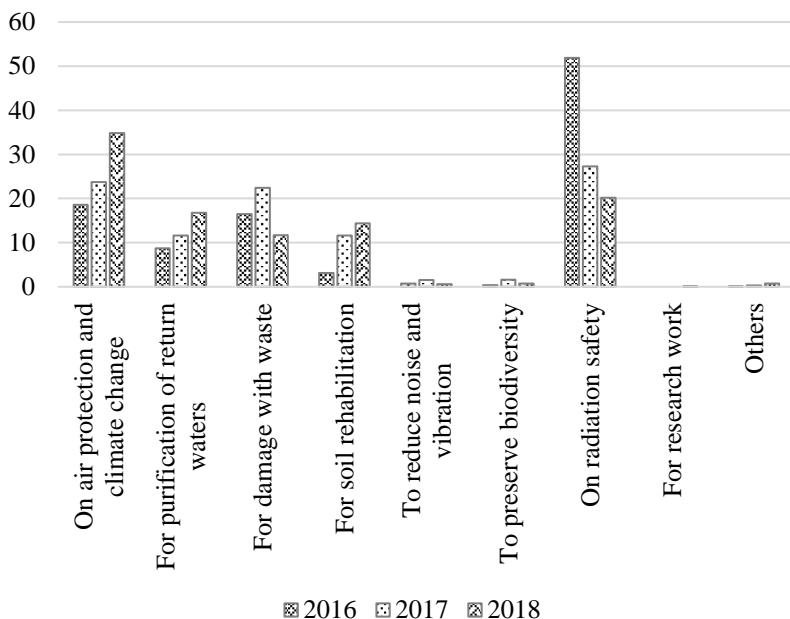


Figure 2.11. The share of capital investment in total investment in environmental protection by type of environmental measures, 2016-2018,%

Costs for other activities of the environmental protection are not significant, but they are necessary, as, for example, the cost of scientific and research work of environmental conjugation. Most of the money is spent on the development of new methods



of ecologization of enterprises, tools for minimization of anthropogenic impact, etc.

Figure 2.11 shows that the amount of capital investments in the environmental protection measures is significantly less than the current costs. Thus, most of the costs are hidden in the fight against radioactive security. However, this trend is shrinking, and already in 2018 capital investments for such measures decreased by 4907.50 million UAH. Although, the negative is that among the three types of capital investments (in purification, in integrated technologies, in other areas of environmental activities) the article "in purification" occupies the largest part, while the article "in integrated technologies" takes another position. This situation interferes with Ukraine's focus on the implementation of automated systems of control over the level of pollutants in the docklands.

Thus, the environmental accounting ensures accurate and reliable formulation of environmental costs incurred by the enterprises. Such accumulated environmental payments, under ideal conditions, should be distributed equally to the environmental needs, at the level of significance, but in Ukraine the costs for the protection of the natural environment are very low. Environmental protection measures are focused on environmental issues, such as reduction of radiation, greenhouse gas emissions, noise or prevention of their release into the environment, as well as recycling of waste and disposal of substances that have a negative impact on the environment.

Of course, the functioning of environmental accounting increases the requirements for reporting in the field of environmental protection, which leads to the need to include environmental impacts of activities of business entities in economic measurements, first of all, environmental costs, including the costs of environmental protection and the costs of environmental pressure due to its degradation. So far,

information in this regard concerns, first, the quantitative values of the level of environmental resources and their changes.

Thus, environmental reporting in the EU countries is a term used for the description and disclosure of data related to environmental risks by the economic entity, influence on the environment, environmental policy, strategy, goals, costs, requirements or environmental indicators for those who have an interest in such information (Driehuis, 2001). Such information is an auxiliary tool that facilitates a quick response to detecting deficiencies.

Task Force on Environment of the European Federation of Accountants defines the purpose of external environmental reporting in the following way: To provide information about the impact on the environment and operating results of the business entity, which is useful for the interested parties in assessing their relations with the reporting entity (Environmental Reporting Guidelines, 2004). Environmental reporting began to be implemented in European countries in the early 1990s. Thus, from this period companies began to report a number of factors impacting the environment, although the companies understood the indirect impact on the population and the actual number of pollutants discharged from their activities. However, without the mandatory requirement of the International Standards in such countries as the USA, Denmark, the Netherlands, mass implementation of environmental reporting would probably not have taken place until now (Averous, 2021, Bao, 1999).

Today, environmental reporting offers competitive advantages, as the public has begun to monitor the environmental activities of the organizations whose products they consume, and gives preference to environmentally friendly products. Based on this, the governments of the EU countries decided on mandatory certification of each company that carries out its activities on the territory of the EU and has an indirect or

indirect impact on the natural environment. Such a course of action was forced because in European countries the environmental protection continues to be a major public issue and an important priority of policy of the EU countries (Germany, France, Czech Republic, etc.) (Avérous, 2021).

The Ministry of Environment of the Czech Republic determines its views on environmental accounting and reporting at both macro and macroeconomic levels. In 2005, the state-level strategy of sustainable development was approved; it intertwines environmental and social issues in the so-called system of sustainable development. Using this system, the government can evaluate their efficiency and material impact of legislative and voluntary measures taken by certain companies and give recommendations which can be used by the companies (Jindrichovska, Purcărea, 2011).

Experience of Romania shows that the first assets of the primary and secondary environmental legislation were adopted starting from 1989. At an early stage, there were some principles of old development that were laid down in the state policy. At the same time Rumania was the first European country to ratify the Kyoto Protocol of the UN Framework Convention on Climate Change. In 2011, Rumanian scientists conducted research on the quality of environmental reporting of companies and noted that: The information provided is general and irrelevant to the users; Rumania's accession to the EU has contributed to positive development of environmental reporting; Rumanian companies limit themselves to providing general information (environmental management, environmental policy, environmental goals and objects) without providing information related to environmental risks, costs and obligations (Ienciu, Muller, Matis , 2021).

In the Netherlands and France, companies are legally obliged to disclose environmental information on a regular basis. For example, French companies did not previously have adequate

environmental disclosure, compared to many other European countries. A recently introduced French law called "Nouvelles Régulations Économiques" requires all French national corporations to inform shareholders and interested parties about a whole range of environmental issues (Arese, 2002). Environmental reporting in the Netherlands is characterized by the principle that companies must take responsibility for reducing the impact of their activities on the environment (Driehuis, 2001). The system is characterized by the combination of voluntary agreements and established requirements at the legislative level. Those companies that are required to make annual reports are required to publish two types of reports: administrative and public reports.

Before making environmental reporting, it is necessary to study in detail the main legal acts that regulate the specified matter in a particular European country. In this regard, IFRS 6 (introduced in early 2009) is specifically concerned with the extractive industries, while IFRS 5 provides guidance on the decommissioning of certain environmental assets and the renewal of costs associated with dowries. In addition, it is important to note that several other standards provide indirect support for the recognition, measurement and disclosure of environmental assets and obligations. IAS 37 "Provisions, contingent liabilities and contingent assets" may be related to environmental obligations. IFRS 3, IAS 27, IAS 28, IAS 31, IAS 24 and IAS 8 respectively apply to business combinations, investments in joint ventures and associations, Disclosure of information about the related parties and identify segments that are listed on the geographically disparate global company.

Thus, the study of environmental accounting and reporting in the EU countries showed that all member states report on the compliance of the level of pollution with the goals of sustainable development, but the question of the effectiveness of such reports in individual countries remains open. Therefore,

domestic scientists, experts and auditors are faced with the task of developing nationwide forms of environmental reporting, considering the experience of the EU countries and using social and environmental studies of accounting.

## **2.2 Causes and purpose of environmental audit**

Sustainable development in general means a balance between economic development and environmental protection. This concept is supported by, among other things, the system of environmental management, which, being implemented in the structure of the division, allows to observe and evaluate the impact of the organization's activities on the environment. However, its implementation is insufficient, because it requires cyclic diagnostics in terms of proper functioning. The solution in this plan is an environmental audit, which is the main tool for assessing the functioning of the environmental management system at the enterprise and the mechanism that supports the concept of sustainable development. Thus, the environmental audit provides a systematic and objective assessment of the organization in terms of its management and processes that are focused on the protection of the environment and harmonizes the balance between the activities of the company and the environment.

That's why to confirm the relevance of environmental audit, the research was conducted with the help of interactive visualization VOSviewer, which gave the opportunity to conduct a bibliometric analysis of articles indexed by the Scopus scientific metric database.

A first analysis of the interactive visualization of the keyword "environmental audit" revealed the presence of four clusters, which confirmed the data in Figure 2.12. This analysis was carried out on the basis of a sample of 94,532 articles. Thus, it is



monitoring, accounting, agriculture, health, air conditioning, air pollution, air quality, environmental performance, and management systems, risk management, etc.

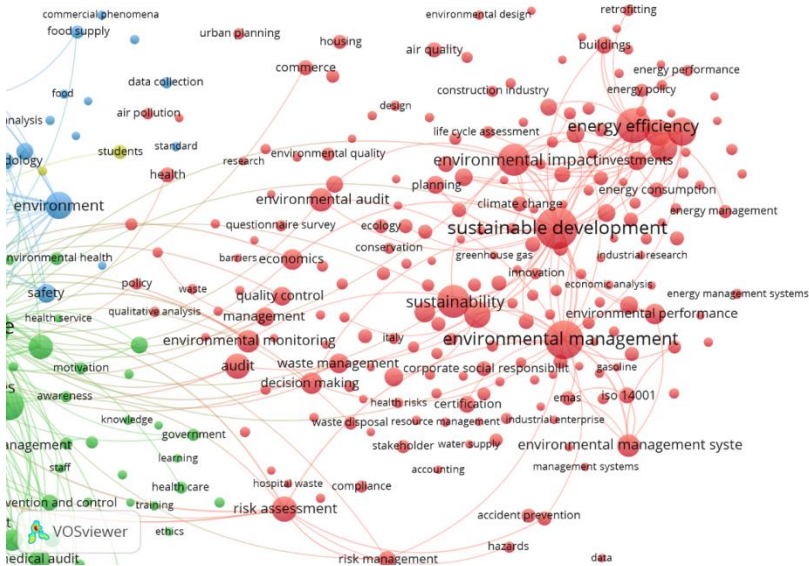


Figure 2.13. Results of bibliometric analysis of keywords co-occurrence on the request «environmental audit» (red cluster)  
Source: VOSviewer 1.6.1 results

Not surprising is the fact that this cluster is the largest, because the environmental audit is mainly the center of research on the old development, energy efficiency and environmental management. Thus, in the scientific and metric framework, environmental audit serves as: method of control over the actual amount of discharges and discounts of pollutants in the production in comparison with the planned one; a method of confirming the cost of incurred environmental costs to confirm environmentally responsible business; a tool for effective management of possible environmental risks, etc. Thus, the environmental audit functions to prevent environmental











the publication (which was based on the materials of the environmental project aimed at identifying the main threats to the planet) were the materials confirming the rapid extinction of the world's biodiversity (in particular, amphibians by 40%, conifers by 34%, coral reefs by 33%, sharks and rays by 31%, some crustaceans by 27%, orchids by 25%, and birds by 14%); loss of habitat for biodiversity (key factors in the disappearance of biodiversity are: degradation of the habitat, exploitation and pollution of the natural environment, changes in climate, etc.); mass destruction of forest massifs (in 2016-2017, mass fires caused the loss of about 3 million hectares of forests); etc.

And the last stage of the research is the identification of the most concentrated research in the field of environmental auditing. And so, the results presented in Figure 2.18 make it possible to understand that the scientists were most focused on the analysis, development of such problems related to such topics as "environmental design", "environmental planning", "energy efficiency", "sustainable development", "environmental management", "benchmarking", "cost effectiveness", "procedure" etc.

Thus, the analysis of the results of the study based on the VOSviewer tool, made it possible to confirm the relevance of the environmental audit study. The result of the research is also the fact that the economic progress brings people unlimited benefits, such as an increase in the standard of living of society and the improvement of public safety. However, despite the positive effects, it also causes significant destruction of nature. Overuse of resources, industrial waste disposal and lack of environmental awareness. Therefore, it is necessary to use appropriate means, which could oppose this phenomenon. The solution to this problem is environmental audit, which is a tool that supports the concept of sustainable development.



international level, i.e. to correlate the existing and develop new approaches to environmental protection, create effective mechanisms for the implementation of the new environmental policy. These factors contribute to the formation of a new European economic cooperation, based on the need for the strongest members of the world economy to help those who require assistance in solving mutual economic and environmental problems.

To begin with, we will analyze the international and domestic literature that examines the terminology of the concept of "environmental audit" (Annex A). Thus, foreign scientists have concluded that environmental audit is one of the effective mechanisms of implementation of control and serves to make effective decisions on the management of the environmental situation. Also, based on the systematized domestic data, it is clear that among the scientists there is no uniform opinion on the essence and functional purpose of environmental audit. On this basis, we formulated our own definition of the concept of "environmental audit" as a management tool designed for the inspection of the company's activities in the field of environmental protection, which serves to implement new environmental technologies to reduce the adverse anthropogenic impact on the environment.

Environmental audit should not be mixed up with the assessment of the impact on the natural environment. Of course, these two categories are tools of environmental management, and both have common risks, but there are some important differences between them. Environmental impact assessment is a predetermined tool, i.e., it is used before any actions are taken. Therefore, this tool tries to predict the impact of the future action on the environment and provide this information to the stakeholders (this tool is also legally enshrined in most European countries). At the same time, the environmental audit is conducted when the impact of certain indicators is already

determined, and is used to review current practices, to assess the impact on the ongoing activities. Thus, the environmental audit provides an overview of what is happening in the organization at the current moment in time.

It should be acknowledged that environmental auditing is often used as a general term that covers various management practices that are used to assess the environmental performance of the company. Most often it is about checking the compliance of systems and procedures with standards or norms, but it is often used to review, collect and evaluate any data that is significant for the environment - it should indeed be called an environmental review. The distinction between environmental audit and environmental inspection is rather complicated, but the analysis of the data in Table 2.2 makes it possible to understand the differences between them.

Regardless of the process that is carried out, some domestic organizations consider it better not to use the term "environmental audit". Therefore, in some cases, when the management orders this kind of audit, it can be a procedure for measuring environmental indicators in accordance with established criteria environmental audit, Environmental assessment or another term used specifically for the purposes of management, with the aim of expanding markets or the search for additional foreign investments.

It should also be noted that the essence of the environmental audit had its origin in the audit, which is carried out based on the financial statements, that is why in the scientific literature you can see the difference between these types of audits.

However, it should be noted that environmental audit and financial accounting audit have similar methods and procedures, but in general there is several differences, which are shown in Table 2.3. Thus, the identified main differences between the audit of financial statements and environmental audit allow us to confirm the fact that these audits are different for their nature,

normative regulation and specificity. Although, the relevance of environmental auditing is increasing, which is caused by an increased anthropogenic impact on the environment, as well as the difference between actual and real indicators of emissions of pollutants into the natural environment by business entities.

Table 2.2. Differences between the features of the concepts of "environmental audit" and "environmental verification"

The difference for	Environmental verification	Environmental audit
The main purpose	Defining environmental performance standards to be met (for example, the company decides to reduce total emissions of organic compounds from 100 tons to 10 tons per year)	Checking the effectiveness of these standards (for example, the company checks whether it has actually reduced emissions to 10 tons per year)
Essence	Checks all known environmental issues and evaluates the effectiveness of each proposed measure according to its own methodology	Evaluates activities only in accordance with current legislation
Periodicity	At the request of management, or before and after the development of environmental management systems	Regularly and on a pre-planned cyclical basis
Limited	Where the business could affect the product environment (ie the choice of raw materials, transportation, manufacture, use and disposal of products)	Usually clearly defined geographical boundaries (for example, limited by environmental opportunities, distribution companies or local government)

Source: Goswami & Prabhasini (2008)



Table 2.3. Comparative characteristics of environmental and financial audit in Ukraine

Indicator	Audit of financial statements	Environmental audit
Legal foundations of audit	Mandatory audit - verification of the reliability of the annual financial statements of entities of public interest Optional audit is an audit that is performed at the request of management	Audit (often) is optional. Held at the request of management or investors to increase the confidence of stakeholders
Regulatory framework	Regulated by the Law of Ukraine "On Accounting and Financial Reporting" and international financial reporting standards	Regulated by voluntary standard (ISO 14001)
Periodicity	Annually (for enterprises defined by law)	At the request of management
Executant	Performed by a certified independent auditor	Performed by external and / or internal staff. There are no legal requirements for the competence of environmental auditors
Method	Defined by international standards and must comply with the General Principles of Accounting	It is developed by the auditor independently in accordance with the requirements of the customer and the peculiarities of the enterprise
Access to audit	Open and available on the websites of such companies	There are almost no public results of the environmental audit

Source: based on Goswami & Prabhasini (2008)

It is necessary to pay special attention to the definition of the main goals of environmental auditing. Thus, they can be divided into the following:

- verification of compliance of environmental activities of the company with regulatory standards and requirements;
- determination of the effectiveness of environmental activities and environmental protection measures of the business entity;
- identification and explanation of weaknesses in environmental activities of the company;
- identification of deficiencies, if such were identified in the course of the audit;;
- development of suggestions and possible areas of development and improvement of the environmental system of the company, or a list of important aspects of environmental policy of the organization.

Thus, the main purpose of the environmental audit is to confirm the compliance of the system of environmental activities of the company with the normatively specified requirements. For this purpose, the auditor can analyze accounting documents, in particular primary documentation, which indicates the fact of the introduction into operation of environmental technology, treatment plants, etc. Also verifies the accuracy of the cost of such equipment, in order to avoid the fact of falsification of documents, and the amount of environmental costs in the statements. During implementation of the specified audit objective, the auditor may conduct audits, tests, analysis of the market with similar equipment, taking into account the price range and the main technological characteristics. It should be noted that the methods of collecting information for the environmental audit can be different. So, for example, to assess the level of pollution of the environment (e.g. atmospheric air or water objects), the auditor can initiate sampling of possible types of pollution. And the expert's findings should be added to their own report, which will confirm or deny the fact of their excessive contamination. Apart from engaging experts, conducting experiments and reviewing

documentation, the auditor can also conduct an observation (in case the facts obtained before this do not correlate with each other). For example, in the case of an audit of a processing plant, the residents of the areas closest to the plant can be interviewed. For example, the survey of employees who work in industrial enterprises on the level of environmental sustainability of the company.

Already based on accumulative information, the auditor decides on the compliance of environmental activities of the enterprise, the institution or organization of the normative and designated requirements and compliance with the goals of sustainable development.

Of course, the auditor also has several requirements, which are regulated by the international standard ISO 9001. Moreover, this standard is gradually updated, so the auditor has a set of requirements, adapted to the current level of audit development.

To assess the efficiency of environmental activities and environmental protection measures of the business entity, it is worth assessing whether the goals that were set before the implementation of environmental protection measures have been achieved. The goals are set at different levels: strategic, tactical and operational. Evaluating the effectiveness of, for example, certain treatment plants, the quality of such treatment, the feasibility of buying them in each environment, provides information about the level of achievement of specific objectives, as well as pointing to those that have not been achieved. Thus, the organization receives a notion about the achievements, as well as about the failures, which is a valuable material for analysis and decision-making by stakeholders.

To fulfill the next goal, which is to identify and explain the weaknesses of the environmental activities of the company, the auditor must identify those aspects of business activities, which require improvement in the future periods, those that should be eliminated urgently, and those that will contribute to increasing

the level of protection of the natural environment. These areas are exclusively recommendatory in nature, but the audit is a mechanism of early prevention, so the information about the emerging violations should encourage the client of environmental audit to implement appropriate environmental protection measures. Quick elimination will be able to prevent the emergence of serious environmental problems and protect the organization from their excessive impact on the natural environment.

But if, in the process of environmental audit was found a violation of environmental legislation, it is reflected in the auditor's report. It is worth noting that an initially identified problem can quickly eliminate the causes and prevent a significant negative impact on the environment in the long term.

As a result of the audit the organization must receive confirmation that it operates in accordance with the current environmental legislation and sells products that meet the specified standards.

Regarding the historical genesis of environmental auditing, it was initiated at the end of the twentieth century in the USA. At that time, at the initiative of the management of industrial enterprises, a program of environmental audit as a tool of internal management was developed to help review and assess the status of operating divisions of the company and their impact on the environment (Goswami & Prabhasini, 2008). Conducting an environmental audit allowed managers to verify the compliance with local and national environmental laws, and as a result, it became the basis for the creation of a corporate environmental policy.

As for the EU countries, the environmental audit first spread in the chemical and petrochemical industries, significantly as a reflection of the significant threats to the environment of these enterprises (Zhang, 1996). Thus, today, environmental audit is a widespread form of verification of the real performance of

enterprises and the compliance of their activities with the regulatory requirements.

Therefore, during the research there were presented issues that correlate with the study of environmental auditing, where special attention should be paid to the interrelation of environmental auditing with the protection of life and health of the population. Also, environmental audit acts as a mechanism for assessing the quality of environmental activities of enterprises, which proportionally affects the sphere of health protection. Particular attention was paid to the essence of the environmental audit, which is a process of compliance verification, and it was also determined that it cannot be equated with the audit of financial statements. Therefore, the correct understanding of the essence of environmental audit is the basis for determining its role in the organization, because it must play an important and valuable role in ensuring the sustainability of business activities.

### **2.3 Perspective directions of reforming environmental audit and reporting in Ukraine**

Today, the national environmental situation requires a strong governmental effort and the use of all possible resources to reduce the adverse impact of the population and businesses on the wildlife. In 2019, the ecological problem was the fallow forests for the reduction of sagebrush and fallen leaves, which affects the pollution of atmospheric air and the reduction of forests through the lack of control over the heat. Also, the most discussed problem is the smitthy havoc, according to the data of the interactive map of smitthyzers, the largest number of natural smitthyzers are in Lviv and Donetsk regions, and their number is only increasing every year (Ecomapa, 2021). In Ukraine there is no administrative and criminal responsibility for excessive waste disposal, there is no requirement to keep a separate type

of environmental accounting for the beginning of the machine-building and chemical industry, there is no separate form of environmental reporting that will be monitored and verified with actual releases of toxic substances of the enterprise for the reporting period, so there is a need to solve low environmental problems at the legislative level, taking into account the experience of the EU countries.

Ukraine started cooperating with the EU starting from 1998 in the field of nature protection and climate change, in particular in terms of prevention of atmospheric air and water pollution, reduction of the volume and safe industrial waste management, protection of forests, protection of biodiversity and their effective use and management of natural resources and implementation of the UN Convention on the Effects on the Environment in a transboundary context, etc (Environment protection, 2021).

At the state level, most domestic laws on economic activity stipulate compensation for damage caused by environmental pollution, but they are not enough to ensure the prevention and elimination of damage caused by nature. Thus, since the times of independence Ukraine has often changed the regulatory field on environmental safety, tax rates, and programs for the development of certain types of resources.

Special attention should be paid to the Law of Ukraine (hereinafter - the law) "About environmental audit"(2004), which provides two forms of environmental audit: voluntary and mandatory, but, having looked deeper into this matter, it turned out that such services are not represented even by some auditing companies of the Great Four. As for the independent auditors, the search for such experts gave no results. Thus, the specified law contains the basic rights and duties of the contractors and contractors, divides environmental audit into external and internal, specifies the procedure of environmental audit, but the law does not mention the responsibility for violation of the

norms of such law. On this basis, it can be stated that the obligation to implement it is equal to zero. Therefore, this statutory act requires reviewing and making changes in terms of responsibility, clear definition of the environmental audit program, because the law was adopted in 2004, which indicates that it is outdated. Changes in some sections of this law must entail changes in the Tax and Criminal Codes of Ukraine. It is also necessary to review the Regulations (standards) of accounting, especially in the aspect of environmental income and expenses, the formation of environmental income, and its use. It is also necessary to adapt the Instruction on the application of the Schedule of Accounts №. 291 and create a separate account for the accounting of environmental costs, revenues, duties and profits. An insignificant part of these changes is the development of Methodological Recommendations on the peculiarities of environmental accounting in enterprises, because there are a lot of laws in Ukraine, but the correctness of their application and interpretation for each particular sector is a problem.

The next problematic law is the Law of Ukraine "On Environmental Impact Assessment" (2017). In our opinion, a separate part of the law should provide for the creation of a national automated information system for preventing and eliminating environmental damage, as well as the creation of an automated information system to prevent and eliminate environmental damage. This mechanism will make the collection of environmental reports (which should be mandatory for all enterprises regardless of the type of activity), will allow to accurately assess the level of impact of enterprises of certain sectors on the environment. On this basis, it is necessary to develop programs to reduce the amount of pollution by certain types of households and increase environmental responsibility among Ukrainians, taking into account the experience of the EU countries.

The main challenges for the government are to resolve the following issues: 1) improvement of the legislative basis of environmental management; 2) determination of the obligation of environmental reports and elaboration of their form; 3) regulatory regulation of the obligation of environmental audit and responsibility for violation of the law; 4) Enhancement of mechanisms for setting environmental priorities; 5) Improvement of efficiency of environmental institutions through improved coordination and ordering of responsibilities at different institutions; 7) expansion and strengthening of implementation of the whole range of tools and mechanisms of environmental policy for the development of appropriate environmental practices in accordance with the requirements of the EU; 8) creation of demand for enhanced environmental management and governance with community participation.

Thus, the solution of the outlined problems will help to improve the environmental situation in Ukraine, put the beginning of environmental responsibility of enterprises and will facilitate Ukraine's entry to new competitive markets. Because the nature protection is one of the most important directions, and rapid development of the industrial sector, insufficient legislation and outdated environmental equipment are the factors of significant anthropogenic impact on the environment.

As for the prospects of development of environmental reporting and audit in the domestic realities, we suggest a few fundamental directions to improve the regulation of environmental activities. Among the main is the introduction of mandatory electronic environmental reporting for business entities which carry out their activities on the territory of Ukraine

This report must accurately reflect all revenues and costs incurred by the company during the reporting period. Particular attention should be paid to the form of environmental revenues,



as they are formed by the company independently. This article may include income from secondary processing of waste products, or income received by composting waste, or income received as a result of the sale of alternative energy, etc.

As for the costs section, it's filled in accordance with the requirements of tax law, and must fully reflect all kinds of damage, which in the course of activity was made by the company. In order for such a report to function effectively and to improve the quality of the environment, it is also necessary to establish liability for violation of such forms in terms of the amount of emissions and costs incurred for the elimination of the caused damage to the natural environment.

Other areas of development of environmental sustainability, in the context of environmental reporting and audit are as follows:

- review of the functions, duties and responsibilities of the Ministry of Ecology, its divisions and other authorities in the sphere of management at the national, state and regional levels. Strengthening the capacity of other central authorities responsible for the management of the environment and natural resources;

- ensuring proper capacity building and training of the state authorities in environmental reporting and auditing, taking into account the principle of sustainable development at the national and regional levels with the involvement of the private sector and the civil society;

- regulatory allowances and subsidies for recycling enterprises and those who use equipment for the protection of the natural environment. Also, the necessary condition is the exemption from paying income tax for 5-7 years to be able to effectively use the equipment for its intended purpose and reduce the tax burden from the designated tax, which will encourage businesses to carry out the estimate processing enterprises in order to maximize profits.

Thus, the identified prospects for the development of environmental reporting and accountability, as well as specific measures to reduce emissions of pollutants in the environment will contribute to increasing awareness of the public on the state of the environment; Improvement of ecological situation and ecological safety of Ukraine; Reduction of discharges of polluting substances into the environment, safe waste management; implementation of environmental reporting and auditing activities aimed at reducing pollution and wasteful use of natural resources; organization of activities for monitoring the environment and providing information to support environmental protection activities.

### **3. RELATIONSHIPS OF ENVIRONMENTAL TAXES WITH COMPONENTS OF NATIONAL SECURITY**

#### **3.1 Conceptual background of national security definition**

In the current realities, the issue of ensuring national security is an object of considerable attention both by the state authorities (who realise their powers and competences within its limits) and by scientists (who study conceptual-categorical apparatus, normative and legal regulation, factors affecting the level of security, etc).

Studies of the literature of the 20th century showed that scientists, during long discussions, did not reach a consensus on the definition of the concept of «national security». Thus, Brown (1983) interprets national security as object determined by national interests. In the countries of the East and the West until the 1980s, national security was interpreted as political and military security, and security was synonymous with the state's defense capability. At the end of the 20th century, scholars began to consider national security from the perspective of all possible stakeholders. Exactly during this period different view of the concept of «national security» was formed. National security began to be considered in the context of the basic values of humanity (Sytnyk, 2012).

The problem of the absence of single understanding of the essence of the concept of «national security» is caused by the multi-component and interdisciplinary nature of this definition.

In current realities, national security is interpreted as: the protection of the interests of society, the state, and the citizen from external and internal threats (economic, ecological, social, energy), to ensure the sustainable development of society, through timely prevention and neutralization of existing or probable threats.

According to the data of the scientometric database Scopus, works of scientists that are related with this topic were identified. It was found that scientific searches was carried out using such diections as: «environmental security», «social security», «energy security», «economic security» AND «environmental tax». The analysis showed that the set of works on the components of national security is formed from 18 scientific works, while each of the scientific works considers national security in some specific context (for example, environmental security), which has a direct or indirect impact on other components (energy, economic).

For example, foreign experts in the field of national security (especially energy and environmental) have empirically proven that in some Scandinavian countries there is a close but negative relationship between energy intensity and GDP (Aloha & Nwulu, 2022). Whereas only an increase in the energy tax can reduce emissions and energy intensity (as opposed to a tax on pollution and resources). In addition, the authors confirmed that a Finnish company or household can receive double dividends thanks to the tax policy (which was not confirmed for the policies of Denmark and Norway). In general, it has been proven that environmental policy can contribute to the environmental and economic security of a country (Sweden is quite a good example).

The importance of the double dividend was also confirmed in the work of Yahoo & Othman (2015). The authors proved that due to the change in the structure of consumption, the well-being of the population can be improved, while CO<sub>2</sub> emissions can be significantly reduced, which will generally have a positive effect on all components of national security.

Jiménez-Gómez et al. (2018) territorially limited their own research. In contrast to the Scandinavian countries, they concentrated on Colombia's energy security. It has been proven that due to the introduction of renewable sources, the country's

energy risk, which arose back in 1994, was reduced. However, in contrast to previously introduced thermal energy sources, there are now more ecological ones that will be able to diversify the energy basket, such as wind energy. The study showed that the existing incentive measures for the installation of wind power plants are ineffective. As an alternative, the authors see an increase in environmental tax rates, which can have a positive effect on the level of tax revenues, and therefore the state will be able to independently finance such projects, or an excessive tax burden will ensure the installation of wind power plants by entrepreneurs, because it will help them save on environmental tax amounts and maximize profits in the long term. perspective

A number of scientists empirically confirm the significant role of environmental tax in ensuring sustainable consumption of natural and economic resources. For example, Samusevych et al. (2021) estimated the level of the optimal ratio of environmental taxes through the prism of national security. The proposed model was based on the construction of such a number of environmental taxes, which will make it possible to maximize the protection of the interests of all interested parties (citizens, the state, society) and serve the accumulation of material values.

In addition, Štreimikienė et al. (2021) evaluated the effectiveness of environmental taxes in ensuring national security, which is a necessary component of sustainable development.

The result of the research of other scientists was the determination of the relationship between the amount of environmental tax paid by enterprises and the level of its environmental security. Plaksienko et al. (2020) emphasize the need to create a certain differentiation regarding the payment of environmental tax for those enterprises that are environmentally responsible to the state and the public. The study of economic and mathematical methods made it possible to confirm the adequacy and relationship between the determined components,

and therefore the differentiation of the environmental tax can become an effective incentive to reduce the level of influence of industry on the state of the environment, which will become a lever for improving the environmental security of the country in general.

Nasir et al. (2022) managed to draw a parallel between environmental policy, environmental tax, energy consumption and energy poverty of the population of Vietnam, which are components of the country's energy security. Thus, it was proven that with the help of an environmental tax, the country's government wanted to reduce energy poverty and thereby increase energy and, as a result, the country's national security. Mathematical calculations confirmed that the effect of the environmental tax increase was obtained only in 2018 (although the implementation was in 2001), which contributed to the highest value of energy security and the lowest value of energy poverty of the population.

In contrast to the above research, in the work of Shokhnekh et al. (2020) attention was focused on the need to create and involve individuals in the system of responsible education, which is designed to gradually influence the increase in environmental awareness of citizens, their responsible attitude to natural resources and their responsible consumption. Scientists believe that this is the optimal component of ensuring environmental security, and further it will have a positive effect on the ecological balance and economic resources, which are limited in current realities.

It should be noted that with the growth in demand for fossil fuel consumption, the relevance of the fight against global warming has increased. Global warming is becoming a threat to the national security of all countries of the world, which is why the importance of renewable energy sources and scientific innovations in the production of low-carbon electricity is increasing. Based on this, Sawangphol & Pharino (2011) proved

the crucial role of an environmental tax in the promotion of low-carbon electricity, which will help provide additional grants and subsidies for research and development measures to reduce the cost of technologies. According to the authors, this will increase private investment in renewable energy sources, and over time will be able to ensure a sufficient level of energy security, as a necessary component of national security.

Dong & Zheng (2021) proved that against the background of high demand for energy cars, the policy of double crediting was introduced to solve the problem of energy and environmental security. Such lending acts as a mechanism for stimulating environmental regulation. The results of the calculations, which were based on exchanges that cooperate with energy cars, showed that: double crediting increases the overall productivity; technological innovation and reputation are positively reflected on the same productivity; an increase in the environmental tax may reduce the contribution of scientific innovation to total productivity. Thus, scientists have proven that flexible environmental regulation can have a positive effect on productivity indicators and on the level of national security in general.

Summarizing the results of the analyzed studies, we note that most authors see the concept of «national security» as its components: economic, ecological, and energy, and emphasize their close relationship. Note that some authors emphasize the need for additional regulation of rates, the tax base of the environmental tax, and also emphasize the need for the implementation and effective functioning of environmental policy by each country. First of all, this is due to the fact that the environmental tax is designed to perform such functions as: fiscal, stimulating, regulatory and compensatory. Therefore, the accumulation of environmental payments in the budget enables the state to ensure the normal functioning of all necessary spheres (social, economic, energy, defense), and also serves as

an incentive for the introduction of innovative technologies to reduce the tax burden from environmental taxes by, for example, installing renewable energy sources, which will not only increase the position among competitors as a socially responsible producer, but also ensure the accumulation of profits in the future.

Therefore, the analysis of foreign and domestic studies showed that there is no single definition of «national security» used by scientists. We believe that this state of affairs is a consequence of the fact that the concept of «national security» is multi-component and interdisciplinary, and its essence should be considered through such parameters as: ecological, energy and economic. Taking this into account, the further study of the theoretical basis of national security was based on the study of works posted in the scientometric database Scopus, with the help of established clichés. The analysis of representative scientific literature confirmed that scientists consider a sufficient level of national security due to the creation of a moderate balance between the state of ecology, economy and energy of an individual country.

### **3.2 Estimation of relationships between environmental taxes and environmental security**

Taking into account the determining role of the environmental tax in the national security of every country in the world, a comparative analysis of the level of tax revenues to the budget of such countries as: Estonia, Denmark, the Czech Republic, Croatia, Bulgaria and Austria was carried out. The selection of countries was based on the availability and completeness of the data posted in the World database Bank regarding the amounts of tax revenues from the environmental tax starting from 1994 to 2020 (Fig. 1.).



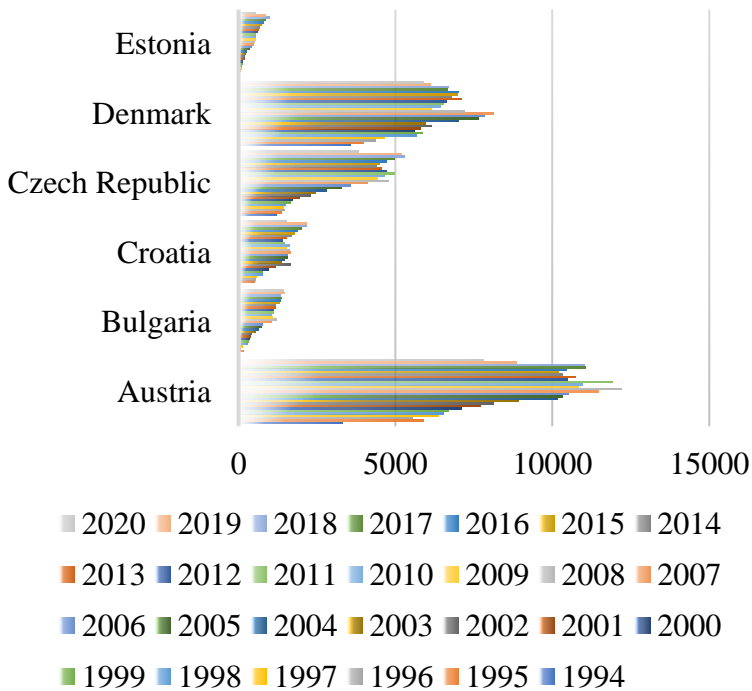


Figure 3.1. Dynamics of environmental tax revenues in several EU countries for 1994-2020

Source: built basen on World data Bank

Evaluating the data presented in the figure, we see that the Austrians generate the largest amount of environmental tax revenues (12,190 million dollars in 2008 ), but we should not ignore the fact that Austria is the second largest country among the compared countries (the first largest is Bulgaria). In comparison of the amounts of accumulated environmental taxes in Austria and Bulgaria, the question arises as to why the data differ to what extent and what exactly affects their level. Some may point to the difference between the population living in the respective territories, but note that as of 2020, the number of

Austrians exceeds the population of Bulgaria by only 807.5 thousand people, despite the fact that the amount of tax paid to the budget of Austria is higher by 6372.9 million dollars for 2020. Therefore, the question of how effectively the process of administration of the environmental tax by the Bulgarian government functions and its appropriate use (for the intended purpose or not) is actualized, which can act as a stimulating fact of influence on the deshadowing of the amounts of the environmental tax.

Among the analyzed countries, Denmark and Estonia can boast of an effective environmental policy, where the government has set fairly high tax rates, which is confirmed by the data displayed in the figure, taking into account their size. Therefore, it is economically more profitable for society (households and enterprises) to follow the principles of sustainable development and consumption, than to pay the full amount of environmental tax, which is based on the level of environmental damage. In addition, the authors of Alola & Nwulu (2022) confirmed the positive impact of environmental policy on the indicators of national security of the Scandinavian countries. As for environmental taxation and the level of national security in the Czech Republic and Croatia, the governments of these countries also adopt effective environmental solutions: additional taxation of fishing and forestry (Croatia), taxation of various types of waste (Czech Republic), although in contrast to Croatia, an environmental tax that collected from Czech enterprises cannot boast of targeted use.

Based on the fact that a number of scientists emphasize the existence of a close relationship between the revenues from environmental tax and national security, we propose to mathematically confirm this hypothesis. Thus, we used the statistical database World Bank, which made it possible to

divide the components of national security into the appropriate indicators of environmental security:

- CO2 emissions, metric tons per capita;
- Methane emissions, % change from 1990;
- Nitrous oxide emissions, % change from 1990;
- Fertilizer consumption, kilograms per hectare of arable land;
- Total fisheries production, metric tons;
- Total greenhouse gas emissions, % change from 1990.

Considering the fact that quite a significant number of scientists describe the impact of environmental parameters on the overall indicator of national security, we collected statistical material that would allow us to confirm the hypothesis regarding the impact of environmental taxes on energy, environmental and economic security based on the averaged relationship between 24 countries (and the research period was 27 years (from 1994 to 2020 inclusive). Stata software was used, in particular, the panel regression modeling toolkit, which made it possible to estimate the average level of connections for 24 countries of the world (Austria, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Ukraine, United Kingdom) during 1994-2020. Selected countries have a broad experience of design of environmental taxes, thus allows formulating a hypothesis about their regulatore impact in terms of different vectors of national security ensuring.

First, the impact of the environmental tax on environmental security indicators was assessed. The first indicator of environmental security is the level of CO2 emissions. The results confirm the statistical significance of the calculations, as evidenced by the significance criteria (Table 3.1). Therefore, these data can be interpreted in such a way that the amounts of the accumulated environmental tax have a significant (at the

level of 99%) impact on the environmental security of the country. In particular, an increase in environmental revenues to the budget by USD 1 million will lead to a reduction of 0.0868 kg of CO<sub>2</sub> emissions, and this confirms the fact that environmental taxes are a significant regulator of the impact on the reduction of anthropogenic impact on the natural environment.

Table 3.1. The results of the assessment of environmental tax impact on the indicator of environmental security, which characterizes CO<sub>2</sub> emissions for the period 1994–2020 years

CO <sub>2</sub> emissions	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.001	0.00	-9.61	0.000	0.00	0.00	***
Constant	8.166	0.51	16.01	0.000	7.167	9.166	***
Mean dependent var	7.132		SD dependent var		2,550		
Overall r-squared	0.010		Number of obs		615		
Chi-square	92.355		Prob > chi2		0.000		
R-squared within	0.156		R-squared between		0.024		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

This trend is also confirmed by the inverse relationship between revenues from the environmental tax and methane emissions (Table 3.2). Thus, under similar conditions of increasing the amounts of the environmental tax (by 1 USD millions), methane emissions will decrease by 0.001%. This confirms the importance of environmental taxation in the environmental security ensuring.

The revealed connections confirm the fact that environmental taxes not only ensure the accumulation of additional financial resources for the restoration of damage caused to the natural environment, but also allow to reduce the level of influence of economic agents on its pollution.

Table 3.2. The results of the assessment of environmental tax impact on the indicator of environmental security, which characterizes methane emissions for the period 1994–2020 years

Methane emissions	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.001	0.00	-11.67	0.000	-0.001	-0.001	***
Constant	-5.347	4.21	-1.27	0.204	-13.599	2.904	
Mean dependent var	-16.181		SD dependent var		19.894		
Overall r-squared	0.001		Number of obs		447		
Chi-square	136.240		Prob > chi2		0.000		
R-squared within	0.275		R-squared between		0.000		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

On the next step the impact of the environmental tax on emissions of nitrogen oxides was assessed (Table 3.3).

Table 3.3. The results of the assessment of environmental tax impact on the indicator of environmental security, which characterizes nitrogen oxide emissions for the period 1994-2020 years

Nitrous oxide emissions	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.002	0.00	-12.49	0.000	-0.002	-0.001	***
Constant	-8.319	4.094	-2.03	0.042	-16.344	-0.295	**
Mean dependent var	-26.214		SD dependent var		19,869		
Overall r-squared	0.005		Number of obs		447		
Chi-square	156.115		Prob > chi2		0.000		
R-squared within	0.411		R-squared between		0.038		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

Therefore, an increase in the budget of environmental taxes paid by households and enterprises by 1 million dollars leads to the reduce in the amount of nitrogen oxide emissions into the atmospheric air on 0,0016%, which increases the quality of the environment and will serve to increase the life expectancy and health of the population, and therefore ensure the environmental security of the country. A similar trend was achieved as a result of calculations of the impact of the environmental tax on costs incurred for fertilizers (Table 3.4).

Table 3.4. The results of the assessment of environmental tax impact on the indicator of environmental security, which characterizes the costs of fertilizers for the period 1994-2020 years

Fertilizer consumption	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.003	0.000	-8.03	0.000	-0.004	-0.002	***
Constant	188.535	16.824	11.21	0.000	155.561	221.509	***
Mean dependent var	152.478		SD dependent var		92.566		
Overall r-squared	0.112		Number of obs		638		
Chi-square	64.421		Prob > chi2		0.000		
R-squared within	0.141		R-squared between		0.195		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

Thus, with the increase in environmental taxes, the consumption of fertilizers will decrease proportionally. It illustrates impact of environmental taxes not only on the environmental security, but also their transmission impact on the food security and the quality of arable land. We believe that this can have a positive effect not only on the state of the surrounding natural environment (by avoiding the cultivation of land plots with chemical protection means (fertilizers) as opposed to

organic fertilizers), but also proportionally affect the health of the population, because the main type of production that needs additional fertilizer is agricultural, which is distinguished by its demand among the population. This makes the context of environmental taxes investigation significantly much broader and allows to extent the non-financial effects of their application in the system of state regulation and ensuring of sustainable development progress.

An important component of ensuring the country's environmental security is the preservation of its biodiversity. In this context, many countries establish taxes on fishing and hunting, licenses for various types of industrial activities. The effectiveness of the impact of such regulatory instruments will be assessed by modeling the relationship between the income from environmental taxes and the total volume of fish catch in quantitative terms (Table 3.5).

Table 3.5. The results of the assessment of environmental tax impact on the indicator of environmental security, which characterizes the total production of fish for the period 1994-2020 years

Total fisheries production	Coef.	St. Err.	t-value	P-value	Low 95%	High 95%	Sig
Environmental tax revenues	-7.268	1.007	-7.22	0	-9.242	-5.293	***
Constant	386182.48	67538.172	5.72	0	253810.1	518554.87	***
Mean dependent var	299576.805		SD dependent var		375429.781		
Overall r-squared	0.212		Number of obs		638		
Chi-square	52.058		Prob > chi2		0.000		
R-squared within	0.102		R-squared between		0.266		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

Another direction that characterizes the impact of the economic system on environmental security is the level of greenhouse gas emissions into the environment, which is determined by both the activities of enterprises and the functioning of households. The conducted assessment proved that environmental taxes are closely related to the level of greenhouse gas emissions (Table 3.6). Note that in this model, the significance is lower and is observed at the level of 95%, in contrast to the previous calculations, but it can be interpreted as such that with an increase in the environmental tax, the amount of emitted greenhouse gases will decrease by 0.00024%. This proves the fact that environmental taxes have a wide regulatory influence on the results of the functioning of the economy in view of the sustainability of the environment.

Table 3.6. The results of the assessment of environmental tax impact on the indicator of environmental security, which characterizes the total emissions of greenhouse gases for the period 1994-2020 years

Total greenhouse gas emissions	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.000	0.000	-2.07	0.038	0.000	0.000	**
Constant	-11.473	5.529	-2.08	0.038	-22.309	-0.636	**
Mean dependent var	-13.409		SD dependent var		26,864		
Overall r-squared	0.052		Number of obs		447		
Chi-square	4.298		Prob > chi2		0.038		
R-squared within	0.017		R-squared between		0.069		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

Thus, the conducted study fully confirmed the impact of the environmental tax on national security in terms of parameters



environmental security. In particular, it was proved that the inverse relationship of the environmental tax on all determined indicators of environmental security. Therefore, increasing the amounts of environmental tax revenues in the budget contributes to the reduction of emissions of CO<sub>2</sub>, methane, nitrogen oxide, costs incurred for fertilizers, emissions of greenhouse gases, which will have a positive effect on the state of the natural environment and, accordingly, the quality and duration of life and health of the population, however when increasing the amounts of such environmental taxes, it is necessary to control the level of environmental pollution quite precisely, because the increase of such taxes may indicate the increase of production capacities by enterprises, which may have a negative impact, for example, on fish production. Such a relationship should stimulate the government to introduce additional stimulating effects to reduce the excessive impact on natural resources and ensure that the environmental tax fulfills a compensatory function.

### **3.3 Assessment of environmental taxes impact on the energy security**

The next direction of national security, which potentially depends on the impact of environmental taxes, is the level of energy security. The analysis of the structure of environmental taxation in different countries of the world points to a number of patterns that allow us to substantiate the impact of environmental taxes on energy security: 1) in most of the studied countries, there are taxes on energy (both general and on the production of energy from certain sources, for example, from coal or gas); 2) since the production of many types of sources involves emissions of harmful substances into the atmospheric air, we can also expect the impact of pollution taxes on the activities of energy producers. To assess the impact of

environmental taxes on ensuring energy security, a number of parameters of energy security were selected:

- CO<sub>2</sub> emissions from electricity and heat production, total, % of total fuel combustion;
- CO<sub>2</sub> intensity, kg per kg of oil equivalent energy use;
- Electricity production from oil, gas and coal sources, % of total;
- Energy imports, net, % of energy use;
- Combustible renewables and waste, % of total energy;
- Energy use, kg of oil equivalent per \$1,000 GDP, constant 2017 PPP;
- Fossil fuel energy consumption, % of total.

The parameter that characterizes environmental taxes is the total revenue from their payment, measured in millions of dollars. USA. Data from 24 countries (Austria, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Ukraine, United Kingdom) for the period 1994-2020 were used for the evaluation.

The first indicator that characterizes the existence of a relationship between the environmental tax and energy security is the total emissions of CO<sub>2</sub> from the production of electricity and heat. Theoretically, taxation of energy production from fossil sources should reduce their share in the country's overall energy balance and, as a result, reduce the level of carbon dioxide emissions in the process of energy production. However, the calculations did not confirm the expected dependence (Table 3.7). Thus, the detected dependence is statistically significant, however, the relationship turned out to be direct - the increase in revenues from environmental taxes is associated with the increase in the level of emissions. This indicates that environmental taxes in the energy sector work more as a fiscal tool.

Table 3.7. Results of the assessment of the impact of the environmental tax on the energy security indicator, which characterizes the total CO<sub>2</sub> emissions from the production of electricity and heat for the period 1994–2020

CO <sub>2</sub> emissions from electricity and heat production	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	0.001	0.000	1.55	0.002	-0.000	0.000	***
Constant	44.315	2.551	17.37	0.000	39.315	49.316	***
Mean dependent var	44.998		SD dependent var		12.961		
Overall r-squared	0.103		Number of obs		495		
Chi-square	2.413		Prob > chi2		0.120		
R-squared within	0.009		R-squared between		0.119		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

We note that the use of different types of energy is not only related to the availability of energy resources, but also has a differentiated impact on the surrounding natural environment, as well as a different level of utility losses. At the same time, the production of "ecologically dirty" energy in the conditions of the spread of the concept of sustainable development is unpromising and faces a number of prohibitions and restrictions. Thus, in the long term, it is important to plan the concept of energy development with the minimization of its environmental impact. This proved the necessity of evaluating the change in the level of emissions from the energy industry under the influence of environmental taxes (Table 3.8). The results are statistically significant, so it can be stated that with an increase of 1 million dollars sums of the environmental tax is followed by a reduction in CO<sub>2</sub> intensity by 0.0000144 kg. That is, the growth of

environmental taxes makes it possible to reduce environmental damage from the use of energy obtained from various sources of its production, which positively characterizes the regulatory effectiveness of environmental taxes.

Table 3.8. Results of assessment of the impact of the environmental tax on the energy security indicator characterizing CO2 intensity for the period 1994-2020 years

CO2 intensity	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.000	0.000	-8.45	0.000	0.000	0.000	***
Constant	2.44	0.117	20.84	0.000	2.21	2.669	***
Mean dependent var	2.275		SD dependent var		0.567		
Overall r-squared	0.007		Number of obs		513		
Chi-square	71.466		Prob > chi2		0.000		
R-squared within	0.133		R-squared between		0.004		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

A similar trend was confirmed when calculating the impact of the environmental tax on the energy security indicator, which characterizes the production of electricity from oil, gas and coal sources (Table 3.9). However, subject to an increase in the environmental tax by USD 1 million the production of electricity from the relevant natural resources will decrease by 0.0004438% of the total volume. This proves that environmental taxes in the long term are not only able to reduce the amount of emissions of harmful substances from energy production, but also stimulate the transformation of the energy balance, since energy producers have financial incentives to reduce their production from traditional sources, as well as to search for alternative sources of production energy. Given that alternative energy technologies require significant financial costs, the

system of environmental taxes and financial benefits in the field of alternative energy can work effectively. We believe that over time we will have to abandon this type of electricity altogether, either due to limited resources or due to the total introduction of renewable energy sources in all countries of the world.

Table 3.9. Results of assessment of the impact of the environmental tax on the energy security indicator characterizing the production of electricity from oil, gas and coal sources for the period 1994-2020 years

Electricity production from oil, gas and coal sources	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.001	0.000	-4.65	0.000	-0.001	0.000	***
Constant	55.094	5.362	10.27	0.000	44.584	65.604	***
Mean dependent var	49,984		SD dependent var		26.439		
Overall r-squared	0.028		Number of obs		519		
Chi-square	21.605		Prob > chi2		0.000		
R-squared within	0.051		R-squared between		0.038		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

One of the most important vectors of ensuring energy security is the country's ability to independently cover energy consumption needs. Thus, the global energy system today is characterized by large-scale cross-border flows of energy resources. At the same time, in most countries, a significant share is occupied by energy imports, which poses threats to energy security. Accordingly, the reduction of this indicator characterizes the growth of the country's energy security. To evaluate the effectiveness of the regulatory policy of the state in this direction, the impact of the environmental tax on net energy

imports was assessed (Table 3.10). Therefore, the results of the calculations indicate a direct connection between the indicated indicators, and therefore, an increase in the amount of the environmental tax can ensure an increase in net energy imports. This indicates the fact that currently environmental taxes do not have such a large-scale impact on the export-import structure of the energy balance of the countries under study.

Table 3.10. Results of assessment of the impact of the environmental tax on the energy security indicator characterizing net energy import for the period 1994–2020

Energy imports	Coef.	St. Err.	t-value	P-value	Low 95%	High 95%	Sig
Environmental tax revenues	0.001	0.000	4.23	0.000	0.000	0.001	***
Constant	39.272	5.36	7.33	0.000	28,766	49.777	***
Mean dependent var	44.719		SD dependent var		26.485		
Overall r-squared	0.007		Number of obs		513		
Chi-square	17.867		Prob > chi2		0.000		
R-squared within	0.038		R-squared between		0.006		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

An important parameter for ensuring energy security is the production of energy from waste and renewable substances. At the same time, this direction also affects environmental security. The results of the assessment of the impact of the environmental tax on the indicator characterizing combustible renewable energy sources and waste are statistically significant, and the relationship between them is direct (Table 3.11). That is, the increase in environmental spending can contribute to energy security by increasing combustible renewable energy sources

and waste (with an increase environmental tax revenues of 1 million dollars, renewable sources will increase by 0.002%).

Table 3.11. Results of assessment of the impact of the environmental tax on the energy security indicator characterizing combustible renewable energy sources and waste for the period 1994–2020

Combustible renewables and waste	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	0.0 02	0.000	6.39	0.000	0.000	0.000	***
Constant	5.529	1.171	4.72	0.000	3.234	7.824	***
Mean dependent var	7.238		SD dependent var		6.031		
Overall r-squared	0.138		Number of obs		513		
Chi-square	40.825		Prob > chi2		0.000		
R-squared within	0.104		R-squared between		0.164		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

The next step was to assess the impact of the environmental tax on energy consumption. In this context, the indicator of energy intensity of GDP is very informative, which generally characterizes the dependence of the economic system on the state of energy and reflects the impact of energy security on the functioning of the national economy as a whole. According to the obtained results (Table 3.12), it can be seen that the criteria of adequacy indicate that the built model is statistically significant, and therefore it can be confidently emphasized that increasing the amount of environmental tax contributes to the strengthening of energy security. Therefore, the quantitative increase of the environmental tax reduces the total energy consumption (by 0.00187 kg under similar conditions of the increase in the amounts of the environmental tax). This confirms

the high significance of environmental taxes not only for energy security, but also for the stability of the state's economic system as a whole.

Table 3.12. Results of assessment of the impact of the environmental tax on the energy security indicator characterizing energy consumption for the period 1994–2020

Energy use	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.002	0.000	-7.06	0.000	-0.002	-0.001	***
Constant	141.706	8.533	16.61	0.000	124.982	158.43	***
Mean dependent var	117.608		SD dependent var		47.039		
Overall r-squared	0.173		Number of obs		508		
Chi-square	49,832		Prob > chi2		0.000		
R-squared within	0.088		R-squared between		0.213		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

And the last evaluated parameter, which also confirmed the high level of influence of the environmental tax on energy security, was the indicator of fossil fuel consumption (Table 3.13). As in the previous calculation, the relationship between the determined indicators is inverse, that is, an increase in the environmental tax contributes to a reduction in the level of fossil fuel consumption. In this context, we note that environmental taxes have a complex transmission effect in ensuring energy security. After all, reducing the consumption of fossil fuel sources is usually characterized by their replacement by renewable sources in the structure of the energy balance, which increases its sustainability, taking into account the exhaustive potential of minerals.



Table 3.13. Results of assessment of the impact of the environmental tax on the energy security indicator characterizing fossil fuel consumption for the period 1994-2020 years

Fossil fuel energy consumption	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.001	0.000	-8.10	0.000	-0.001	0.000	***
Constant	77.924	3.715	20.97	0.000	70.642	85.206	***
Mean dependent var	73.118		SD dependent var		18.146		
Overall r-squared	0.028		Number of obs		513		
Chi-square	65.553		Prob > chi2		0.000		
R-squared within	0.131		R-squared between		0.036		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

As for energy security, based on the averaged relationship, we state that an increase in the environmental tax by 1 million dollars will allow to increase the total emissions of CO<sub>2</sub> from the production of electricity and heat (by 0.000066%), net energy import (by 0.0004601%), combustible renewable energy sources and waste (by 0.0001407%). The inverse relationship is observed between the environmental tax and CO<sub>2</sub> intensity (will lead to a reduction of 0.0000144 kg), electricity production from oil, gas and coal sources (will reduce by 0.0004438% of the total volume), energy consumption (will decrease by 0.00187kg), fossil fuel consumption (will decrease by 0.0018711%). Therefore, based on the obtained results of panel-regression modeling, it can also be argued that the environmental tax affects the level of energy security, and therefore is a necessary component in the analysis of the national security of an individual country.

### **3.4 Investigation of environmental taxes impact on the economic security**

In the context of ensuring national security, ensuring the stable development of the economy is also important. This determined the need to study the impact of environmental taxes on economic security. A number of parameters characterizing different areas of economic security were selected for evaluation:

- GDP growth, annual %;
- Income share held by lowest 20%;
- Industry (including construction), value added, % of GDP;
- Current account balance, % of GDP.

The parameter characterizing environmental taxes is the level of tax revenues of this group. Similar to the previous blocks of research, the data sample was formed for the years 1994-202 for 24 countries (Austria, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Ukraine, United Kingdom).

The results of panel regression modeling showed that the built models are statistically significant in all four cases, and therefore environmental taxes affect the level of economic security. The results of the study are shown in Table 3.14, indicating a feedback relationship, and therefore an increase in the amount of planting income from the environmental tax reduces the GDP growth rate. This may indicate that environmental taxes restrain the development of industries with a high level of harmful impact on the surrounding natural environment or with a high level of energy intensity. It can be assumed that at the initial stages there will be a reduction in the rate of economic growth, however, in the course of structural

transformations, we can expect a recovery of the rate of economic development and ensuring growth in other sectors.

Table 3.14. The results assessment impact environmental tax per indicator economic security which characterizes GDP growth for the period 1994-2020 years

GDP growth	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.001	0.000	-3.68	0.000	0.000	0.000	***
Constant	2.713	0.226	12.00	0.000	2.27	3.157	***
Mean dependent var	2.233		SD dependent var		3.695		
Overall r-squared	0.030		Number of obs		628		
Chi-square	13.520		Prob > chi2		0.000		
R-squared within	0.011		R-squared between		0.297		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

The next block for the analysis of economic security is the equality of income distribution among the population. This indicator characterizes the socio-economic security of the country and reflects its ability to uniformly increase the well-being of the population. In the long term, it is the indicators of the even distribution of the population's income that characterize the stability of the country's economic development, the growth of social and economic capital, compliance with the principles of democracy, increasing the efficiency of public spending, controlling the level of unemployment and ensuring the prosperity of the national economy. When analyzing the relationship between the environmental tax and the share of income belonging to the lowest 20%, a feedback relationship is also observed (Table 3.15). Accordingly, a reduction of this share of income by 0.000001% is possible, but with an increase in the amount of environmental tax by 1 million dollars.

Table 3.15. The results assessment impact environmental tax per indicator economic security which characterizes the share of income belonging to the lowest 20% for the period 1994 - 2020 years

Income share held by lowest 20%	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.000	0.000	-0.98	0.329	0.000	0.000	
Constant	7.837	0.282	27.81	0.000	7.285	8.389	***
Mean dependent var	7.825		SD dependent var		1.334		
Overall r-squared	0.012		Number of obs		423		
Chi-square	0.955		Prob > chi2		0.329		
R-squared within	0.002		R-squared between		0.006		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

Unfortunately, the revealed connections negatively characterize the impact of environmental taxes on economic security. The increase in the tax burden leads to a reduction in the incomes of the population, namely its most vulnerable group.

On the other hand, the influence of environmental taxes on the development of industry is important. Thus, preliminary results show that environmental taxes reduce GDP growth. At the same time, it is important to assess their impact on the performance indicators of industry as the largest generator of impact on the natural environment. The obtained results showed that such influence is statistically significant (Table 3.16) – the statistical significance of the obtained results is at the level of 99%. At the same time, this relationship is quantitatively measured by inverse dependence. If the amount of environmental tax increases by 1 million dollars, the added value of industry will decrease by 0.000224%. This allows us to claim that the slowdown in economic growth under the influence of

environmental taxes is due to changes in the scale of industrial operations.

Table 3.16. The results assessment impact environmental tax per indicator economic security which characterizes the added value of industry for the period 1994-2020 years

Industry (including construction), value added	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	-0.000	0.000	-12.4	0.000	0.000	0.000	***
Constant	27.748	0.870	31.89	0.000	26.043	29.454	***
Mean dependent var	25.007		SD dependent var		4.675		
Overall r-squared	0.103		Number of obs		627		
Chi-square	153.869		Prob > chi2		0.000		
R-squared within	0.214		R-squared between		0.098		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

The global measure of a country's economic security is its position in the foreign trade balance. Thus, dependence on imports not only characterizes the loss of competitiveness, but also increases the risks of internal instability due to external shocks. The export orientation of the country is also characterized by a certain level of risks. At the same time, the current state of affairs indicates the intensification of integration processes, which requires the openness of economies. At the same time, it is important for the country not only to increase export parameters, but also to observe the balanced development of the economic system, which does not foresee the exhaustion of the country's resource potential and ensures the possibility of its functioning both autonomously and in cooperation with external counterparties. That is why the state of the balance of

payments account was chosen as the next indicator for assessing the impact of environmental taxes on economic security.

Although the level of significance of the impact of the environmental tax on the current account balance is not too high, statistical significance of the relationship between the indicators at the level 90% can be interpreted as affecting the level of economic security by environmental taxes (Table 3.17).

Table 3.17. The results assessment impact environmental tax per indicator economic security which characterizes the balance of the current account for the period 1994-2020 years

Current account balance	Coef.	St. Err.	t-value	p-value	Low 95%	High 95%	Sig
Environmental tax revenues	0.001	0.000	1.74	0.081	0.000	0.000	*
Constant	-1.843	0.78.	-2.36	0.018	-3.373	-0.314	**
Mean dependent var	-1.255		SD dependent var		5.346		
Overall r-squared	0.066		Number of obs		621		
Chi-square	3.041		Prob > chi2		0.081		
R-squared within	0.000		R-squared between		0.149		
*** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$							

The obtained results prove that the growth of income from environmental taxes has a positive effect on the state of the country's current balance in foreign operations. On the one hand, such consequences are positive for the economic security of the country. But on the other hand, if the growth of tax revenues is associated with the scaling of environmentally harmful activities that provide not only the country's own needs, but also the country's exports, then it can be argued that in the long term, such dependence creates threats to national security already due to its environmental impacts. So, provided that the producer country has to compensate for the consequences of

environmental depletion, and the consumer country benefits from the results, in the long term such an increase in the scale of foreign trade increases the risks for the country's national security.

Summarizing the conducted research, we can state that parameters that characterize economic security were also marked by adequacy, and confirmed that the constructed models are statistically significant. That is, it would seem that the field of ecology has an indirect effect on the level of economic security, but the conducted research confirmed the opposite state of affairs. On the basis of the conducted calculations, we confirm that the amounts of environmental tax paid by households and enterprises to the budget have a high impact on each of the parameters of national security, and therefore it can be interpreted that environmental taxes are not only intended to establish a balance between the level of environmental damage and the amount of incurred costs for its compensation, but also ensure the stable development of the state.

Thus, the conducted study proved that environmental taxes have a wide regulatory potential of influence on national security, which makes their use relevant in view of the possibility of complex stimulation of the necessary transformations in the national economy, which will ensure the growth of environmental, energy and economic security.

## **4. ENVIRONMENTAL TAXES AND LOCAL COMMUNITY DEVELOPMENT**

### **4.1 Environmental taxes and local community resilience: bibliometric analysis**

In the context of the implementation the Sustainable Development Goal, ensuring progressive development of cities and communities becomes one of the priority directions of reforming world economic relations by 2030. At the same time, economic growth and local community resilience largely depend on environmental factors. That is why it is interesting from both a theoretical and a practical point of view to identify the relationship between environmental taxation (as one of the key tools for the implementation of the state fiscal and environmental policy) and local community resilience. This objective will be realized based on a bibliometric analysis of the Scopus publications on relevant topic with Vosviewer toolkit.

It should be noted that there are 152 Scopus publications in keywords, title or abstract of which it is mentioned both “environmental tax” and “local” and “resilience”. The first Scopus paper on the relevant topic was published in 1990, and the latest – in 2022. Figure 4.1 illustrates the dynamics of Scopus publications on environmental taxes and local community resilience in 1990–2022.

Considering data from Figure 4.1, it might be noted that in 1990–2006 there were no significant scientific interest to this issue, while from 2007 the intensity of publication activity increased significantly. Maximum number of papers on the relevant topic were published in 2019, while in 2020 and 2021 the dynamics decreased. This may relate to COVID-19 pandemic and shifting of scientific focus from the research of the chain “environmental taxes” – “local community resilience” to the chain “COVID-19” – “local community resilience”.



Nevertheless, despite a certain drop in publication by topic, the study of this relationship remains relevant.

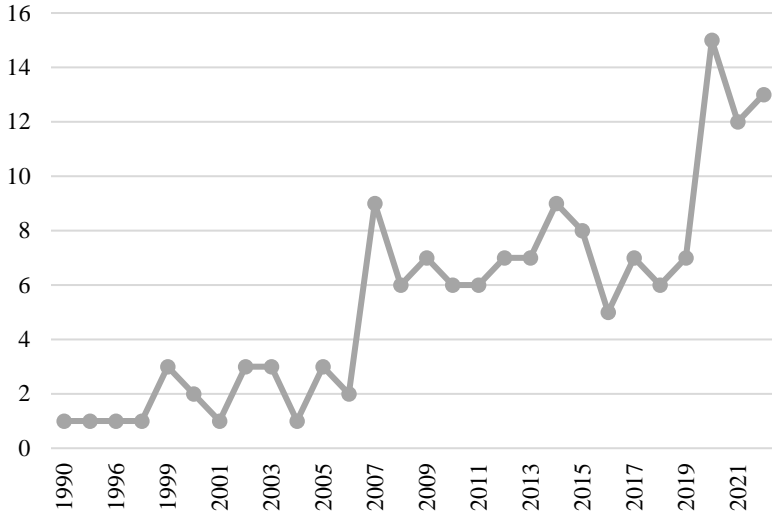


Figure 4.1. Number of Scopus publications on environmental taxes and local community resilience in 1990–2022

Source: created based on Scopus

In addition to the analysis of the general dynamics of the number of articles by topic, the study of their geographical affiliation is also of interest. According to Figure 4.2, it can be noted that the largest number of relevant publications for 1990–2022 were prepared by scientists from China, the USA, the United Kingdom, Japan and Canada. At the same time, Ukrainian scientists also belong to the flagships of scientific research in this field. Thus, domestic researchers published 6 articles on this topic.

Moreover, Table 4.1 illustrates TOP-10 the most cited Scopus publications concerning relationships between environmental taxation and local community resilience.

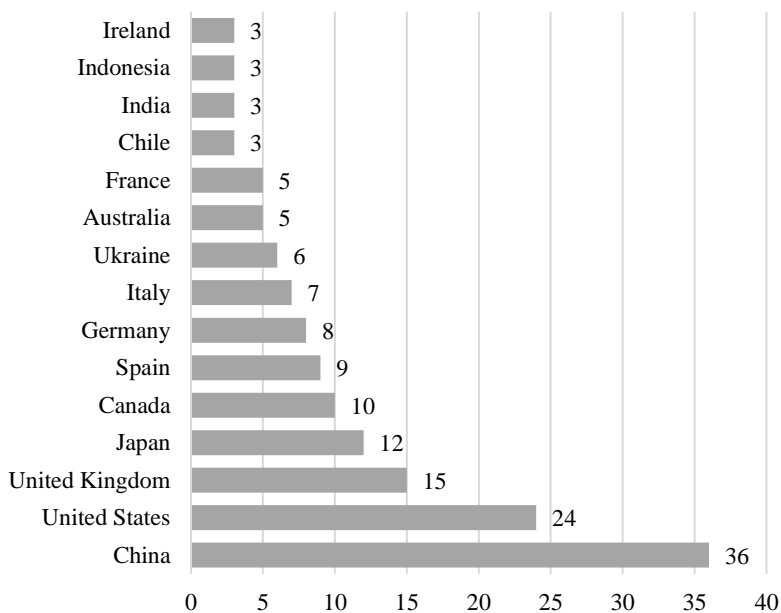


Figure 4.2. TOP–15 countries with the biggest amount of Scopus publications on environmental taxes and local community resilience in 1990–2022

Source: created based on Scopus

Table 4.1. TOP-10 the most cited Scopus publications on environmental taxes and local community resilience in 1990–2022

Document Title	Authors	<2018	2018	2019	2020	2021	2022	Total
Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology	Gallagher K.S., Muehlegger E.	200	57	50	33	46	38	424
Competition in regional environmental policies when plant locations are endogenous	Markusen J.R., Morey E.R., Olewiler N.	190	8	16	7	12	11	244

Document Title	Authors	<2018	2018	2019	2020	2021	2022	Total
A model for assessing the economic viability of construction and demolition waste recycling - The case of Ireland	Duran X., Lenihan H., O'Regan B.	84	9	14	18	13	15	154
Carbon leakage from unilateral Environmental Tax Reforms in Europe, 1995-2005	Barker T., Junankar S., Pollitt H., Summerton P.	65	5	8	6	4	4	92
Taxes, subsidies, and insurance as drivers of United States coastal development	Bagstad K.J., Stapleton K., D'Agostino J.R.	46	11	8	10	9	7	91
A systematic review of motivational values and conservation success in and around protected areas	Cetas E.R., Yasue M.	4	15	15	16	15	21	86
Integrating local ecological services into intergovernmental fiscal transfers: The case of the ecological ICMS in Brazil	Ring I.	45	3	6	9	12	7	82
The social costs of marine litter along European coasts	Brouwer R., Hadzhiyska D., Ioakeimidis C., Ouderdorp H.	1	9	8	11	17	12	59
Study of the environmental impacts based on the "green tax" - Applied to several types of building materials	Wu X., Zhang Z., Chen Y.	35	4	5	4	8	2	58
Environmental externality of coal use in China: Welfare effect and tax regulation	Chen Z.-M., Liu Y., Qin P., Zhang B., Lester L., Chen G., Guo Y., Zheng X.	17	15	10	4	4	6	56

Source: created based on Scopus

At the next stage, considering the bibliometric data on Scopus papers published during 1990-2022, visualization maps were built using Vosviewer (Figure 4.3 and Figure 4.4).

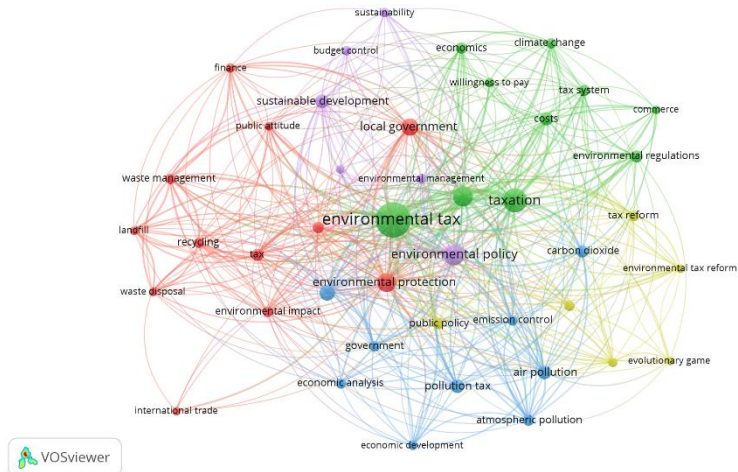


Figure 4.3. Visualization map on co-occurrence of keywords in Scopus publications on environmental taxes and local community resilience in 1990–2022

Source: created based on Scopus with Vosviewer

Considering bibliometric analysis results presented at Figure 4.3, it should be noted that there are 5 contextual clusters of research on environmental taxes and local community resilience, namely:

- red cluster (12 items) – covers publication concerning waste management, recycling and effective natural resources using in terms of local community resilience ensuring;
- green cluster (10 items) – covers papers focused on budgetary and fiscal issue, tax culture and willingness to pay environmental taxes to affect climate change and trigger local community resilience;
- blue cluster (9 items) – covers publications mostly focused on air pollution and greenhouse gas emission limitation using pollution taxes;

- yellow cluster (6 items) – consists of papers aimed at combination of environmental policy reform and tax reform;
- purple cluster (6 items) – includes papers focused on budget control in combination with sustainable development perspective.

In order to clarify evolutionary patterns of scientific research on environmental taxes and local community resilience, it is also necessary to point out peculiarities of overlay visualization within the bibliometric analysis framework (Figure 4.4).

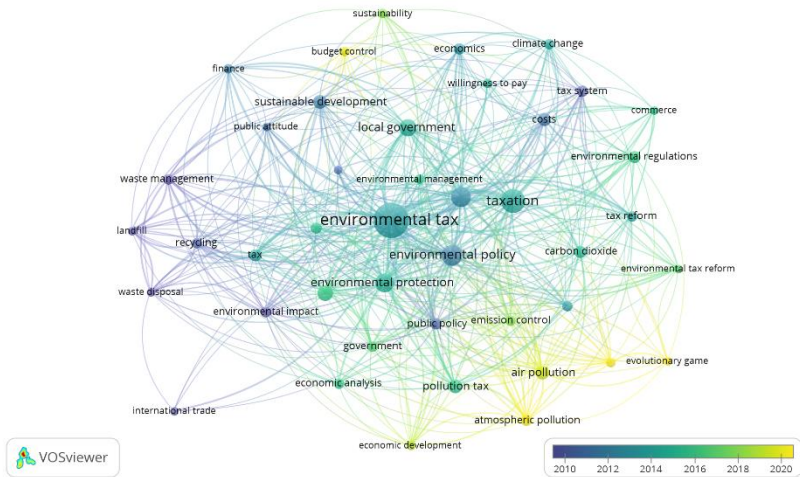


Figure 4.4. Overlay visualization map on co-occurrence of keywords in Scopus publications on environmental taxes and local community resilience in 1990–2022

Source: created based on Scopus with Vosviewer

It should be noted that earlier publications in this sphere relate to waste management, the use of tax instruments to stimulate the responsible behavior of economic agents in this direction, and to ensure local community resilience. The next wave of scientific research cover the issue of environmental taxation in the context of combating global climate change and ensuring environmental

responsibility. Instead, the most recent publications relate to combating atmospheric air pollution, ensuring the effectiveness of budget control, and promoting the sustainable development of communities and territories.

It should be noted that local community resilience might be ensured if local budget is formed considering such basic principles:

- principle of objectivity – compliance of the target operational and strategic guidelines of the budget policy with the real (objective) state of development of economic relations in the country and the dynamics of macroeconomic indicators;

- principle of progressivity – the formation of budget policy for future periods taking into account the achievements of previous years;

- principle of obligation – the obligation to fulfill regulated norms and implement specific measures within the framework of budget policy;

- principle of openness and transparency – the availability of information on various aspects of budget policy implementation, as well as control at various stages of the budget process;

- principle of scientific validity - the budget policy should be built taking into account the modern achievements of scientific thought;

- principle of effectiveness – measures developed within the budget policy should be aimed at maximizing a positive result in specific socio-economic conditions.

## **4.2. Role of environmental taxes in ensuring local community resilience**

In the context of the active implementation of the financial decentralization reform in Ukraine, one of the key tasks facing authorities at various levels is achieving balanced development

of local budgets and ensuring local community financial resilience. The solution of this task is ensured by expanding the sources of formation of the revenue base of local budgets (for example, collecting to the relevant local budgets the excise tax from retail trade of excise goods, increasing the share of environmental tax that is redistributed to the budgets of lower levels, etc.). At the same time, an important task that remains relevant even after the completion of the first and the second stages of the decentralization reform is the assessment of its real progress, especially in the context of identifying the impact of expanding the sources of local budgets revenue formation on their financial capacity and local community resilience.

In order to fulfil this objective, it is essential to characterize the dynamics of state budget and local budgets revenues in Ukraine during 2011–2020 (Figure 4.5).

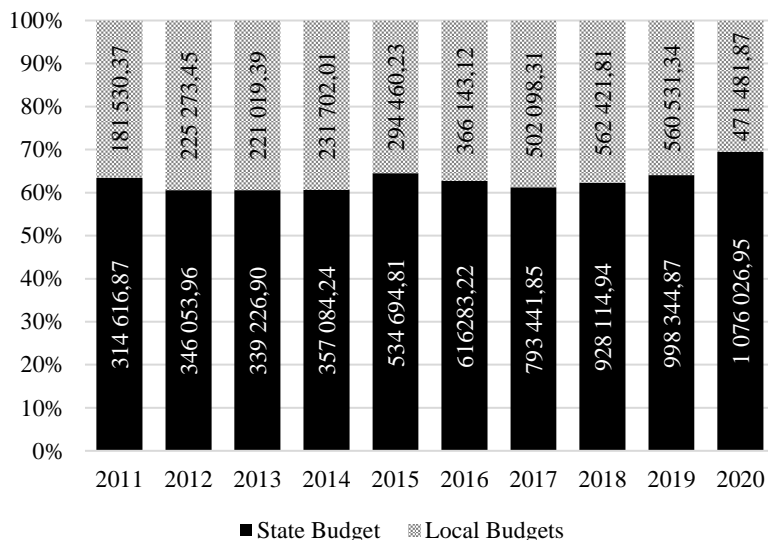


Figure 4.5. Dynamics of state budget and local budgets revenues in Ukraine in 2011-2020, mln UAH

Source: created based on the State Treasury Service of Ukraine reports

As far as it can be concluded from the Figure 4.5, the state-to-local budgets revenues ratio remain almost stable during the period of analysis even if comparing period before and after fiscal decentralization reform in Ukraine. It also might be considered that the share of state budget revenues in the structure of consolidated budget of Ukraine varies in the range 60–70 % during 2011–2020, while the share of local budgets revenues does not exceed 40 %. It is also interesting that the share of state budget revenues in the structure of consolidated budget of Ukraine even increased in 2015 despite launching the first stage of fiscal decentralization reform, in 2016–2017 it stabilized and equalized to the 2012–2014 level, while in 2019–2020 the upward trend was renewed. This led us to the conclusion that fiscal decentralization reform in Ukraine have some impact on the increase of the absolute values of local budgets revenue, while after the analysis of relative indicators became obvious that this reform did not lead to the real improvement of local budgets fiscal autonomy and local communities' resilience.

It is also becoming crucial to analyze specifically the state-to-local budgets tax revenues ratio (Figure 4.6). It should be noted that most of tax revenues are collected in the State Budget of Ukraine (the share of state budgets tax revenues varies between 75–80 %, while in the local budgets it is accumulated no more than 25 % of all collected taxes in Ukraine). Nevertheless, it should be noted that the absolute value of tax revenues in State Budget increased almost 4 times during 2011–2020, while the same indicator for local budgets is little less – 3.25. The volumes of local budgets tax revenues began dynamically grow after launching fiscal decentralization reform.

Since the volume of tax revenues is the main indicator of the financial capacity of local budgets and local community resilience, it is necessary to analyze the indicator of tax decentralization, which is calculated as the ratio of tax revenues



of local budgets to tax revenues of the consolidated budget (Figure 4.7).

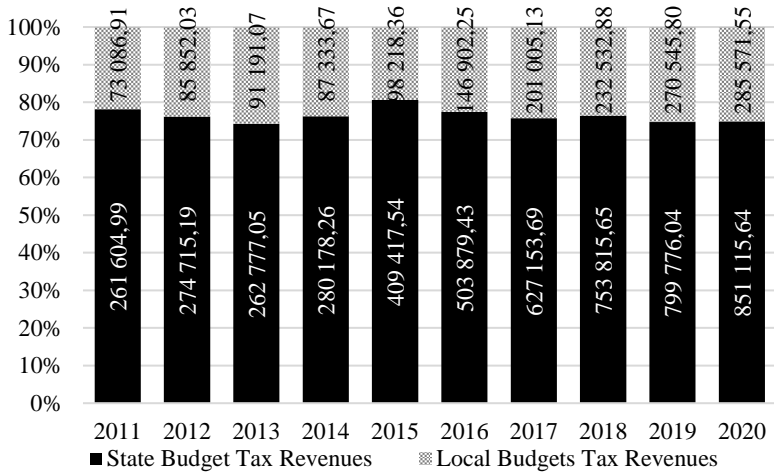


Figure 4.6. Dynamics of state budget and local budgets tax revenues in Ukraine in 2011-2020, mln UAH

Source: created based on the State Treasury Service of Ukraine reports

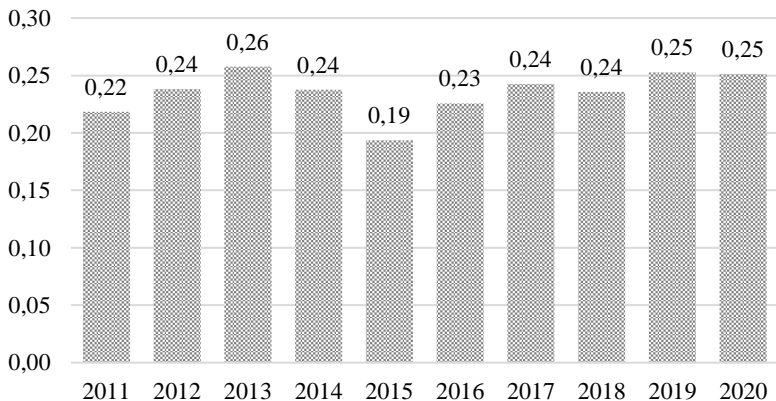


Figure 4.7. Dynamics of local budgets tax decentralization in Ukraine in 2011–2020, %

Source: created based on the State Treasury Service of Ukraine reports

Thus, according to the presented analytical information, it can be seen that the level of tax revenue decentralization has become somewhat lower after the decentralization reform compared to the pre-reform period.

Since the revenue part of local budgets is predominantly formed from not only tax revenues but also from inter-budgetary transfers, for a more comprehensive understanding of the state of the local budgets' financial capacity and local community resilience, it is important to analyze this indicator in more detail (Figure 4.8).

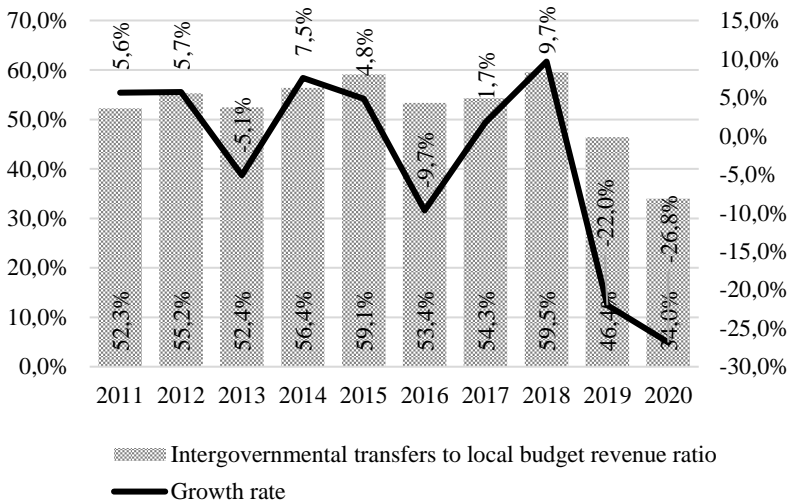


Figure 4.8. Dynamics of the share of official transfers in local budget revenues (left axis) and growth rates of transfers to local budgets (right axis) in Ukraine in 2011–2020, %  
Source: created based on the State Treasury Service of Ukraine reports

As it can be seen from Figure 4.8, the share of official transfers in local budgets revenues is about 50 % but based on the data it can be observed a sharp decline in its weight (to 34%) and the decrease rate is -26.8% in 2020. Because if the own

revenues of local budgets is not sufficient to fulfil the tasks assigned to local authorities and at the same time the dependence on revenues from the state budget increases, this indicates the imperfection of the distribution of powers in the system of inter-budgetary relations and the need to increase revenues to local budgets.

Therefore, it can be concluded that positive changes in the state of of the local budgets' financial capacity and local community resilience are becoming noticeable and fiscal decentralization reform forma the background for local community autonomy and self-sufficiency.

At the same time, to identify those tax revenues that contribute to strengthening the financial capacity of local budgets, it is worth analysing their structure in the pre-reform and post-reform periods, which is presented at Figure 4.9.

The presented analytical data allow us to clearly trace the difference between the structure of tax revenues of local budgets before the start of the fiscal decentralization reform and after it. During 2008–2014, from 71% to almost 78% of tax revenues of local budgets were formed by redistribution of national taxes on incomes, profits, and increases in market value, while after 2015, their significance in the overall structure of tax revenues decreased to 65%. However, in the pre-reform period, 11–17% of tax revenues were generated by fees (rents) for the use of natural resources, while in the post-reform period, its share barely exceeds 2%. Among the positive changes activated by the reform of fiscal decentralization, the noticeable increase in the specific weight of local taxes and fees, which make up more than a quarter of tax revenues of local budgets, deserves special attention.

In addition, due to the inclusion in the local budgets of excise tax from retail trade of excisable goods, a new block appeared in the structure of tax revenues – internal taxes on goods and

services, the specific weight of which during 2015–2020 varies in the range of 5–10 %.

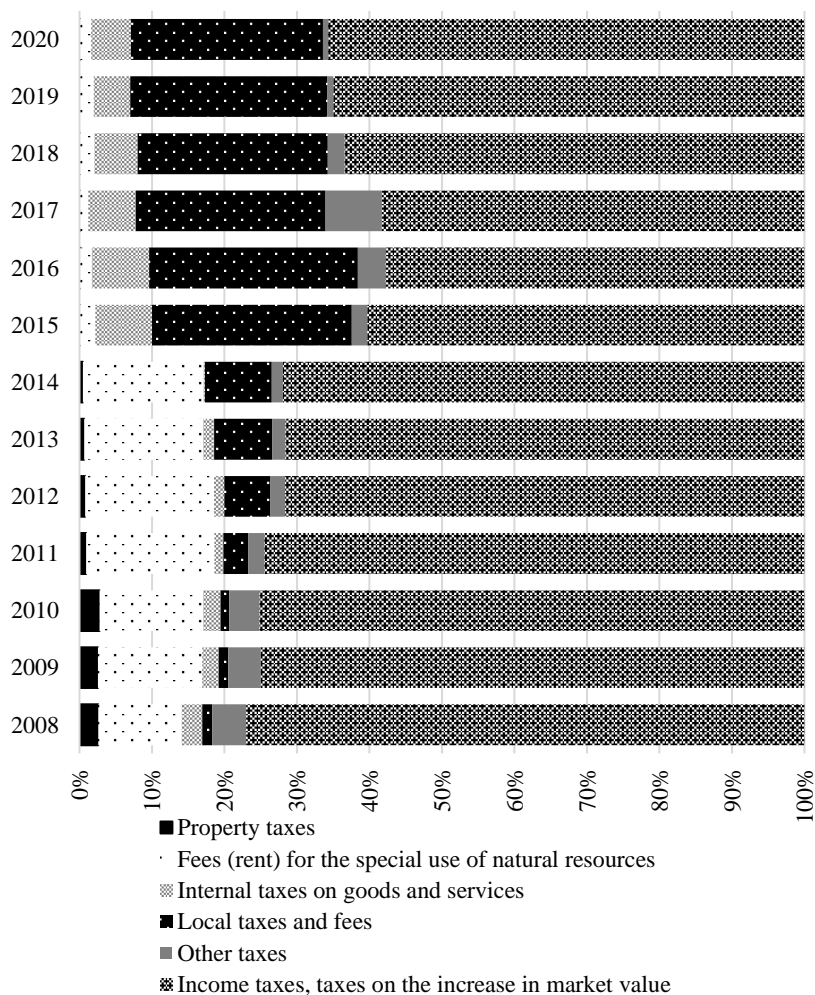


Figure 4.9. Dynamics of tax revenues structure of local budgets in Ukraine 2008-2020, %

Source: created based on the State Treasury Service of Ukraine reports

In the context of substantiating the significance of the environmental tax for budgets of different levels, it is advisable to analyze its specific weight both in the total revenues of the relevant budgets and in the tax revenues of each of them, which are presented at Figures 4.10–4.13.

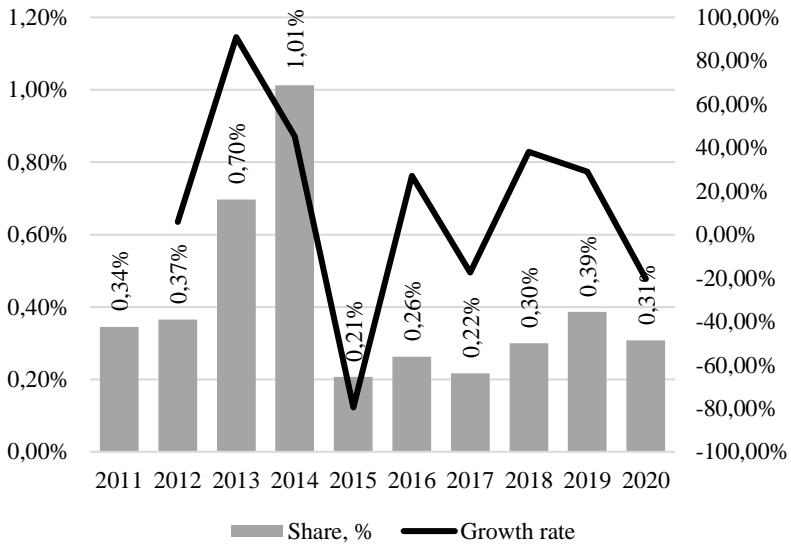


Figure 4.10. Dynamics of the environmental tax weight in the revenues of the State Budget of Ukraine (left axis) and the dynamics of its change (right axis) for 2011-2020

Source: created based on the State Treasury Service of Ukraine reports

According to the results of the analysis of information presented at Figure 4.10, it can be noted that the environmental tax is not characterized by a high level of fiscal efficiency, since its share in the revenues of the State Budget of Ukraine does not exceed 1% (except for 2014, in which this specific weight was 1.01%). It is also worth noting that on average during the research period, the value of the indicator is 0.41%, which indicates the absence of significant fluctuations. The most

significant change of the studied parameter was in 2013 and 2014, while this trend leveled off already with the beginning of the implementation of the fiscal decentralization reform.

The dynamics of the weight of the environmental tax in the tax revenues of the State Budget of Ukraine is presented at Figure 4.11.

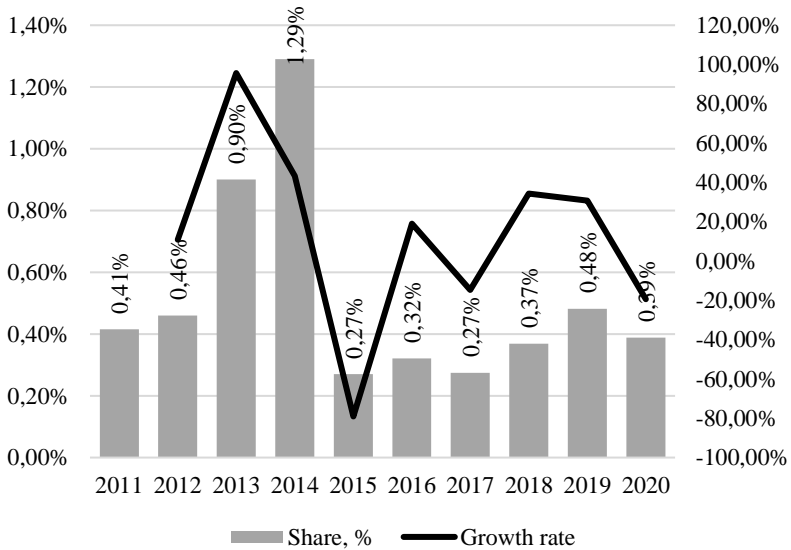


Figure 4.11. Dynamics of the environmental tax weight in the tax revenues of the State Budget of Ukraine (left axis) and the dynamics of its change (right axis) for 2011-2020

Source: created based on the State Treasury Service of Ukraine reports

It is worth noting that the average value of the studied indicator for 2011-2020 is 0.52%, and the highest specific weight of the environmental tax in the tax revenues of the State Budget, as well as in its total revenues, was precisely in 2013 and 2014.

Thus, in general, it can be noted that despite the change in the proportions of environmental tax redistribution between state

and local budgets in the pre-reform and post-reform periods, this did not lead to significant dynamic and structural changes in the level of this indicator for the State Budget of Ukraine.

At the same time, in order to formalize the role of environmental taxes in ensuring the financial capacity and local community resilience, it is expedient to analyse the dynamics of its specific weight in general revenues and tax revenues of local budgets, presented at Figures 4.12 and Figure 4.13.

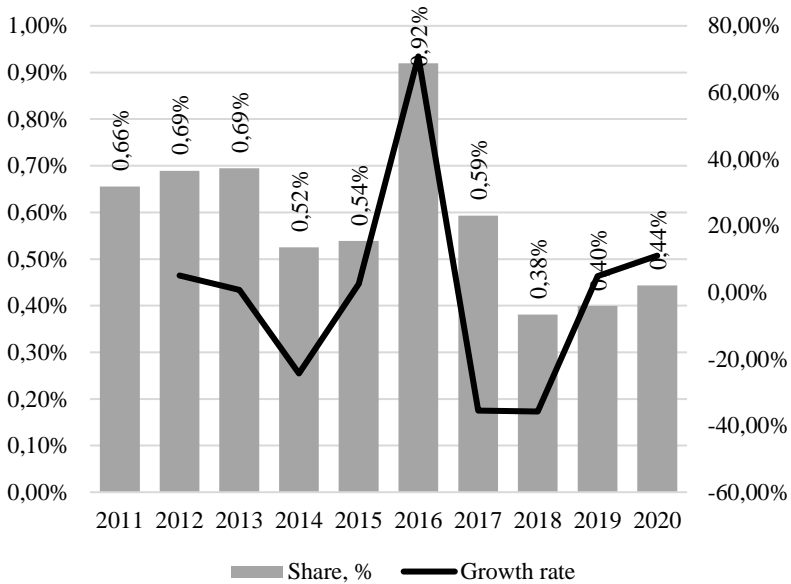


Figure 4.12. Dynamics of the environmental tax weight in the revenues of the local budgets of Ukraine (left axis) and the dynamics of its change (right axis) for 2011-2020

Source: created based on the State Treasury Service of Ukraine reports

It is fair to note that the environmental tax plays a somewhat higher fiscal value for local budgets (both in general revenues and tax revenues). In particular, the share of environmental tax

in local budget revenues for 2011–2020 was on average 0.58%, and in tax revenues – 1.44%.

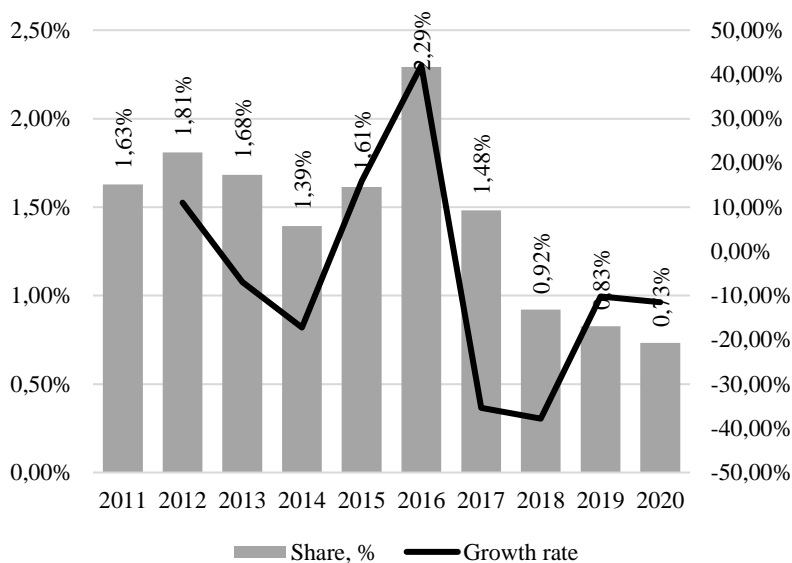


Figure 4.13. Dynamics of the environmental tax weight in the tax revenues of the local budgets of Ukraine (left axis) and the dynamics of its change (right axis) for 2011-2020

Source: created based on the State Treasury Service of Ukraine reports

In addition, it is worth noting that this indicator in local budgets revenues, unlike the State Budget of Ukraine, reaches its maximum value in 2016, while in 2017–2020 its significance gradually decreases. Thus, it is fair to note that despite the change in the proportions of environmental tax revenues to local budgets, its fiscal significance remains critically low for both local and state budgets.

In general, according to the results of the analysis, it can be noted that the fiscal decentralization reform led to the transformation of the structure of tax revenues and the increase in the importance of certain groups of taxes and fees, the role of which was much smaller in the pre-reform period.



### 4.3 Local community resilience in times of coronavirus disease (COVID-19) pandemic

The coronavirus disease (COVID-19) pandemic has led to the need to activate fundamental transformational processes designed to ensure that the destructive impact of COVID-19 on the country's national security, macroeconomic stability and local community resilience is absorbed. In such conditions, it is important from both a theoretical and a practical point of view to determine the theoretical-empirical causal relationships and its changes in the pandemic comparing with pre-pandemic period. To implement the task, it is proposed to carry out a bibliometric analysis using the Vosviewer toolkit. It is found 1061 Scopus publications for the search query (TITLE-ABS-KEY (COVID-19)) AND (municipal OR "local community" AND resilience). Number of relevant documents by countries is presented at Figure 4.14.

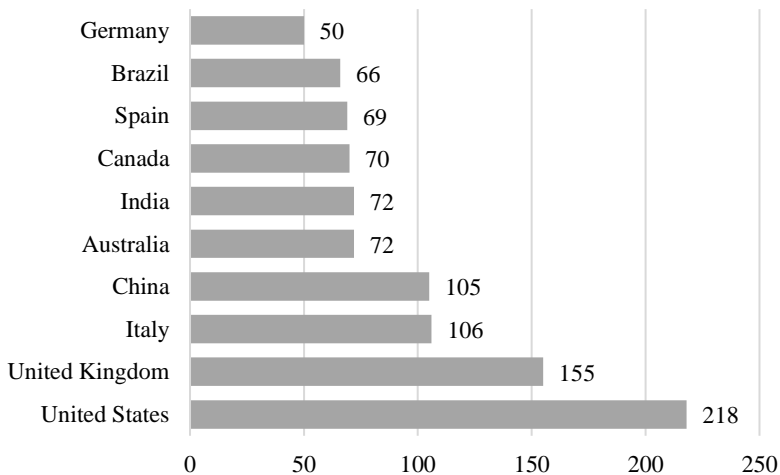


Figure 4.14. Number of Scopus publications on relevant topic by countries

Source: created based on Scopus

Thus, it can be noted that researchers from the United States, United Kingdom, Italy, China, and Australia provide the largest number of publications on relevant topic. It is interesting to note that the world leaders in the number of COVID -19 cases are the United States, India, Brazil, France, and Germany, and in terms of mortality – the United States, Brazil, India, Russia and Mexico (Worldometer, 2022). Thus, there is a coherence between COVID-19 morbidity and mortality rates and the publishing activity of scientists on the same topic in some countries. Number of documents on relevant topic by subject are presented at Figure 4.15.

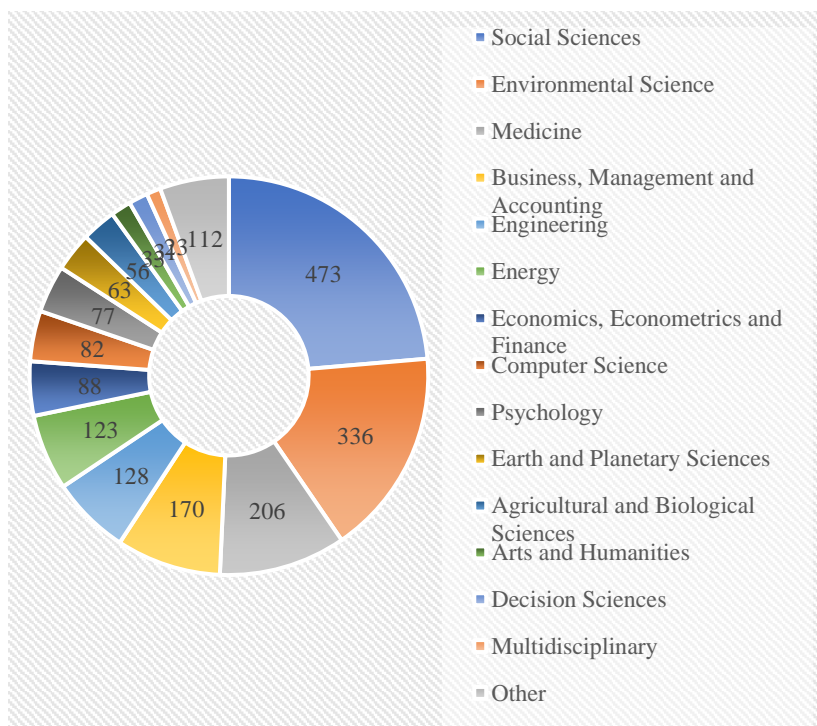


Figure 4.15. Number of Scopus publications on relevant topic by subject are presented

Source: created based on Scopus



- blue cluster (73 items) – covers publications mostly focused on different medical risk factors of COVID-19;
- yellow cluster (69 items) – consists of papers aimed at combination of environmental and sanitation factors impact in resistance to COVID-19;
- purple cluster (67 items) – includes papers focused on local community development and resilience in terms of COVID-19 negative impact.

Moreover, Figure 4.17 demonstrates co-occurrence of documents on relevant by countries.

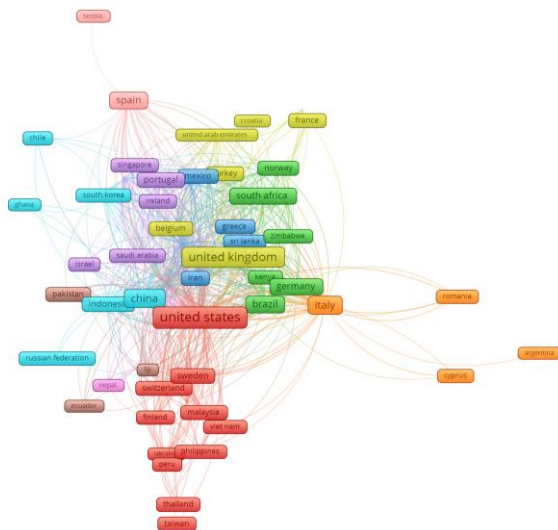


Figure 4.17. Co-occurrence of Scopus publications on COVID-19 and local community resilience by countries

Source: created based on Scopus with Vosviewer

As far as it can be seen from Figure 4.17, there is intercontinental cooperation between authors of Scopus publications on COVID-19 and local community resilience.

The TOP-10 most cited Scopus publications on relevant topic are presented in Table 4.2.

Table 4.2. TOP-10 the most cited Scopus publications on COVID-19 and local community resilience in 2020–2022

Document Title	Authors	2020	2021	2022	Total
The 2020 report of The Lancet Countdown on health and climate change: responding to converging crises	Watts N., Amann M., Arnell N. et al.	1	309	215	529
Economic and social consequences of human mobility restrictions under COVID-19	Bonaccorsi G., Pierri F., Cinelli M., Flori A., Galeazzi A., Porcelli F., Schmidt A.L., Valensise C.M., Scala A., Quattrociochi W., Pammolli F.	41	228	170	441
Socialising tourism for social and ecological justice after COVID-19	Higgins-Desbiolles F.	46	194	156	396
Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic	Sharma H.B., Vanapalli K.R., Cheela V.S., Ranjan V.P., Jaglan A.K., Dubey B., Goel S., Bhattacharya J.	6	119	133	265
Slum Health: Arresting COVID-19 and Improving Well-Being in Urban Informal Settlements	Corburn J., Vlahov D., Mberu B., Riley L., Caiaffa W.T., Rashid S.F., Ko A., Patel S., Jukur S., Martinez-Herrera E., Jayasinghe S., Agarwal S., Nguendo-Yongsi B., Weru J., Ouma S., Edmundo K., Oni T., Ayad H.	42	124	88	255
The psychological impact of COVID-19 pandemic lockdowns: A review and meta-analysis of longitudinal studies and natural experiments	Prati G., Mancini A.D.	0	77	170	248

Document Title	Authors	2020	2021	2022	Total
Governance, technology and citizen behavior in pandemic: Lessons from COVID-19 in East Asia	Shaw R., Kim Y.-K., Hua J.	42	106	96	244
Reviving tourism industry post-COVID-19: A resilience-based framework	Sharma G.D., Thomas A., Paul J.	1	73	159	234
Impact of COVID-19 on the social, economic, environmental and energy domains: Lessons learnt from a global pandemic	Mofijur M., Fattah I.M.R., Alam M.A., Islam A.B.M.S., Ong H.C., Rahman S.M.A., Najafi G., Ahmed S.F., Uddin M.A., Mahlia T.M.I.	1	97	116	217
Impacts of COVID-19 on energy demand and consumption: Challenges, lessons and emerging opportunities	Jiang P., Fan Y.V., Klemes J.J.	0	85	128	213

Source: created based on Scopus

It can be noted that within TOP-10 Scopus publications on COVID-19 and local community resilience most of them concerning changes in economic, social, energy or environmental spheres affected by pandemic.

In order to underline causality between COVID-19 and local community (municipal) resilience, it is necessary to analyse Municipal Resilience Index, methodology formation of which presented at Figure 4.18.

The global Municipal Resilience program has engaged with 140 cities in 66 countries.

According to OECD definition “Resilient cities are cities that can absorb, recover and prepare for future shocks (economic, environmental, social & institutional). Resilient cities promote sustainable development, well-being and inclusive growth. The OECD is investigating how cities can increase their resilience.”

The radial diagram shows the performance of the city on each of the 12 Goals of the City Resilience Index.



Figure 4.18 – Municipal Resilience components

Source: <https://www.cityresilienceindex.org/#/city-profiles>

Unfortunately, there are no analytical data on the Municipal Resilience because these approaches are rather new but their launching defining perspectives for further in-depth research on the impact of COVID-19 or other similar threats on local communities' resilience in nearest future.

## CONCLUSIONS

The development of various sectors of socio-economic life is accompanied not only by the growth of the national product, the improvement of the level of population well-being, but also by the aggravation of environmental problems and the activation of previously irrelevant environmental risks. The scale and severity of environmental problems have led to the fact that the ecological perspective occupies one of the most important places in the context of the implementation of Sustainable Development Goals to 2030.

An important contribution to the formation of the conceptual, organizational and functional foundations of environmental taxation was made by A. Pigu. The scientist identified the environmental tax as an important instrument for overcoming the negative consequences of anthropogenic and industrial impact on the environment. The analysis proved that among modern theoreticians and practitioners in the field of environmental taxation, there is currently no ambiguity regarding the primary role of this tool – as a tool for encouraging environmentally responsible behavior or as a tool for restraining environmentally threatening behavior of economic agents. No less debatable is the issue of using tax revenues from environmental taxes: to strengthen the fiscal capacity of the budget or to finance environmentally protecting programs. Given this polarity of theoretical and practical approaches, environmental taxes can perform fiscal, stimulationg or restricting functions. In the world practice there are the following types of environmental taxes: energy tax, carbon tax, water pollution tax, aAir transportation tax, air pollution tax, vehicle emissions tax, waste tax, packaging tax, tax on pesticides, fertilizers, chemicals, fees for environmental protection. However, in European countries the most common are energy taxes, transport taxes and taxes on resources and



pollution. At the same time, the first group is characterized by the highest level of fiscal potential in European countries.

The analysis of the evolutionary patterns of the formation of environmental taxation in Ukraine proved the existence of its origins even in the times of Kyivan Rus. However, in its current form, the system of environmental taxation was formed in 2011 with the adoption of the Tax Code of Ukraine.

It is also worth noting that environmental reporting and environmental auditing are becoming popular as a tool for stimulating corporate environmental responsibility. Informational, control, analytical and statistical functions can be distinguished among the functions of environmental reporting. At the same time, the environmental audit provides a systematic and objective assessment of the organization in terms of its management and processes that are focused on the protection of the environment and harmonizes the balance between the activities of the company and the environment.

Based on the empirical analysis results on the impact of environmental taxes on the components of national security, it was established that it is an inhibitor of the growth of greenhouse gas emissions, fertilizer consumption, fishery production, and electricity production, but acts as a driver for the development of renewable energy and electricity imports. Environmental taxes also have negative impact on macroeconomic dynamics and the equality of income distribution.

Analysis of the impact of environmental taxes on the financial autonomy and local communities resilience proved the absence of a statistically significant impact of this tool in ensuring the financial capacity of local budgets.

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## ANNEX A

Table A.1. Approaches of domestic and foreign scientists to the interpretation of the concept of "environmental audit"

Foreign approach		Domestic approach	
Author	Peculiarities of interpretation	Author	Peculiarities of interpretation
Zhang (1996)	Economic overview, economic valuation and economic valuation activities carried out by independent auditing institutions and auditors, focusing on compliance, transparency and efficiency of behavior	Law of Ukraine «About the protection of environment»	Environmental audit (voluntary, mandatory) is performed to evaluate the effectiveness of environmental protection measures to meet the needs of internal stakeholders (insurance companies, shareholders, investors, owners, the public, etc.)
Hong' an & Jiang (1998)	It is an auditing activity that attests to the authentication of the environmental management system of the government, enterprises or institutions and evaluates their impact on the environment, which ensures their effective control and compliance with the requirements of sustainable development	Shulgenko (2005)	Independent verification of accounting (financial) statements and other documentation for compliance with the current environmental legislation



Continuation of Table A.1

Foreign approach		Domestic approach	
Author	Peculiarities of interpretation	Author	Peculiarities of interpretation
Qiang (1999)	The type of independent economic supervision, on the validity, legality and efficiency of financial income and expenses associated with economic activity in the sector of dowkill management,	Shevchuk et al. (2010)	A management tool based on a systematic approach that assesses the environmental efficiency of a company's management for the preservation of the natural environment
Gao & Wu (2000)	Includes financial and compliance audits and is a type of control activity that monitors responsible entities for their environmental responsibilities by reviewing environmental reports of responsible entities and environmental management activities	Danylyshyn. (2002)	Enterprise activities for the implementation of independent domestic activities carried out on the basis of the contract, Which include the collection and evaluation of information about the state of technological and environmental equipment in the company, its compliance with environmental legislation, to ensure environmental sustainability

Continuation of Table A.1

Foreign approach		Domestic approach	
Author	Peculiarities of interpretation	Author	Peculiarities of interpretation
Li & Yan4g (2004)	Validation of the fairness, legality and efficiency of activities that combine environmental responsibility in accordance with environmental auditing standards	Borysov (2002)	Performing independent qualified analysis and assessment of business activities that affect the environment and developing recommendations to reduce the negative impact on the environment
Cambridge dictionary (2021)	Review of company operations to assess their impact on the environment and analysis of factors regarding the company's compliance with environmental protection laws	Law of Ukraine «About ecological audit»	This is a documented, independent process of evaluation of the object of environmental audit to determine the compliance of certain activities, measures, conditions, requirements of Ukrainian legislation on the protection of the natural environment

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