

INNOVATIVE MODEL OF DEVELOPMENT OF FUEL AND ENERGY COMPLEX OF UKRAINE

Kovshun N.E.

National University of Water and Environmental Engineering (NUWEE), Professor, Doctor of Economic Sciences, Professor, Department of Enterprise Economy, Ukraine

Ignatiuk I.Z.

National University of Water and Environmental Engineering (NUWEE), Associate Professor, Candidate of Economic Sciences, Associate Professor, Institute of Postgraduate Education, Ukraine

Moshchych S.Z.

National University of Water and Environmental Engineering (NUWEE), Associate Professor, Candidate of Economic Sciences, Institute of Postgraduate Education, Ukraine

Malanchuk L.O.

National University of Water And Environmental Engineering (NUWEE), Candidate of Sciences (Economics), Assistant Professor Department of Public Administration, Documentation and Information, Ukraine

Abstract

Prospects for the development of resource-saving technologies in mining are priorities, the state and further development of which depends on the existence of an independent Ukrainian state and the development of the energy sector of the economy. The essence of this process is that energy sector reforms should help integrate it into the EU energy space and at the same time create a positive foundation for reforming the entire economic complex of Ukraine, raising people's living standards to European standards. A special role in this is played by new technologies, the introduction of which is one of the main tasks of a steady progress in the strategy of development of the mining and processing industry. The solution to this complex problem is related to the introduction and increase of efficiency of resource-saving technologies of mining and processing of minerals.

The mining industry is currently in a difficult state, driven by both objective and subjective factors. Among the problems that need urgent solution is the reduction of the negative impact of the fuel and energy complex on the environment, which necessitates the improvement of the environmental management system with the use of new technologies.

Introduction

Ukraine as an independent state has not overlooked all the environmental problems that are characteristic of modern society. With a considerable list of works planned and completed during the years of independence, the state of the environment remains crisis with a tendency to deteriorate. For the sake of objectivity, it should be noted that Ukraine inherited from the Soviet Union an environmentally dangerous structure of the economic complex - dominated by metallurgical, mining, fuel and energy, chemical and petrochemical industries, extensively developed agriculture. The partial improvement of the environmental pollution and the reduction of harmful emissions observed since 2000 are not due to the systematic work of the authorities on environmental protection, but simply due to a significant drop in production in the basic industries. By and large, no progress has been made besides building a vertical of environmental watchdogs and establishing a specialized ministry in the executive branch. During the years of independence, Ukraine failed to address any of the environmental problems inherited from the Soviet regime.

The Ministry of Energy and Environmental Protection of Ukraine, which was established on December 9, 2010 through the reorganization of the Ministry of Environmental Protection of Ukraine, is functioning in Ukraine in 2019 and is joined by the Ministry of Energy and Coal Industry of Ukraine. The main purpose of such transformations is to ensure a comprehensive approach to public policy on the use of natural resources and energy, and to formulate a single policy to address the negative effects of global climate change. This approach is common in European and world practice, in particular in EU countries (France, Denmark, Greece, Portugal and Australia). In other words, the development of the country's energy supply and the preservation of the ecological balance are indispensable components of the sustainable development of society.

Mining is a major strategic prerequisite for the development of the economy, the basis for ensuring all types of social life

Therefore, defining and implementing the directions of its development are priority tasks in ensuring national security, political and energy independence, sustainable development.

Fuel and energy complex (FEC) of Ukraine covers the activities of exploration and production, processing and production, storage and transportation, transmission and distribution, trade and sale (sale) of energy products - fuel, electricity and heat. Formed in its time as an integral part of the fuel and energy complex of the USSR, it does not fully meet the conditions of energy functioning on the basis of sustainable development. Thus, the general structure of Ukraine's fuel and energy complex is shown in Fig. 1.

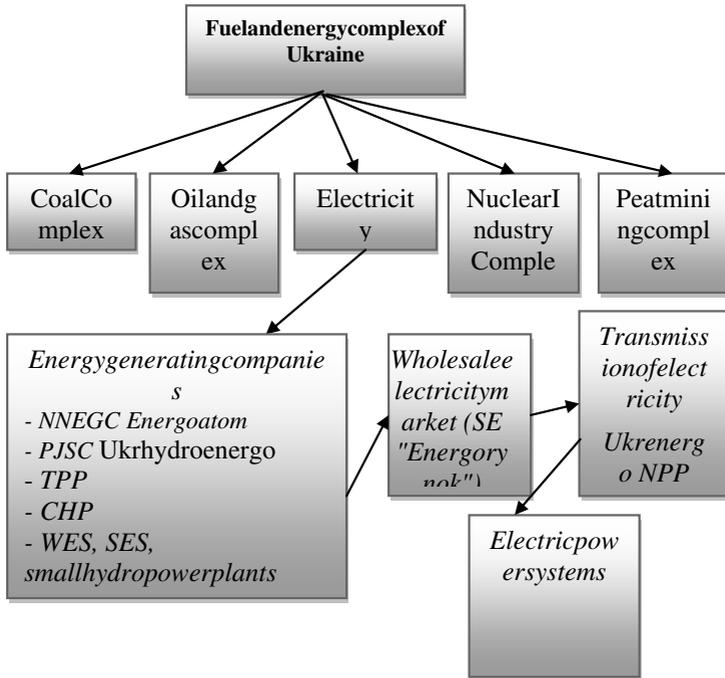


Fig. 1. Fuel and energy complex of Ukraine

Generally, the implementation of the state policy on the functioning of the fuel and energy complex occurs within the three spheres concerning fossil fuels; development of nuclear power; electricity complex. Ukraine's energy supply activities are carried out by the coal-industrial complex; electricity complex; nuclear-industrial complex; peat mining complex; oil and gas and oil refining complex.

The base for the fuel and energy complex of Ukraine is the coal industry. Analyzing the coal industry, it is worth noting that in terms of geological reserves of fossil coal, Ukraine ranks first in Europe and eighth in the world. Explored reserves amount to about 56 billion tons, forecast reserves - about 170 billion tons of coal of all brands - from brown to anthracite and coking [1].

Currently (excluding annexed territories) in Ukraine, coal reserves are operated by almost 50 mines. Some of them - 33 mines with a total production capacity of 11.7 million tons - belong to state-owned coal mines. The private sector is represented by 16 mines, the vast majority of which are in concession at DTEK LLC.

One of the main problems of the industry is the low technical development of production, the lack of widespread introduction of innovative technologies for field development. Currently, under the authority of the Ministry of Energy and Environmental Protection of Ukraine, only 1 mine (3%) has been operating for less than 30 years since the start of coal production. 6 mines (18.2%) have a lifetime of 30 to 50 years, 15 mines (45.5%) - 50-70 years, and 11 mines (33.4%) - more than 70 years. At the stage of liquidation are 13 unprofitable coal mines, 5 more mines are in the stage of preparation for liquidation. The two liquidated mines contain drainage complexes for the construction and reconstruction of which were foreseen by mine elimination projects[2].

The state scientific, technical and design potential of the industry consists of 8 institutes. The state of affairs in the field of coal-industrial complex is characterized by the following key indicators: volume of production at coal-mining enterprises, cost of 1 ton of finished commodity coal production (FCCP), number of employees at state-owned coal-mining enterprises, amount of budget support to cover losses and losses.

The trends of the mentioned indicators during 2016-2019 indicate an aggravation of the negative situations in the industry. For example, recent years are characterized by a general decline in production volumes, an increase in state support for coal mines to partially cover the costs of the cost of finished commodity coal products, import dependence, and a decrease in the number of employees of state coal mines.

In the current conditions, the problem of assessing the efficiency of functioning of state-owned enterprises in the coal industry complex is acute. During the period, the production of ordinary coal decreased by 9.7 million tons as a whole. At state-owned enterprises by almost 2 million tons. At the same time, the share of production by the private sector has increased, although the number of state-owned mines is almost double the number of private mines.

Thus, the share of coal production by state coal-mining enterprises in 2016-2018 is approximately 13% of the total production in Ukraine (Fig. 2). At state-owned coal-mining enterprises, the cost of 1 ton of GTVP for the 12 months of 2018 amounted to 3200 UAH, and for the first half of 2019 - 3860 UAH. However, in the cost structure, wages and salaries account for almost 50%. Costs of finished coal products for the first half of 2019 amounted to UAH 4,869.0 million and increased by UAH 345.5 million or 7.6% compared to the corresponding period of 2018. Budget support for state-owned coal mining companies in 2018 amounted to UAH 3 726 million, of which UAH 2,661 million to cover losses. In turn, only UAH 484 million was allocated for technical re-equipment and modernization.

The volume of finished commodity coal produced by state-owned enterprises for the first six months of 2019 amounted to 1 255.4 thousand tons, which is 85.3 thousand tons less than planned (-6.4% to the plan) and 89, 7 thousand tons to the corresponding period of 2018. The value of commodity coal products in the same period amounted to UAH 2 732.4 million, which is UAH 110.1 million, or 3.9% less than in the corresponding period of the previous year. Due to the increase in prices of coal products by an average of 3.0% compared to 2018, it allowed to receive UAH 292.4 million of additional income, but due to the loss of commodity output the positive result was reduced by UAH 402.5 million. Long-term deficit of own and budgetary funds for technical re-equipment of coal-mining enterprises registered and operating in the territory in which the state authorities fully exercise their powers (in 2013-2017, the financing of technical re-equipment from the state budget was not carried out at all) led to the fact that only 20 new treatment holes were commissioned in 2015 from the 32 lava coal mines; in 2016 - 15 new potholes; in 2017 - 25 lav; in 2018 - 16 lavas, compared to 73 introduced in 2013.

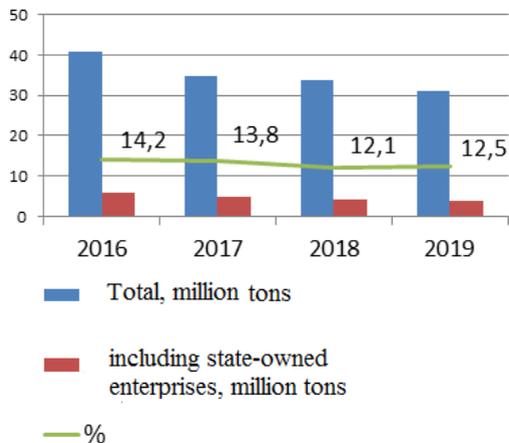


Fig.2. Dynamics of coal production in Ukraine

In 2019, the number of operating treatment holes is only 36 (with an operating line length of 5 896 m) against 48 holes (with a line of 7 814 m) in 2016. Due to the lack of mining equipment, coal is extracted from 11 treatment holes by jackhammers (SE "Mirnogogradvugillya", SE "Toretskugol", SE "Pervomaiskugol" and PJSC "Lisichanskugol"). There is no clearing front at the mines 1-3 Novogrodivsk, Privolnyansk and Novodruzhesk.

At the same time, it is burdened with a whole set of environmental problems. It has a complex man-made impact on the environment, namely changing natural hydrological regimes; remove large tracts of land for waste heaps and waste heaps from the standard environmental regime; stationary powerful sources of harmful emissions into the atmosphere and hydrosphere are created.

Peat-mining industry in Ukraine is represented by 9 peat-mining enterprises (in Volyn, Zhytomyr, Kyiv, Khmelnytsky, Rivne, Sumy and Chernihiv regions). They are united in the state concern Ukrtorf [3].

Ukraine is the southernmost European country in which peat resources are of industrial importance, making peat a real reserve for improving Ukraine's fuel and energy balance. The largest resources in peat are in the three regions of Polissja: Volyn, Rivne and Chernihiv. On their territory, 1051 fields were discovered and explored (36% of all country deposits), and the geological peat reserves amount to 1.09 billion tons (50% of Ukraine's reserves)[4].

The main negative trend during 2016-2019 is the gradual decline of the prepared for extraction of peat reserves due to the decrease of the areas set aside for the production activity of the land. The reason for this is the too complicated procedure of land allocation for the development of peat lands. Another factor that does not allow to increase peat production and production of peat briquettes is the moral and physical obsolescence of technological equipment at state peat mining enterprises. In order to stimulate the development of peat extraction and its processing, the following measures should be implemented:

- optimize the structure of the enterprises of the branch, liquidate the branches and subsidiaries, which have developed their own reserves or whose activities were unprofitable;
- concentrate equipment, machinery and mechanisms on prospective enterprises;
- involve representatives of the scientific community in the study and solution of the problems of the peat mining industry.

As for the development of the gas industry, it operates on a relatively small resource base - proven natural gas reserves in Ukraine amount to 1193 billion cubic meters, forecast resources - 3491 billion cubic meters. The largest stocks (43 percent of total forecast stocks) in Eastern Ukraine. The shelf of the Azov and Black Seas is also promising - up to 46% of forecast stocks. Potentially unconventional gas reserves are potentially promising:

- 1.2 trillion.shale gas cubic meters;
- 8.5 trillion.cubic meters of dense gas collectors;
- over 12 trillion. cubic meters of coal bed methane.

In the field of oil and gas condensate production there is a decrease in key indicators. Total oil and gas condensate production accounts for about 20% of Ukraine's total consumption of petroleum products. At the same time, there is a fall in production volumes by state-owned enterprises and an increase in production volumes by private enterprises. The problems of functioning of the gas industry are similar to the problems of oil production, but have specific features taking into account the transit capabilities of the gas transportation system of Ukraine.

Taking into account the current trends in the world, it should be noted that the use of renewable energy sources will save traditional

scarce energy resources and improve the ecology of production. However, the current lack of incentives by the state aimed at supporting the independent development of the peat mining industry does not allow it to ensure proper use of energy potential, which in turn puts obstacles in the way of reducing Ukraine's energy dependence on imported energy (natural gas, oil).FEC

There is no closed technological cycle of radioactive waste processing in the FEC of Ukraine. All operating nuclear power plants have their own temporary storage facilities for spent fuel and radioactive waste. Their filling is on average 60%. Liquid radioactive waste repositories are filled by 20-80%. These repositories are temporary and are not designed for long-term storage and increase of radioactive waste. For example, about 200 tons of irradiated and fresh nuclear fuel mixed with other components are concentrated at the Shelter facility of the decommissioned Chornobyl NPP.

The volume of radioactive waste in Ukraine is projected to increase due to:

- return of highly radioactive waste to Ukraine after the processing of spent nuclear fuel of Ukrainian NPPs in Russia;
- operation of operating NPPs as a result of their prolonged service life, introduction of new nuclear power units;
- accumulation of radioactive waste for temporary storage;
- the absence of a truly modern infrastructure for the treatment, storage and disposal of radioactive waste.

In general, in the years of Independence, with the tragic example of previously committed criminal negligence (Chornobyl NPP), all governments of Ukraine have postponed resolving the problems of radioactive waste management for an uncertain future. For a country with 15 nuclear reactors operating at 4 NPPs and technological dependence on the treatment of radioactive waste from Russia, the absence of an appropriate state program could lead to new catastrophic consequences in the near future.

So, as we can see, FEC of Ukraine does not meet the requirements for the energy complex of an independent state: two fundamental principles of energy, namely - reliable, sustainable energy supply and efficient use of energy resources, have been significantly violated. Due to inconsistent activities of the state authorities, not only the improvement and optimization of the fuel and energy com-

plex was not carried out, but also its technical condition, technological and raw material external dependence, as well as the increase of negative technogenic influence on the environment, despite the significant reduction of production volumes, production and production, resources in Ukraine.

Introducing the innovative model of development of the fuel and energy complex of Ukraine, foreign experience should be taken into account. Currently, about 18 countries on the European continent plan to completely stop coal production and combustion and thus reduce greenhouse gas emissions. Abandoning coal is an important step in the fight against global warming, because it is the dirtiest fuel.

For example, Germany is preparing to give up coal consumption by 2038; Great Britain by 2025, France by 2022; Greece - until 2028; Hungary until 2030. Japan, Portugal and the Netherlands also refused to develop the coal industry.

Analyzing the European experience, it can be noted that the abandonment of coal and the transition to renewable energy are a general trend towards a sustainable future and part of the climate change commitments made by the EU in the context of the ambitious European Green agreement ”and the 2015 Paris Agreement.

The EU's transition to a climate-neutral economy is linked not only to the need to fulfill legal and political obligations, but also to a change in the mentality of Europeans and the massive climate strikes of young people. After all, the use of fossil fuels, in particular coal, is associated not only with the destructive effects on the atmosphere, land and water resources, flora and fauna, which is manifested in the collapse of the mountain range over treatment facilities, the drainage of aquifers, salinization and pollution of soil, soil and soil surface water, but also threatens the health of citizens.

Ukraine also has the Green Energy Transition Concept by 2050, which envisages the full replacement of coal generation and the transition of Ukraine's economy based on the use of fossil fuels - coal, oil, gas, to a climate-neutral economy in the long run. The main tasks of the Concept are:

- energy efficiency;
- reduction of the share of extractive industries in the economy and, accordingly, complete replacement of coal thermal power plants by 2050;

- integration of energy markets of Ukraine with the European ones.

Particular attention should be paid to minimizing the potential negative impact on the socio-economic and environmental situation in the coal mining regions. To this end, appropriate integrated programs aimed at social reconversion of regions should be developed and implemented; mitigating the social and environmental consequences of restructuring; development and implementation of employment measures and providing psychological support to former employees of coal mining enterprises; involvement of energy efficient developments and technologies in the process of restructuring of coal enterprises, taking into account the most successful experience of the EU Member States.

In view of the above, we believe that in order to achieve sustainable growth through the development of a more competitive low carbon economy, which requires efficient, rational use of resources, environmental regulation is a key element at this stage as a legal basis for the establishment and implementation of an environmentally friendly management process. , adoption and implementation of decisions enshrined in international, regional (European), national (state, corporate, international) (state, public) legislative and regulatory acts [5]. In Fig. 3 schematically shows an environmental management system that is guided by the principles, methods and tools of environmental regulation.

Analyzing the applied nature of the opportunities for energy of Ukraine, which will be opened by the implementation of the task of the NES for integration into the EU energy space, we mentioned above the planning of the strategic change of directions of electricity flows: from the existing scheme "Russia's Unified Energy System - Ukrainian Energy System" to the scheme "Ukrainian Energy System - EU Energy System" . Unfortunately, the political approach to this problem dominates the economic and (especially dangerous) over the technological. Abstracting from the analysis of possible economic losses, we will discuss in more detail the technological and organizational-legal problems of reorientation of electricity flows.

First, Ukraine's energy system is characterized by technological conservatism - that is, during the last two decades, there have been no significant changes in both the generation structure and the net-

work structure. Placement of generation capacity, base consumers, network capacity, structure of fuel resources have practically not changed. The unified power system of Ukraine operates in parallel with the energy associations of the Republic of Belarus, Moldova, the Russian Federation (OEC Center, UES of the South), except the so-called "Burshtynenergy" (Burshtyn TPP, Kaluskaya TPP and Tereble-Rickskaya Hydroelectric Power Plant), which is with the European grid.

Second, the fall in electricity consumption in Ukraine in the 1990s created an impression on government officials and experts about the artificial excess of generating capacity and slowed down the processes of modernization in electricity. In technological terms, Ukraine has fallen behind even its closest neighbors by decades. In accordance with the project, the scheme of capacity allocation of Zaporizhzhya NPP, Khmelnytsk NPP, Exactly NPP is not completed. The structure of the generating capacity is not optimized.

Third, state interference in power management is weakened, especially after two stages of so-called privatization of the industry have taken place, which has led to the domination of the interests of oligarchic groups over the interests of consumers. The Ministry of Energy and Coal did not become a source of energy policy in the country.

Fourth, the energy market management system, established over ten years ago, needs continuous improvement.

The analysis provided grounds for concluding generally about the positive trends in the relationship between energy development, overall economic growth and the reduction of the negative environmental impact of FEC.

However, their instability must be taken into account. And considering that the period from 2012 to the present is characterized by the deepening of the systemic crisis in the fuel and energy complex of Ukraine and its characteristic signs are the reduction of electricity production, reduction of oil and gas production, the curtailment of the work of coal-mining enterprises, we believe that in order to achieve the strategic priorities of national energy development, identified in the NES Ukraine project for the period up to 2035, some conceptual positions require correction and clarification.

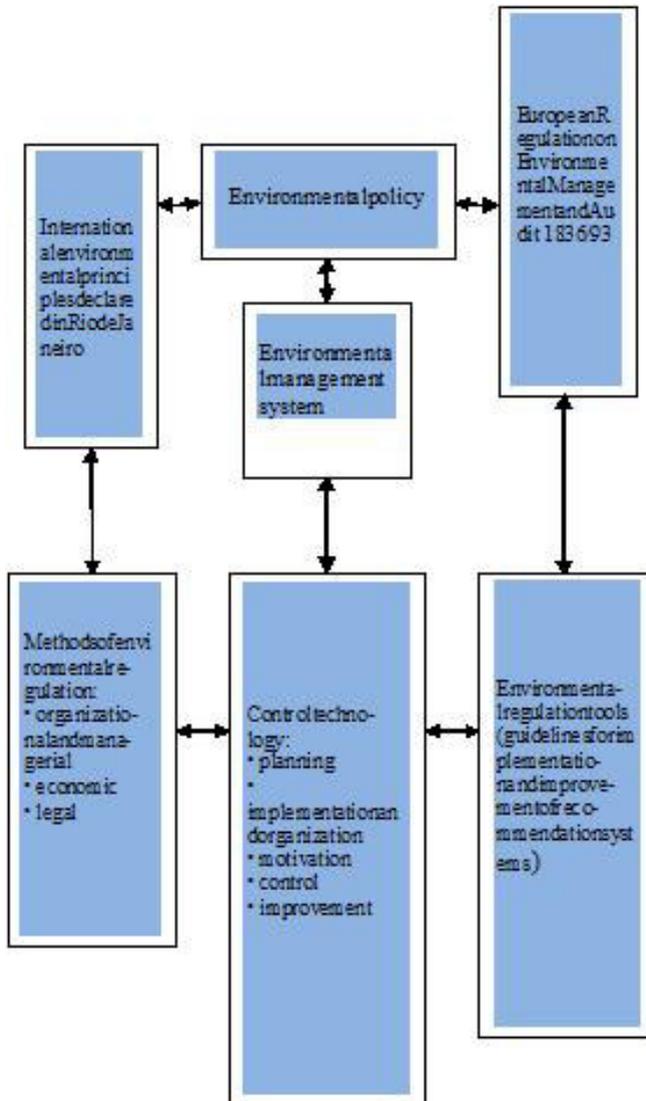


Fig. 3 - Environmental Management System

This, in particular, the accelerated achievement of energy independence, must be implemented taking into account the development of its own technological capabilities and environmental regulatory methods and mechanisms.

In independent Ukraine, a system of environmental regulation has been established, containing active legislative, administrative, economic measures and levers, which are used by public authorities of different levels to force pollutants to limit harmful substances, as well as to materially encourage conscientious environmental users.

To prevent the negative impact of anthropogenic activity on the environment and the rational use of natural resources in the system of organizational and management methods, special procedures were introduced at the state level: environmental expertise; environmental monitoring; standardization and standardization; target planning.

It is worth noting that integrated environmental programs are an effective way of solving nature conservation issues. They make it possible to provide the necessary concentration of economic, financial and production resources in priority areas of environmental policy. Forming government programs allows you to concentrate resources to solve a particular problem; unite the efforts of all stakeholders; set strategic goals and develop long-term strategies. However, in the context of inconsistent government policy, the results of the use of targeting methods do not meet the predicted possibilities.

In Ukraine, a system of state regulation of the state of the environment has been created, one of the key elements of which is the ecological regulation of the functioning and development of economic entities, including FEC (Fig. 4).

However, the implementation by the state authorities of the available capacity to regulate the state of the environment is insufficient.

It should be noted that today the innovative direction of development is the basic strategy for business, where knowledge together with social capital creates competitive advantages of individual countries and regions to a greater extent than their natural resources [6]. Innovation processes are becoming a major source of economic growth, especially in the context of the current paradigm of sustainable development and scarcity of natural resources, including energy [7]. Quality technological and organizational change is the basis of innovation.

Strategic directions of innovation activity are legislatively determined for the FEC of Ukraine modernization of power plants; new and renewable energy sources; the latest resource-saving technologies; protection and rehabilitation of the person and the environment.

Legally, the main task of the programs of innovation activity in the fuel and energy complex is to create the optimal fuel and energy balance of the state, taking into account energy security; diversification of sources of supply of energy raw materials and energy technologies; increase in the share of coal and electricity consumption by reducing the share of natural gas; development and implementation of the latest technologies of coal combustion and modernization of thermal power plants; creation of its own nuclear fuel cycle; development of the use of renewable energy sources.

Considering the technological level of the fuel and energy complex, the total need for innovative financing (according to experts) annually ranges from 8 to 12 billion UAH. Undertakings will not be able to obtain such financial resources without their own foreign investments.

Therefore, the problem of creating an attractive investment climate in FEC of Ukraine to activate innovation processes is of particular importance.

An objective indicator of the effectiveness of innovative activities in the fuel and energy industry, taking into account the requirements of environmental regulation, should be to achieve certain levels of baseline indicators that characterize the efficiency of the fuel and energy and its environmental impact.

As an option for possible evaluation, we propose a set of parameters, shown in table 1, formed using data from the National Institute for Strategic Studies [8-10].

Achieving these levels of benchmarks requires more than just boosting investment activity.

Ultimately, the environmental regulation of FEC (as well as other sectors of the economic complex) requires the construction of a new system of relationships in the chain: central government - regional government (local government) - the entity.

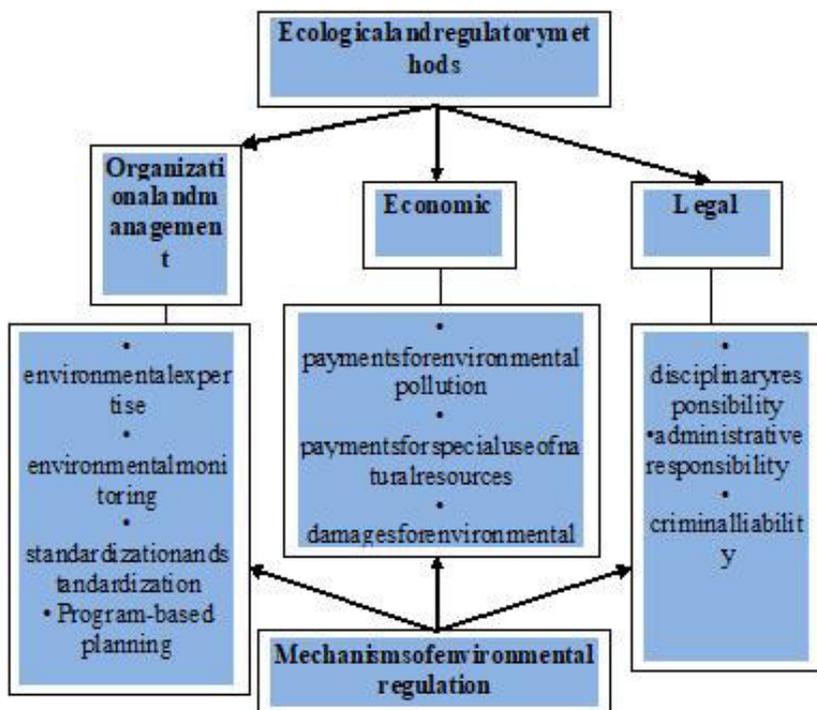


Fig. 4. Methods and mechanisms of environmental regulation

Table 2
Baseline performance indicators the functioning of the FEC and its environmental impact

Indicators	2013 year	2020 year	2025 year	2030 year	2035 year
1. GDP energy intensity, kgc/\$ 1 of GDP	0,33	0,27	0,23	0,20	0,17
2. Fuel consumption at TPP for electricity sold, gp/kWh.	396	384	367	353	334
3. The level of residual resource of FEC fixed assets, %.	20	30	50	60	80
4. The share of shunting power generating capacity of fuel and energy complex to the total installed capacity, %.	8,6	12	14	16	18
5. The share of losses in distribution grids, %.	12	11	10	9	8

6. The share of exchange trading in energy,% of domestic consumption, including electricity, coal, oil, gas and other fuels.	10	25	50	60	70
7. Share of renewable energy sources in gross final energy consumption,%.	4,5	11	15	18	20
8. The share of local alternative fuels in local fuel and energy balances,% to total consumption.		10	15	18	20
9. Reduction of CO ₂ equivalent by end-use,% since 2010.		>5	>10	>15	>20
10. Reduction of CO ₂ emissions in the production of 1 kWh,% from 2010		>5	>10	>15	>20
11. Reduction of specific emissions in CO ₂ equivalent in production 1 Gcal, %, from 2010.		>5	>10	>15	>20
12. The share of capacity in thermal generation that meets EU environmental requirements (SO ₂ , NO _x , ash emissions), %.		20	40	80	100

However, the dominant role of central authorities in the implementation of the system of environmental regulation and control of this process has objectively encountered insurmountable difficulties in the current conditions, namely: lack of effective and objective environmental monitoring; poor control over the implementation of state environmental programs and a formal approach to monitoring the implementation of regional environmental programs.

At the same time, regional authorities and local self-government (unlike similar structures in EU Member States) do not consider the environmental issues of their territories as absolutely priority issues, focusing mainly on socio-economic issues, the state of housing and communal services, and employment.

Conclusions

The innovative model of the development of the FEC of Ukraine, taking into account the requirements of environmental regulation, requires a change in the system of relations between the authorities, strengthening the competence, activity and capacity of local authorities to solve environmental problems created by economic entities located in the territories of the respective communities, and euro adaptation and consistent investment from business entities, as well as EU budget support and financial assistance. Increased investment in environmental programs, effective control and monitoring, application of environmental management at the sectoral, regional levels and directly by economic entities will provide the process of reforming environmental regulatory tools for the Euro adaptation of national energy.

References

1. Formation and use of strategic reserves of fuel and energy resources in foreign countries. (2018). <https://ua.energy/wp-content/uploads/2018/01/1.-Formuvannya-strategichnyh-zapasiv.pdf>.
2. **Kulitsky S.** Coal industry of Ukraine: the state and problems of development in the context of national security. Ukraine: events, facts, comments. **21.** 62–74 (2019) <http://nbuviap.gov.ua/images/ukraine/2019/ukr21.pdf>.
3. **Kirichok OS, Shcherbak SD** Basic principles of public policy in the field of energy efficiency and renewable energy in Ukraine and in the world. The United Nations Industrial Development Agency (UNIDO) is supported by the Global Environment Facility (GEF). Kiev. P.49. (2015)
4. **Shershun M.** Ecological-economic problems of development of the peat industry in Ukraine / M. Shershun, I. Tymoshchuk, S. Moshchich // British journal of Science, Education and Culture. – London University Press, **1(7)**, Vol. 3. P. 240–247. (2015).
5. **Moshchych S.Z.** Organizational and managerial methods of ecological regulation and their application at international and national levels [Electronic resource] Global and national problems of economy: electronic science. kind. / The Nikolaev nat. them. V.O. Sukhomlinsky. - Nikolaev, (2016). **9.**553–558. <http://global-national.in.ua/issue-9-2016>
6. **Balatsky O. Lukyanyin V., Lukyanykhina E.** Ecological management: problems and prospects of formation and development. Economy of Ukraine. **5.** 68–73.(2000)

7. **Christine Rosenberger.** Ukraine's Energy Policy [Electronic resource]. Konrad Adenauer Stiftung. Access mode: <http://www.kas.de/ukraine>.

8. **Malanchuk Z., Malanchuk E., Ignatyuk I., Malanchuk L., Moshchich S.** Strategic framework for the development of rational subsoil use in Ukraine. Australian and New Zealand Journal of Fundamental and Applied Studies. – Sydney University Press, **1 (15)**, V. 3. 126–132. (2015)

9. **Yakymchuk A.Y., Navrotskyi R.L., Kovshun N. E.** Natural resources potential as innovative and investment development prospect. Polesie Scientific Bulletin. **3 (11)**. V. 1. 179–186. (2017)

10. **Kovshun N.** Basis for the realization of sustainable development strategy in Ukraine. Economics of Sustainable Development: methodological approaches and practical solutions: collective monograph / by general edition of O. Kendikhov. – Kyiv : Center of educational literature., 25–30. (2016)

DESIGN AND IMPLEMENTATION OF A JET PUMP DREDGE

Bondarenko A.O.

Doctor of Technical Sciences (D.Sc.), (Tech.), Professor of mining machines and engineering department, National TU Dnipro Polytechnic, Dnipro, Ukraine

Ostapchuk O.V.

Doctor of Technical Sciences (D.Sc.), (Tech.), Associate Professor at the Department of Renewable Energy National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute»

Purpose. Experimental confirmation of mathematical models obtained in previous studies, testing and industrial implementation of a jet pump dredger.

Methodology. Standard methods of experimentation with experimental and industrial mining of construction sand applied with different settings of the jet suction member.

Findings. The method for calculating the rational parameters of hydraulic ripper was introduced in the design of a jet suction member with a hydraulic ripper. The use of a jet working member as the main equipment of a jet pump dredger made it possible to efficiently mining a gravel bed during the development of the East-Bugsky-2 construction sand deposit. The industrial implementation of the jet pump installation using the example of an ejector dredger project showed the practical feasibility, technological and economic efficiency of the use of ejector dredgers in the mining of flooded and underwater sand and gravel deposits with a significant