

Resource saving as a tool for environmental and production management in ensuring economic security of sustainable enterprise development

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Abstract. The study is dedicated to the role of resource-saving as an efficient tool for environmental and production management in the context of ensuring sustainable development and economic security of enterprises. The article analyzes the environment and assesses the progress of environmental protection in the national economy according to the Environmental Performance Index. It is determined that resource saving is aimed at optimizing the use of resources and minimizing losses in production processes to reduce enterprises' environmental impact and increase their competitiveness. Industrially developed countries spend on average 2.5% of GDP annually on innovative energy and resource-saving solutions (the UK – 2.2%, Germany and France – 2.5%, the USA – 2.7%, Japan – 2.9%, Sweden – 3.3%), while the investment resource-saving potential, unfortunately, is minimized and amounts to 0.34%. At the same time, the share of enterprises' funds in the total expenditures on innovations is constantly increasing to 83.9% in 2020. More than 80% of enterprises implemented resource-efficient measures precisely because of changes in energy and raw material prices, independently finding ways to implement their actions to efficiently use resources.

1 Introduction

Production and economic activities have a significant impact on the natural environment, and resource saving is becoming a key tool in the environmental and production management of enterprises. Rapid industrialization and growing demand for resources, rational use of energy, water, raw materials and other material resources are important to ensure sustainable development of enterprises and economic security [1, 2].

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Resource saving is not only an environmental responsibility but also a strategic step towards optimizing production processes. Enterprises that successfully implement and practice resource saving principles receive significant benefits in the form of cost reduction, increased competitiveness and sustainable development.

In this context, the economic security of enterprises is closely related to the ability to use resources rationally, avoid their overconsumption and ensure the efficiency of production processes. This relationship makes resource saving a strategic link in ensuring the environmental, social and economic sustainability of modern business [3].

One of the most pressing and growing problems is environmental sustainability directly related to the way of using natural resources and production processes.

Enterprises are facing the challenge of achieving economic growth without sacrificing environmental responsibility. Resource saving is a key factor in meeting this challenge. Reducing the use of raw materials, optimizing energy processes and rationalizing the use of resources are becoming priorities for enterprises to support sustainable development.

Besides, in the context of growing public awareness of environmental issues and increased attention to environmental responsibility, enterprises that actively implement resource saving principles have great potential to attract and retain customers, investors and partners.

In addition, in the context of global challenges related to climate changes where emission regulations and standards are becoming stricter, enterprises that take into account resource saving aspects are more adaptable and competitive in the economic environment.

Thus, resource saving is defined not only as the strategic step towards sustainable development but also as a prerequisite for ensuring the economic security of enterprises in the current and future conditions, and the study and implementation of resource saving principles is becoming a necessity for enterprises in the context of modern challenges and consumer needs aimed at sustainability and environmental responsibility.

The purpose of the study is to deeply understand and define the role of resource saving as the key tool for environmental and production management in the context of ensuring sustainable development and economic security of enterprises. This research paper is aimed at the advanced study of the issue and the provision of specific recommendations, contributing to the improvement of environmental and production management practices and ensuring the sustainable development of economic security of enterprises.

2 Literature review

The international community pays special attention to environmental protection based on the principle of sustainable economic development. It is reflected not only in the United Nations Conference on Environment and Development (Rio de Janeiro, 1992) [4], the International Declaration on Cleaner Production (United Nations Commission on Sustainable Development, 2012), the Rio+20 World Summit on Sustainable Development [5] but also in the approach to solving these problems on a global scale, as well as in international actions that have been actively implemented on a global and regional scale since the 1970s. The new concept of civilization development proclaimed in Rio de Janeiro is based on human ecology, economy and the recognition of the close interrelation of social problems and the fact that their comprehensive solution is possible only by close cooperation and coordination. The efforts of all members of the international community resulted in the Declaration with sustainable development goals and requirements as well as the definition of changes in existing economic models of consumption and production. The global community has long offered various concepts of environmental management as a system of environment load management.

Demand Side Management (DSM) is a key concept in the organization of resource saving. It was developed in the USA in the mid-1970s, and the concept was used as a synonym for load management and energy saving [2].

Least Cost Planning (LCP) means taking into account the optimization of resource consumption in determining the cost of manufacturing and production expenses [1].

Integrated Resources Planning (IRP) can be defined as a method of assessing whether energy savings are more attractive than expanding the energy supply sector by building new capacity and as a means of optimizing systematic and structured programs to affect energy demand [6].

Numerous scientists studied resource saving and environmental and production management, making a significant contribution to the understanding and improvement of these issues.

Bondar Iu. et al. [7], Hutsaliuk O. et al. [8], and Kharazishvili Y. et al. [9] are known for their work in environmental and production management and innovation strategies at the enterprise. They study environmental management and resource saving at enterprises; examine the relationship between the economy and the environment; stress the importance of creating efficient resource use systems to achieve sustainable development.

Erik Hansen explores sustainable production and the importance of resource saving in the context of economic security of enterprises. He examines efficient methods and strategies for enterprises to reduce costs and improve environmental impact [10].

Xavier Bazoval examines practical aspects of resource saving and production management in terms of closing production cycles. He studies how this can contribute to the sustainable development and economic security of enterprises [11].

Theoretical and methodical approaches to resource saving management were studied by such scientists as Danilishyn B.N. [3], Vozniuk M.A. [12], Vitka N.Y. [13].

Basics of modern scientific views on understanding the fundamentals of resource saving are revealed in papers by the following scientists: Pryvarnykova I.Y., Lytvynenko Y.I. [14], Kondratenko N.O., Taradai V.N. [15]. Scientists studied theoretical aspects of resource saving and mechanisms for increasing its efficiency, considered applied aspects of environmentalization of the nature management and resource saving policy, emphasized the need for proper waste management, etc.

These scientists make a significant contribution to the development of theoretical and practical aspects of resource saving and environmental and production management at enterprises, expanding knowledge and understanding of the importance of these aspects for ensuring the sustainable development of economic security of enterprises.

However, despite the large number of scientific papers and significant achievements in the study of theoretical principles of resource saving, the systematization of resource saving measures in the national economy requires further research.

3 Methods

The resource saving factor is the driving force behind management at all levels of increasing the efficiency of production and consumption of resources. The most important of them include: technological development, changes in resource prices, institutional factors, social and environmental changes, and globalization processes [16].

The development of technology mainly depends on the frequency and quality of inventions and discoveries in rational and economical use of natural resources as well as on the timing of their implementation in actual activities of business entities. The impact of technological development factors on resource saving can be expressed by P. Pilzer's formula [17]:

$$W = P \cdot T_n \quad (1)$$

where W is the available amount of natural resources suitable for industrial use (national wealth); P is a relatively fixed total stock of natural resources (discovered and undiscovered reserves); T is technology; n is the effect of technical achievements on natural resources.

Technology is the information factor determining the efficiency of the social production process. According to formula 1, the use of technology depends on the value of n that characterizes the level of technology development. Thus, constituent elements of formula 1, T and n , are interdependent and jointly affect the production of goods satisfying social needs.

The volume of manufactured products when using natural resources at a certain stage of technology development can be determined by formula 2 [16]:

$$V_{m.p.} = P \cdot C_e \quad (2)$$

where $V_{m.p.}$ – is the volume of manufactured products; C_e – is the coefficient of efficiency of using natural resources in production.

Formula 2 shows the impact of factors of scientific and technological progress (technological development) on the level of efficiency of using public resources.

Factors of changes in resource prices are an important catalyst for the resource saving process and create conditions for the shift to resource-saving development. The increase in resource prices has led to the increase in the cost of production of enterprises, resulting in the need for resource saving. Increased resource costs dramatically increase economic benefits of resource-saving measures, stimulating the adoption of managerial decisions facilitating implementation.

The quantity, quality and growth rate of resource stocks as well as the monopoly position of resource owners are related to fluctuations in resource prices. Sufficient resources on the market for producing goods can lead to stable or reduced prices, reducing incentives of consumers to save resources. The decrease in the supply of resources due to the decline in natural reserves causes the increase in resource prices and stimulates resource saving processes. An important factor affecting resource prices is the degree of monopoly of resource owners. They can artificially create a shortage or surplus of resources, manipulate prices and thus discourage or encourage the implementation of resource saving measures.

The definition of environmental and economic benefits of resource saving measures is based on changes in the total amount of resources. When determining 24 resource intensity indicators, the method of using a composite resource intensity indicator is more complete and accurate and can take into account economic, environmental and social impacts of resource saving.

Calculating the environmental benefit and economic benefit from resource saving is based on indicators of economic benefit and resource intensity of investment projects.

Authors of the paper [18] suggest using such indicators as net present value, internal rate of return and payback period to assess resource saving projects. The net cash flow is calculated by comparing the total energy intensity per unit of production activity by type of energy carriers before and after the implementation of energy saving, taking into account the amount of saved energy and its price per unit and is determined by formula 3:

$$R = \sum_{i=1}^m (e_{0i} - e_{li}) O_i P_i \quad (3)$$

where R is the main results from the implementation of investments, UAH; m – is the number of types of energy resources, the consumption of which changes as a result of the measure implementation; e_{oi} , e_{li} is energy intensity of 1 UAH of manufactured products for the i type of resource before and after the implementation of the measure, in natural units/UAH; O_i is the volume of manufactured products after the implementation of the measure, UAH; P_i is the unit price of the i type of energy resource, UAH.

Calculating the environmental and economic effect of resource saving. A common indicator for assessing resource saving measures is the difference between the economic benefit received from the project implementation and the cost. At the same time, in national practice, environmental and social components of resource saving are not actually taken into account when calculating the economic effect.

Methods allowing to assess social and environmental components of the economic effect of corporate resource saving [19]. The annual environmental and economic effect (EE) obtained by the enterprise implementing a set of resource saving measures is determined by formula 4:

$$EE = E_r + E_p + E_{ce} - \Delta A \sum + A_{from} + E_{n.s.} \quad (4)$$

where E_r is annual resource savings, UAH; E_p is the reduction in the amount of environmental payments of the enterprise due to the implementation of resource saving measures, UAH; E_{ce} are savings in other current expenses (purchase of auxiliary materials, energy, reduction of wage costs due to increased labor productivity), UAH; $\Delta A \sum$ is the total increase in the amount of depreciation charges for resource saving measures, UAH; A_{from} is a part of economic losses avoided by the enterprise by implementing resource saving measures, but which are not included in its environmental payments, UAH; $E_{n.s.}$ is the reduction of annual environmental and economic losses of enterprises as a result of industrial emergencies related to the resource, UAH.

The maximum value of the annual environmental and economic effect is a criterion for making a managerial decision on the implementation of the resource saving project.

4 Results

Resource saving is an important tool for environmental and production management aimed at optimizing the use of resources and reducing the negative impact of production processes on the environment. It is based on the principles of efficient use of resources, minimization of waste and pollution, as well as on innovation and technological solutions aimed at preserving natural resources.

As part of environmental and production management, resource saving includes a range of the following strategies and practices:

1. Efficient use of energy: Implementation of energy efficient technologies, optimization of production processes and energy management systems.
2. Rational use of raw materials: Minimizing the cost of raw materials by optimizing production cycles, using recycled materials and implementing recycling technologies.
3. The use of renewable resources: Development and adoption of technologies based on the use of alternative energy sources and renewable resources.
4. Water resources management: Efficient use of water by production processes, minimization of losses and pollution of water bodies.
5. Waste and pollution minimization: Introduction of waste management programs, adoption of wastewater and flue gas treatment technologies.

Resource saving helps companies not only reduce costs and increase productivity but also reduce their negative impact on the environment and increase their social responsibility.

Implementation of resource saving practices in environmental and production management is a key step towards ensuring sustainable development and preserving natural resources for future generations.

Due to climate change and environmental degradation, the world is moving towards more sustainable forms of production. Climate change, underutilization of resources, waste generation and unsustainable models of material consumption pose a threat to the global economy. Thus, a shift from a fossil fuel-based development model to a bio-based development model would be one of the ways to overcome these obstacles.

Over the past 200 years since the Industrial Revolution, the world's population has grown exponentially, while industrial and food production, resource consumption and environmental pollution have skyrocketed. Humans are using more resources, producing more waste and polluting the environment than the Earth's natural ability to regenerate and cleanse.

Over the past 50 years, despite the enormous efforts of humankind to protect the environment, the earth system has continued to deteriorate rapidly. The 2019 report by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) found that 78% (14 out of 18 people) of the benefits they derive from nature have increased as a result of intensified human activities, such as land use change. Income is rapidly declining along with population growth, economic development, and technological progress [20].

One of the most important indicators used to analyze the state of the environment and assess the progress of environmental protection in the national economy is the Environmental Performance Index (EPI) [21]. The index allows us to understand the state of the environment and public health and assess how far countries are from achieving their environmental policy goals.

According to the 2022 Environmental Performance Index ranking of countries, the top five countries out of 180 include: Denmark – 77.90 points out of 100, the UK – 77.70, Finland – 76.50, Malta – 75.20 and Sweden – 72.70 (Table 1).

Table 1. Environmental Performance Index ranking of countries [22].

| Country | 2022 | | 2020 | | 2018 | | Areas of change over 10 years |
|-------------|---------|-------|---------|-------|---------|-------|-------------------------------|
| | ranking | value | ranking | value | ranking | value | |
| Denmark | 1 | 77.90 | 1 | 82.5 | 3 | 81.6 | 14.9 |
| The UK | 2 | 77.70 | 4 | 81.3 | 6 | 79.89 | 23.0 |
| Finland | 3 | 76.5 | 7 | 78.9 | 10 | 78.64 | 21.0 |
| Malta | 4 | 75.2 | 23 | 70.7 | 4 | 80.9 | 25.4 |
| Sweden | 5 | 72.7 | 8 | 78.7 | 5 | 80.51 | 15.8 |
| Luxembourg | 6 | 72.3 | 2 | 82.3 | 7 | 79.12 | 13.5 |
| Slovenia | 7 | 67.3 | 18 | 72.0 | 34 | 67.57 | 8.6 |
| Austria | 8 | 66.5 | 6 | 79.6 | 8 | 78.97 | 7.2 |
| Switzerland | 9 | 65.9 | 3 | 81.5 | 1 | 87.42 | 8.2 |
| Iceland | 10 | 62.8 | 17 | 72.3 | 11 | 78.57 | 4.4 |
| Poland | 46 | 50.6 | 37 | 60.9 | 50 | 64.11 | NA |
| Russia | 52 | 49.6 | 60 | 49.5 | 109 | 52.87 | 6.2 |
| Bahrain | 90 | 42.0 | 56 | 51.0 | 96 | 55.15 | 5.7 |
| India | 180 | 18.9 | 169 | 27.6 | 177 | 30.57 | -0.6 |

In 2022, was ranked 52nd with a score of 49.60, which is much better than in 2020 – 60th place (index of 49.50). Over the past ten years (2012-2022), Russia has improved its index by 6.20 [22].

Safe and fair spaces for humankind define the space between environmental and social boundaries and emphasize the need to achieve sustainable development. D.W. O'Neill, A.L. Fanning, et al. have assessed safe and fair spaces of 150 countries and found that no country can ensure sustainable use while meeting the basic needs of its inhabitants. They also recommend increasing current levels of resource use by at least 2-6 times to fully achieve social justice [23].

In 2015, the United Nations Summit on Sustainable Development published the 2030 Agenda for Sustainable Development, suggesting 17 Sustainable Development Goals and 169 specific targets that require innovative models and methods to achieve these goals [24]. The enormous challenge of achieving the Sustainable Development Goals stresses the urgent need for the systematic understanding of mechanisms connecting people and nature [25] to improve human well-being and maintain sustainable resource use and environmental integrity [26].

The G20 should promote new economic models, increase resource efficiency and achieve sustainable growth. Institutions, societies and organizations have taken a variety of actions to address this problem in the way that meet the current demands without compromising the potential to meet the needs of future generations.

Limited resources should be used efficiently. One of the methods of such activity is resource saving. Resource saving means activities related to the conservation of any type of resources, i.e. resource saving is determined by the specific manifestation: material, land, labor, energy and other resources. Resource saving can be understood as the rational and integrated use of various resources, economical consumption and reduction of environmental impact based on the current state of technology development.

According to the type of accumulated resources, resource saving is divided into: material saving; water saving; energy saving; labor saving; and cost saving (preservation of material and technical facilities of production). Depending on the content of the process, resource saving can be considered in the following areas:

- reasonable resource saving is the maximum increase in the efficiency of resource use in the economy at the current state of technology development while reducing the impact on the environment;
- efficient resource saving is the efficient transformation of resources into final products;
- resource saving means a direct reduction in resource consumption per unit of output (direct savings), rationalization of the placement and storage of production and inventory (indirect savings)

Resource saving results in increased social, environmental and economic efficiency of production. Resource saving indicators are shown in Figure 1.

Before developing a resource saving management policy, the corporation's administration should analyze its activities, in particular [27]: analysis of the structure and quantity of consumed resources; dynamic analysis of resource consumption; analysis of the movement of resources in the production cycle; assess the level of accounting and control over the use of resources; analysis of physical and mental wear and tear of used machinery and equipment.

One of the main tasks faced by enterprises is to choose the method for resource saving management. At the same time, all these methods should form a comprehensive system. Therefore, it is recommended to link the approach to resource saving management to the existing resource saving management.

| Social | Environmental | Economic |
|---|---|--|
| <ul style="list-style-type: none"> • life expectancy; • rate of morbidity of the population; • provision of housing; • working conditions of citizens; • access of citizens to education, healthcare system, participation in public administration. | <ul style="list-style-type: none"> • emissions of harmful substances; • volumes of consumption of clean water; • share of plowed land; • development of rural areas; • volumes of buried hazardous waste; • volumes of green areas in cities. | <ul style="list-style-type: none"> • volumes of consumption of goods; • volumes of savings and investments per capita as a result of resource saving; • capital investments in resource saving activities; • volumes of financing of resource saving measures; • reduction of costs for the creation of territorial infrastructure due to resource saving; • increase in tax revenues to the territorial budget during the implementation of resource saving measures. |

Fig 1. System of resource saving indicators.

The analysis of the enterprise's resource saving state should address both qualitative and quantitative aspects. The qualitative analysis includes studying the prospects for resource saving due to scientific and technological progress, studying the state of commodity and resource markets, forecasting changes in supply and demand and their impact on the economic activity of the enterprise, as well as determining the necessary conditions and factors for the development of corporate resource potential. The quantitative analysis of resource saving is a complex task and is an integral part of the overall analysis of the economic potential of the enterprise. Besides, it is multi-level because the data obtained from the implementation at lower levels are transferred as raw information to higher levels for analysis.

The main characteristic of resource saving activities at modern enterprises should be a focus on the implementation of a set of measures that can be introduced quickly and cover all aspects of their activities and allow them to achieve maximum savings. An integrated resource saving management system of the enterprise should provide objective conditions for its implementation.

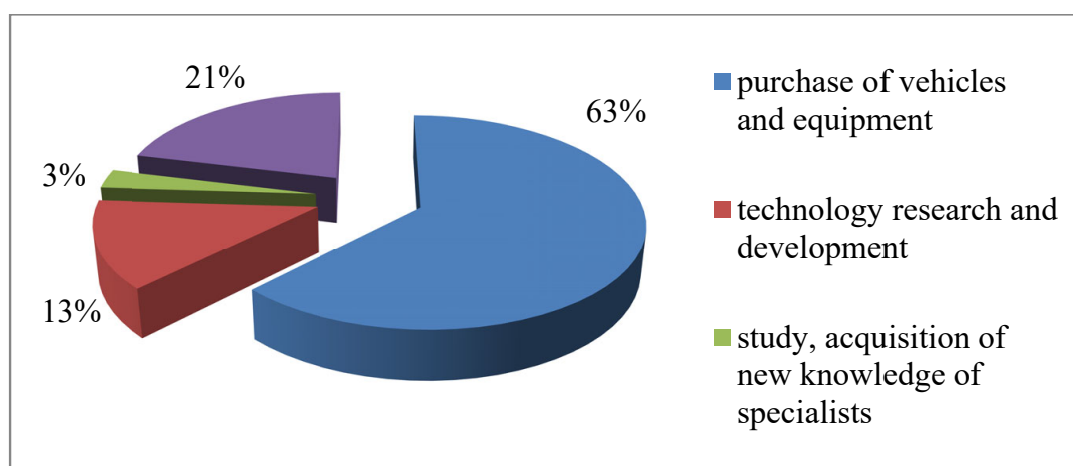


Fig. 2. Key areas of enterprise expenditures aimed at resource saving, % [28].

Key areas of enterprise expenditures (in percentage terms) aimed at resource saving are shown in Figure 2. The data shows that the national industry is moving towards resource saving and optimization of production processes but has not gone so far as to develop its own advanced technology to increase resource efficiency.

With the efficiency of using enterprise's material resources being largely related to the equipment and technology used by the enterprise, one should also add a set of methods, i.e., technical methods of resource saving management should be included in the classification of technology. But when the engineering and technical approach to resource conservation management excludes the legal approach from the classification, we believe that this is also unreasonable, as it is impossible to manage resource conservation reasonably without taking into account existing departmental laws and regulations. Therefore, we suggest distinguishing technical methods of resource saving management as an additional fifth group of methods.

Technical methods of resource saving management include: development of autonomous energy, application of scientific methods of labor organization, application of advanced technologies for the development of autonomous energy, optimization of equipment operating modes, use of automatic conveyor lines; energy audit; methods of material calculation, etc. An important characteristic of technical approaches to resource saving management is that they are applicable only to the internal environment of the enterprise, since engineering and technical services rarely operate outside the internal environment of the enterprise [29].

Corporate energy audits play a special role in this group of resource saving management methods. The energy audit is the assessment of the enterprise's energy consumption efficiency conducted by independent experts. These experts provided practical suggestions and measures to protect resources. This is the difference between the energy audit and the energy inspection. The latter only involves checking whether energy consumption parameters comply with the standards. A brief description of all groups of methods used in resource saving management is shown in a classification table 2.

Table 2. Classification of resource saving management methods [15, 30].

| Classification feature | Groups of management methods | | | | |
|--------------------------------------|---------------------------------|--|---------------------------------------|-----------------------------------|-------------------------------------|
| | Economic | Technological | Organizational and administrative | Social and psychological | Legal |
| Nature of interaction | Indirect | Direct | Direct | Indirect | Direct |
| Behavioral motives | Material interest | Mixed (compliance with technical requirements for results) | The need to meet quality requirements | Moral interest | The need to comply with legislation |
| Basis for choosing a specific method | Technical and economic analysis | Engineering and technical analysis | Organizational analysis | Social and psychological research | Analysis of the current legislation |

Based on this, the application of a particular resource saving management method, depending on specific factors of using material resources, can be carried out in three main areas: management of machinery and equipment; management of people; organization managing the production process via the interaction of people, technology and equipment.

The choice of an area should be directly related to the identification of the source of material resource losses.

For example, the process and technology area is frequently related to material losses occurring due to the use of too material-intensive methods and techniques for processing materials. If we talk about people management, losses in this area are most often caused by employee mistakes, low staff qualifications and lack of interest in improving productivity. Sources of losses for organizations throughout the production process can be: poor task control; irrational organizational structure that does not ensure uninterrupted production; poor communication between departments and between the administration and subordinates; poor logistics, etc.

Elements of the management system are distinguished by areas of application of the resource saving approach to production, logistics, sales, engineering and technical support. The matrix of resource saving management methods in relation to management areas is shown in Table 3.

Table 3. Resource saving management methods by areas of using material resources.

| Management methods | Areas of using material resources | | | |
|-----------------------------------|--|--|---|--|
| | Engineering and technological support | Logistics | Production of goods | Sales |
| Technological | Technical regulations | Informatization and computerization | Upgrading | Informatization and computerization |
| Organizational and administrative | Organizational regulations and briefing | Organizational briefing | Organizational regulations and briefing | Organizational briefing |
| Economic | Timing planning, standardization and control of resource consumption | Standardization and control of economic indicators | Planning, standardization, control and financial incentives | Financial incentives and control over the implementation of the sales plan |
| Social and psychological | Intangible and tangible methods of motivation aimed at increasing productivity and quality | | | |
| Legal | Compliance with relevant laws and regulations | | | |

The choice of certain resource saving management methods is related to the organization's goals. Key goals of resource saving are to increase profits, improve product quality, reduce material and energy intensity of production, and shorten the production cycle by saving resources.

When considering resource saving at each stage of production as a comprehensive use of all economic resources, it should be noted that their savings are possible only if equipment, technology, labor organization and production are improved. This can only be achieved if employees and executives have the necessary level of moral and material interest, an enhanced sense of responsibility for the results of their work and appropriate incentives at all levels of production.

To protect the scientific, technical, technological, production and human potential of the enterprise from active or passive threats, one should constantly monitor and adjust the condition of organizational resources, which will result in its operational stability, financial success, scientific, technological and social progress.

Enterprise resources are a very important part of the production process. No activity is possible without the use of resources. Thus, resource saving and efficient use strategies are of current importance and require constant research and advancement.

The main focus of the resource saving strategy is to use innovations in technology, use new materials to replace materials with limited availability or prices and save resources (Fig. 3).

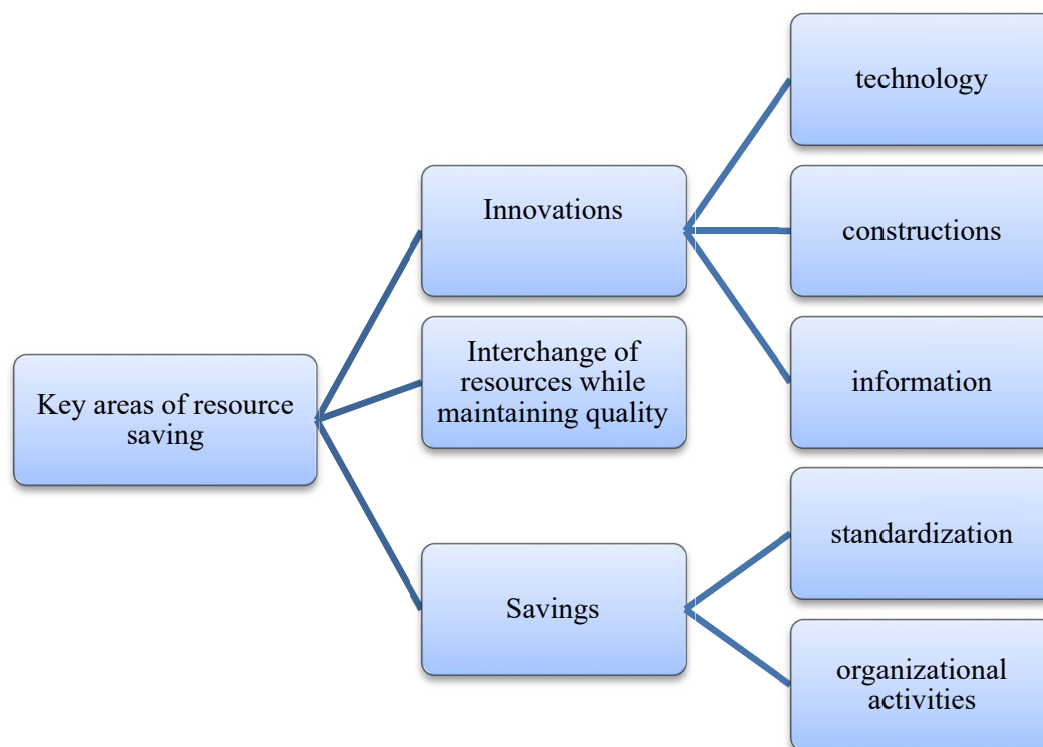


Fig. 3. Key areas of resource saving.

Using each of these areas will help increase the efficiency of your business and its stable operation.

However, in the process of developing and implementing resource saving measures, you should take into account usability. In other words, saving on employee salaries will not improve labor efficiency, and replacing high-quality materials with low-quality and inexpensive ones will lead to the decrease in demand and the loss of competitiveness of goods and services on the market.

Thus, resource saving should be considered as a set of measures that take into account not only a substantial reduction in resource use but also the further development of the enterprise, its strategic focus and the impact of the implemented measures on the prospects for further activities.

In this context, the main resource saving measures should primarily focus on reducing the energy and material intensity of products, eliminating losses of raw materials and energy, using technologies and materials to improve product quality, and expanding the use of secondary resources in economic circulation.

Making managerial decisions on resource saving by the enterprise is the process of choosing the most appropriate measures to solve the problem of efficient use of enterprise resources as well as the reasonable way to prevent unnecessary resource losses. The sequence of managerial decisions on resource saving should be considered as an interrelated complex system of actions combined for the efficient use of resources.

One of the crucial factors of resource saving as a tool for environmental and production management in the context of sustainable development is to increase the economic and environmental efficiency of economic activity. It means the need to reduce the amount of natural resources consumed per unit of produced goods (ultimately, the monetary equivalent of one unit of GDP) in order to decrease the amount of pollutants and waste produced in the same amount as each sector of the economy. Production is associated with a production unit and the economy as a whole.

Unreasonable approaches to environmental management in Ukraine in the 20th century led to the fact that the country's economy had one of the lowest environmental efficiency indicators in the world at the turn of the second and third millennia, i.e., it was one of the most environmentally intensive economies [11].

Current environmental changes pose a real threat to the lives and health of Ukrainian citizens and Ukraine's national security. If public health is considered as a cumulative indicator of man-made environmental stress, then objective medical data indicate the growing impact of environmental factors on the physical potential of our society.

These global challenges to ensure conditions for sustainable development are particularly important for Ukraine. The country's strategic interest is to ensure stable social and economic growth based on the rational use, protection and restoration of natural resource potential.

It requires coordination of the national policy on structural adjustment, upgrading and development of the industrial and agricultural sectors of the economy and services with the policy on environmental protection and rational use of natural resources, as well as the development and implementation of ways to solve these problems based on mechanisms of the market economy (Fig. 4).

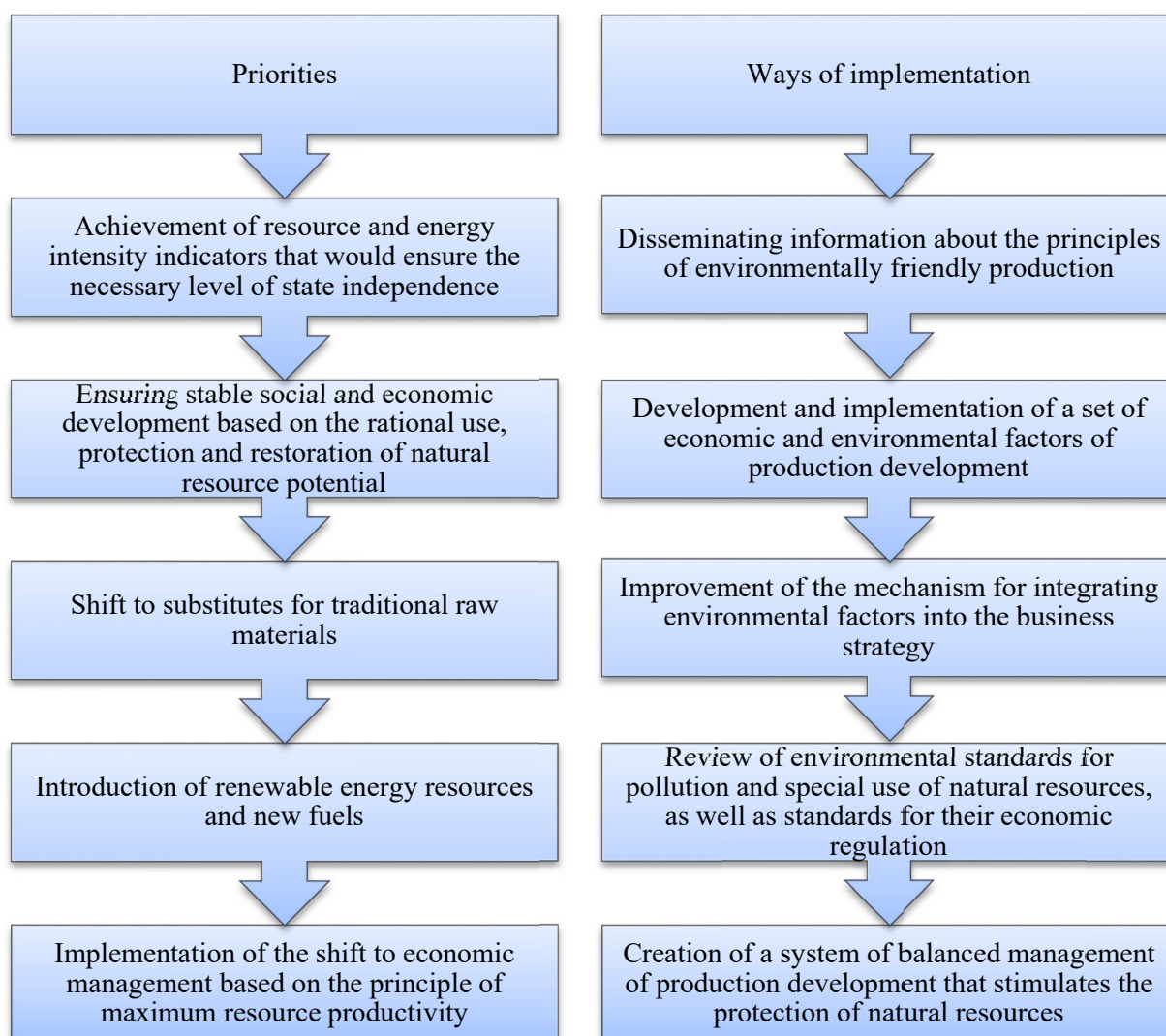


Fig 4. National priorities for the development of environmentally friendly production.

The Ukrainian economy is facing the challenge of in-depth structural adjustment and renewal, creating conditions for accelerating the transformation of production technology, ensuring the competitiveness of products, and reducing the negative impact on the environment. Economic policy can only be efficient if it protects the environment and optimizes decision making in every sector of the economy.

Resource-saving clean production is a comprehensive preventive environmental strategy that constantly reduces occupational risks of personnel, reduces the environmental impact and improves economic benefits of production. This includes reducing the consumption of raw materials, water and energy, eliminating the use of toxic substances, and reducing all emissions and waste from the enterprise. The manufacturing sector should mobilize internal corporate resources to implement technological and process trends, which coincides with insufficient government support for innovative solutions aimed at improving the efficiency of resource saving measures and the lack of a favorable investment environment to attract additional financial resources. For example, industrially developed countries spend on average 2.5% of GDP annually on innovative energy and resource saving solutions (the UK – 2.2%, Germany and France – 2.5%, the USA – 2.7%, Japan – 2.9%, Sweden – 3.3%) [28]. The vast majority of these costs are covered by enterprises themselves (about 58.0%) [28]. Ukraine's investment resource-saving potential is minimized: the share of investment in this type of activity is decreasing annually and amounts to 1.05% in 2000, 0.54% in 2010 and 0.34% in 2020 compared to GDP. At the same time, the share of funds from enterprises themselves is constantly increasing in the total amount of expenditures on innovation (from 69.9% in 2000 to 83.9% in 2020) [28].

Currently, the natural catalyst for increasing resource saving at the enterprise is raising resource prices. Thus, according to the survey of enterprises, more than 80% of them implemented resource saving measures precisely because of changes in energy and raw material prices (Fig. 5). Besides, 81.1 % of enterprises noted that they independently find ways to implement their environmental actions and efficient use of resources [28].

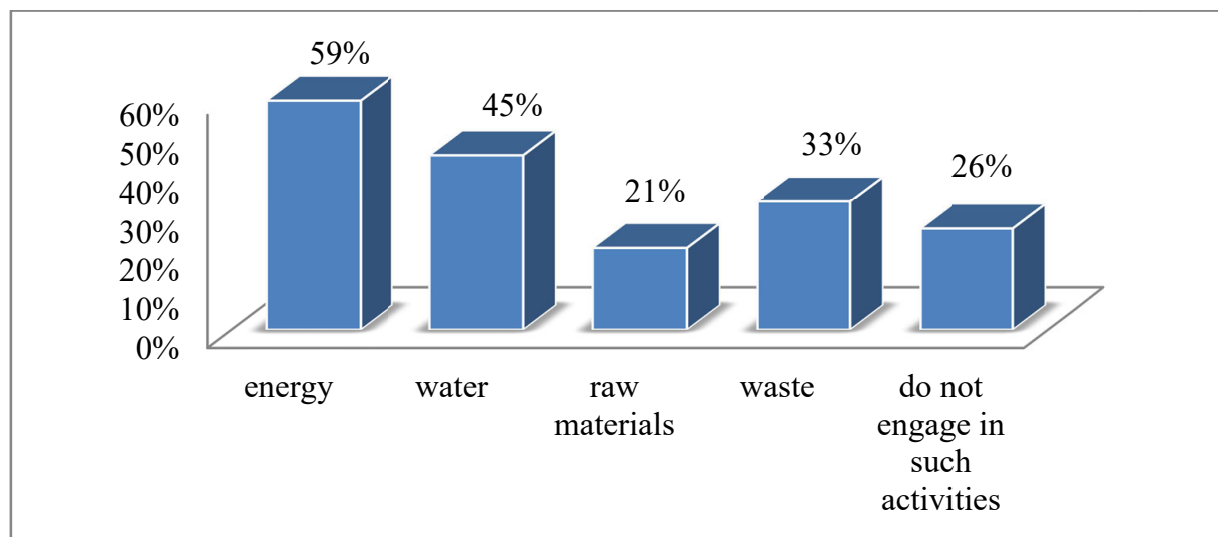


Fig 5. Activity areas of Ukrainian enterprises to improve the efficiency of resource use [28].

The development of the resource saving strategy at the enterprise reflects a set of principles, factors, methods and measures to ensure the steady reduction in the consumption of total resources per unit of useful effect of a particular product in case of ensuring the economic security of the enterprise (Fig. 6).

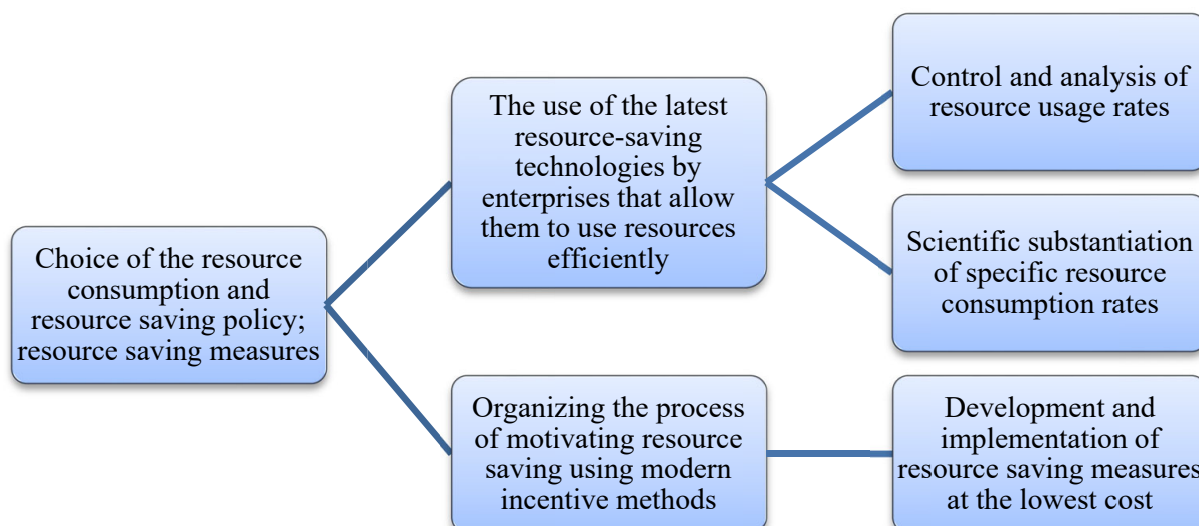


Fig. 6. Resource saving strategy at the enterprise.

Conditions for sustainable development of economic security of enterprises imply not only resource saving but also their efficient use in order to minimize the negative impact on the environment and ensure economic stability. The resource saving strategy in these conditions should be comprehensive and focused on achieving several key goals [31]:

1. Optimization of resource use: Enterprises should analyze their production processes and identify opportunities for reducing the consumption of such resources as energy, water, raw materials, etc. The introduction of efficient technologies and processes will reduce costs and improve productivity.

2. Minimizing waste and pollution: It is necessary to work on reducing the amount of waste and its impact on the environment during production. This can be achieved by recycling waste, implementing technologies for the treatment of industrial wastewater and flue gases, as well as minimizing the use of harmful substances.

3. Development of alternative energy sources and use of renewable resources: Enterprises should actively research and adopt production based on alternative energy sources, such as solar and wind energy, as well as the use of biomass. It will not only reduce dependence on traditional energy sources but will also reduce greenhouse gas emissions.

4. Social responsibility and participation in sustainable community development: Enterprises should take an active part in solving environmental and social problems in their region. It can include cooperation with local authorities, participation in community improvement programs and assistance in the development of local infrastructure.

In general, the resource saving strategy in the context of sustainable development of economic security of enterprises should ensure a balance between economic, environmental and social interests, resulting in stability and positive impact on the environment and society [32-35].

The environmental component of economic security is a powerful condition for ensuring the sustainable development of national enterprises. According to the definition officially recognized by the International Atomic Energy Agency, environmental safety is the protection of people or the environment from excessive negative impact. Despite the significant drop in production in various sectors of the economy over the past decade, the situation in this area has not changed. At the same time, there is a clear differentiation of ecological regions in terms of this component of economic security.

On the one hand, the provision of environmental components is generally low in eastern, central and southern regions where industrial production is concentrated. In contrast, the situation in the western and northern regions is satisfactory. From the perspective of enterprises manufacturing certain products on a commercial basis, the problem of protecting social and environmental safety can only be solved by carefully observing national (international) standards for the minimum permissible content of harmful substances released into the environment, for example, by complying with the environmental requirements of manufactured products. The use of resource saving tools for enterprise production will allow systematizing the results of resource consumption assessment and visualizing the resulting economic and environmental effect (Fig. 7 and Fig. 8).

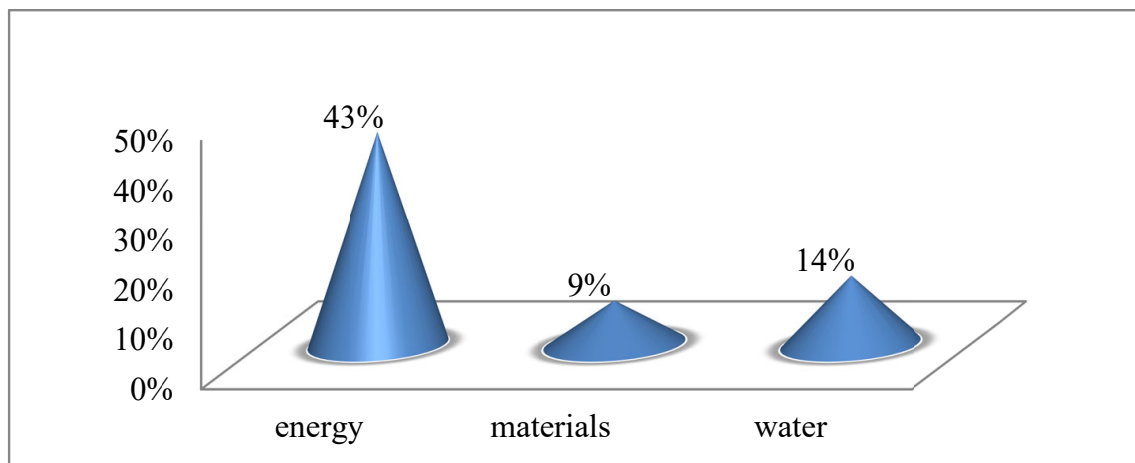


Fig. 7. Changes in resource productivity, % [4].

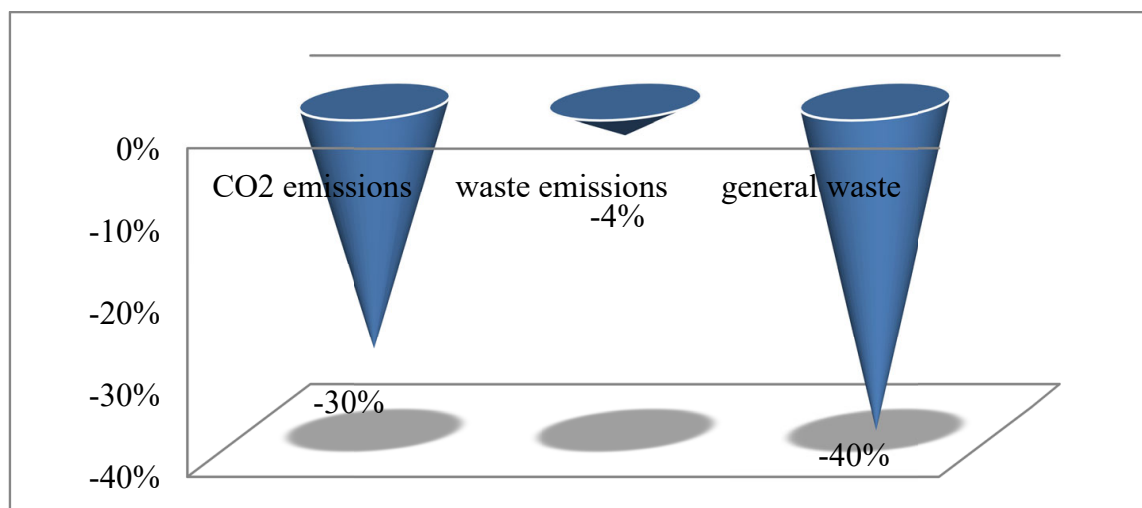


Fig. 8. Changes in pollution intensity, % [4].

Manufacturing enterprises will not voluntarily take measures to ensure environmental control of production processes and finished products, as it will increase the cost of treatment facilities and efficient environmental technologies. The only thing that encourages companies to produce environmentally friendly goods is the imposition of huge fines for violating environmental standards. Ways to ensure the environmental component of business economic security:

1. Based on general strategic recommendations and the results of the analysis of the efficiency of the implemented measures, one plans a set of measures for the future partial development of the economic security environment.

2. Make sure that the environmental component of the plan is a part of the overall plan for achieving the overall appropriate level of economic security. It looks like a logical scenario for the implementation of the set of necessary measures in a calendar sequence and adds a calculation of the efficiency of the actual implementation of these measures.

3. The algorithm of the process of protecting the environmental part of economic security consists of the following sequential operations:

- to calculate the efficiency of measures taken to protect the environmental component of economic security based on the reported data on financial and economic activities of enterprises (organizations);
- to analyze calculations and make recommendations to improve the efficiency of measures being implemented;
- to develop alternatives for the implementation of the planned measures;
- to select priority options based on a comparison of calculations of the efficiency of the planned measures;
- to transfer the selected planning scheme as part of the general economic security plan to the unit carrying out functional planning of financial and economic activities of the enterprise (organization);
- to efficiently implement the planned measures.

The behavior that negatively affects the level of the power part of the company's economic security is caused by the number of reasons, namely:

- competing companies have a low level of corporate culture and use non-market means to affect corporate activities;
- certain regions of Russia features a high level of economic crime;
- business motives that encroach on the life and health of enterprise's executives and employees;
- targeted influence aimed at deteriorating the company's image and sales of its products.

The general scheme of organization of the economic security component of the enterprise is shown in Fig. 9.

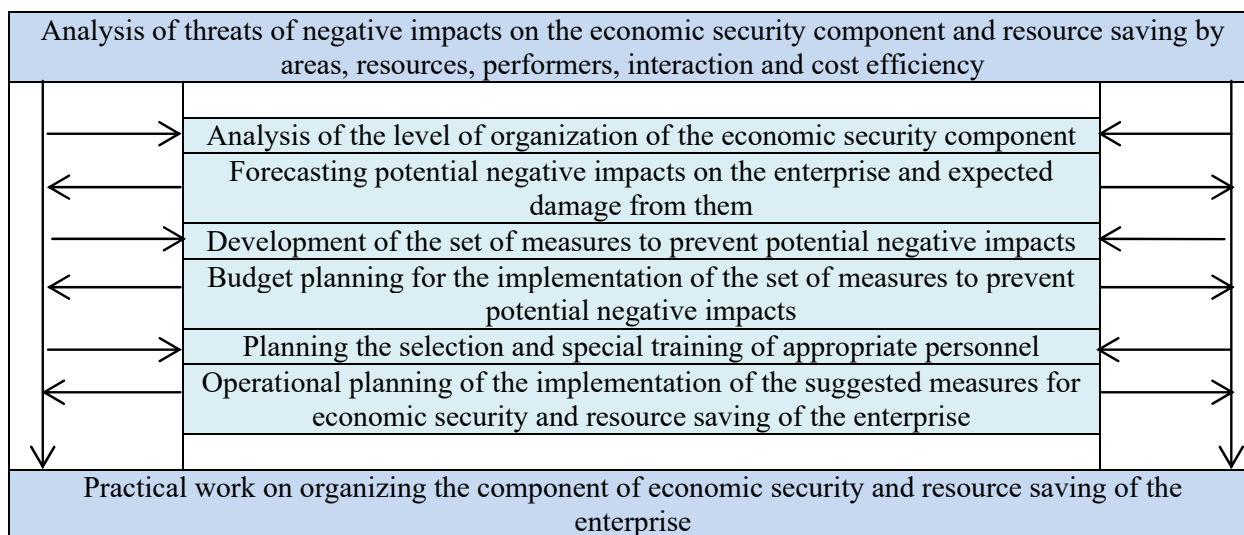


Fig. 9. General scheme of organization of resource saving in ensuring the economic security of sustainable development of the enterprise.

Thus, resource saving is an important tool for ensuring the sustainable development of economic security of enterprises. This approach is aimed at optimizing the use of resources in order to ensure the efficiency of production processes, reduce costs and minimize negative environmental impact. Some key aspects of the role of resource saving in ensuring the sustainable development of economic security of enterprises include the following:

- resource saving allows enterprises to maximize the use of available resources in order to reduce costs and increase productivity.

- reducing production costs due to the efficient use of resources; enterprises can reduce the cost of energy, water, raw materials and other materials in order to increase profitability and competitiveness.

- resource saving helps to reduce emissions of harmful substances, water waste and other negative environmental impacts, contributing to sustainable development and conservation of natural resources.

- the need for resource-saving technologies and practices stimulates innovations and the development of new markets, resulting in the growth of enterprises and the economy.

- enterprises that actively apply resource-saving practices can win the trust of consumers, investors and regulators, which improve their reputation and relations with stakeholders.

Thus, resource saving is a crucial element of the sustainable development strategy for the economic security of enterprises, ensuring their sustainability and efficiency in the changing world. The adoption of resource-saving practices allows enterprises not only to save money but also to preserve the environment for future generations.

5 Conclusions

The research shows that resource saving is the key tool for environmental and production management that plays a crucial role in ensuring sustainable development and economic security of enterprises. This approach has become the foundation for the development of modern enterprise management strategies aimed at optimizing the use of resources, reducing waste and environmental impact.

It should be noted that resource saving increases productivity, reduces raw material and energy costs, and reduce the environmental footprint of enterprises. The article examines and analyzes the environment, as well as assesses the progress of environmental protection in the national economy according to the Environmental Performance Index. According to the ranking of countries ordered by the Environmental Performance Index in 2022, the top five countries out of 180 include: Denmark – 77.90 points out of 100, the UK – 77.70, Finland – 76.50, Malta – 75.20, Sweden – 72.70, Russia is ranked 52nd with a score of 49.60, which is much better than in 2020. It allows ensuring economic efficiency in the long run, reducing risks and increasing the competitiveness of enterprises. Besides, resource saving helps to improve the image of enterprises, increases their social responsibility towards society and contributes to the positive environmental impact. Integration of resource saving principles into the management strategy allows enterprises to become not only economically sustainable but also responsible participants in environmental development.

It is determined that resource saving is the key tool for environmental and production management in the context of ensuring sustainable development of economic security of enterprises. This approach is aimed at the rational use of resources and minimization of the negative impact of production processes on the environment, contributing to the economic stability and competitiveness of enterprises in the long term.

In general, resource saving is an important element of the sustainable development strategy for the economic security of enterprises, ensuring their sustainability, efficiency and social responsibility. Enterprises that implement resource-saving practices can expect the positive impact on their operations and preserve the environment for future generations.

Therefore, resource saving is the key factor in achieving sustainable development of economic security of enterprises. Its efficient implementation requires a systematic approach, active adoption of the latest technologies and constant monitoring of results.

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