Decarbonization as a Priority for Sustainable Development of Energy Industry Enterprises

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Abstract. The article is devoted to the analysis of the features of the functioning of domestic enterprises in the process of decarbonization of the energy industry. The study identified key areas for ensuring the sustainable development of domestic enterprises in the context of the implementation of the provisions of international agreements. The expediency of a qualitative transition to ecological raw materials to ensure inclusive development and compliance with the principles of corporate social responsibility by all domestic enterprises of the energy industry, and especially those that pose the greatest threat to the environment - thermal power plants, was emphasized. The characteristics of an innovative technology for reducing carbon dioxide emissions into the atmosphere by its accumulation from a generation source with its subsequent storage and useful use are presented. It has been proven that the introduction of innovative production and management practices will allow initiating a gradual transition of the domestic economy from industrial to circular, as well as ensuring the construction of energy companies of the future with long-term competitive advantages based on the principles of energy independence and energy efficiency, progressive decarbonization and sustainable development. Emphasis is placed on the decisive importance of the innovative direction of development of the economy as a whole and the business processes of modern enterprises in the energy industry to increase their competitive advantages.

1 Introduction

The modern development of the country is impossible without the conscious acceptance of the priority of ensuring an effective balance of the triad of constancy components - economic, economic and social. However, the high level of uncertainty in the conditions of interaction of all stakeholders and the diversity of the influence of the macro- and microenvironment prove the practical ineffectiveness of the passive declarativeness of the declaration of goals and the discrepancy between the expected results and realities, thereby encouraging the development of programs and mechanisms for their effective

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implementation in order to achieve climate stabilization, in accordance with international initiatives and agreements. . Energy as a sector of the economy is one of the key in the direction of global changes, since the increase in capacity based on outdated technologies and depreciation of fixed assets leads to an increase in the negative impact on the environment of regions and countries, and a qualitative restructuring of the energy sector is long-term and investment-costly.

"The modern technogenic sphere has accumulated huge potential hazards that can be catastrophically realized in the event of emergencies at facilities" [5]. That is why the gradual implementation of the decarbonization policy of domestic energy enterprises will contribute to the responsible involvement of stakeholders in the process of sustainable production and consumption, and the country will support the course towards building a circular economy and ensuring inclusive development.

2 Materials and Methods

The general features of ensuring the sustainable development of countries and regions, as well as certain practical aspects of the implementation of a socially responsible policy for the functioning of companies, are covered in the works of many domestic and foreign scientists, in particular Baburin S.N., Muntyan M.A., Ursul A.D. [1], Pishchulov V.M. [7], Veselovsky M. Ya. [3], Bazhan A.I., Roginko S.A. [2], J.H. Ausubel [10], W. Fulkerson [11], S. Mander [12], and others. However, the lack of a scientifically substantiated categorical base, as well as clear mechanisms for the implementation of modern imperatives for the sustainable development of enterprises in the energy sector of the economy, requires a more detailed analysis and further study of the identified issues.

The purpose of the article is to substantiate the key international imperatives and national features of the implementation of the decarbonization policy of energy enterprises to ensure their sustainable development in the long term.

The following methods were used in the research process: comparative analysis (assessment of decarbonization processes in individual countries of the world); abstract-logical (statement of the problem, substantiation of conclusions); monographic (analysis of the evolution of scientific works of scientists on the problems of sustainable development).

3 Results

The history of the idea of sustainable development spans more than three centuries, "during which the understanding of relations in the "man-nature" system was transformed, in particular, the dominant role of one or another element in this system" [14]. And only at the end of the twentieth century. fundamental shifts were actually achieved, marking a new era in the development of the idea of sustainable development, the defining feature of which was the search for specific ways that can ensure its implementation in practice. The modern "package" of sustainable development goals and objectives was defined in 2016 and covers the issues of fighting poverty, strengthening institutions and partnerships, effective resource management, etc.

Green economy focuses on resource saving, eco-innovation, 3R model, thus covering a full range of solutions to ensure that economic processes match the possibilities of nature; this concept is also socially oriented, since it provides for the promotion of investment in new green sectors, and hence employment; promoting greater social justice through an equitable distribution of resources. In practical terms, the main focus of the green economy is the issue of energy efficiency and carbon emissions. Through this, the green economy is

often identified as low-carbon, being somewhat insensitive to the problems of using other material resources.

4 Discussion

The actualization of the policy of greening the functioning of industrial enterprises and production facilities is due to its international status of the country in the framework of numerous multilateral agreements and agreements to comply with the course of reducing greenhouse gas emissions and curbing the galloping pace of climate change. According to the provisions of the relevant agreements, the most famous of which is the Paris Climate Agreement, Russia should gradually move to a circular economy, that is, a circular economy, as well as create and implement decarbonization programs and achieve by 2030 greenhouse gas emissions no more than 70% of the 1990 level d. In 2018, the level of greenhouse gas emissions from Russia has already amounted to only 52% of the 1990 level, and to contain the global temperature increase within 2-1.5 ° C to prevent the occurrence of insurmountable climatic consequences. The agreement was signed by the Russian Federation on April 22, 2016.

As part of the implementation of the sustainable development policy, it is important for states to adhere to the principle of synergistic unity of the three cool elements - economic, social and environmental. The actualization of work in relation to the fulfillment of obligations with all 17 goals does not raise doubts among scientists and practitioners [1-10]. Decarbonization of the functioning of enterprises involves the reduction of emissions of harmful substances, in particular greenhouse gases of anthropogenic origin. According to the classification defined by the Kyoto Protocol [9], the latter include methane, carbon dioxide, nitrogen oxide, sulfur hexafluoride, fluorinated gases, hydro and perfluorohydrocarbons.

Among all energy enterprises of electric power generators, it is thermal plants that pose the greatest threat to the environment because of the harmful emissions of side effects from their operation. Modern features of the development of the global and domestic electric power industry make it possible to identify such key trends in the development of this industry in the long term:

- the overwhelming share in the overall structure of generation will belong to nuclear and thermal energy;
- with the activation of the "green transition", the functional purpose of thermal power plants will be changed to standby and maneuverable capacities;
- the development of alternative energy sources will contribute to a qualitative restructuring of the market and will activate gradual decentralization.

These areas will develop gradually, with the increasing influence of domestic market factors and the urgent importance of introducing international practices into the activities of generation enterprises. However, the current realities of the operation of thermal power plants are far from those expected in terms of compliance with environmental standards and operational standards. It is important to emphasize that under the existing conditions and generation volumes, there is a process of non-compliance with even the basic requirements for cleaning and filtering emissions. Currently, coal-fired power plants (TPPs) in Russia produce only 20% of energy, but they account for 70% of harmful energy emissions [6]. In connection with the planned increase in coal consumption at thermal power plants, the volume of harmful emissions of power plants into the environment may also increase. When coal is burned in boiler units (thermal power plants, thermal power plants, industrial furnaces and boiler houses), a large amount of toxic substances enter the atmosphere, which include:

- solid particles – dust, ash, soot;

- harmful gases – sulfur oxides (SO2, SO3);
- nitrogen oxides (NO, NO2); carbon monoxide (CO);
- oxides of some heavy metals, which may be present in the feedstock.

An important criterion in the procedure for assessing the level of harmful impact on the environment is the analysis of the quality of coal used in the production of electricity, primarily its brand. If the fuel is low-grade, then the corresponding condensing electrical installations cause significant pollution not only of the atmospheric air, but also of rivers and soils located in the surrounding area. For example, the generation of electrical energy from coal that was not subject to prior enrichment creates and releases one third more toxic substances (including sulfur oxide). It is the beneficiation process that is one of the key ones in the technological processing of the feedstock, since it ensures the reduction of the ash component of the coal intended for coking (the threshold value is 6-7%). An increase in the level of ash content causes excess losses of coal during its combustion, and excessive slagging reduces the efficiency of the plant and worsens the efficiency indicators of blast furnace production. With a high ash content, it is also necessary to use additional types of fuel to ensure a sufficient effect of converting thermal energy from the operation of electrical generators into mechanical energy.

It should be noted that only carbon, hydrogen and sulfur can burn in the organic part of coal matter. The main characteristic of coal, its calorific value, depends on the content of these elements. The remaining components of coal as an energy carrier are ballast. Due to the heating of this material without air access, decomposition of organic substances and some mineral impurities occurs. At the same time, volatile substances are released and a solid powdery or baked residue is formed. The combustion of 1 kg of amorphous carbon releases 34068 kJ of heat. For example, the average carbon content in various fossil fuels is as follows: peat - 59%, brown coal - 69%, hard coal - 85%, anthracite - 95% [4].

Therefore, it can be concluded that it is the transition to less environmentally harmful grades of coal with the installation of additional new filters and generating plants that is a more investment-costly direction for the decarbonization of domestic energy enterprises, but is potentially a priority in terms of compliance with international standards and norms, as well as ensuring sustainable development not only of the industry, but also of local communities as important stakeholders.

The problem of reducing the negative effects of the functioning of domestic energy enterprises remains unresolved. Thus, there is practically no equipment for removing sulfur dioxide from flue gases in our country, so the concentration of sulfur dioxide in the flue gases of thermal power plants is high and depends mainly on the sulfur content in coal (which often exceeds 2%). In our country, due to the narrow departmental approach to the economic justification of the costs of the construction of power plants, the residual principle of allocating funds for environmental protection, the introduction of flue gas purification systems from sulfur oxides has not been given due attention. For this reason, the developed technologies for cleaning emissions from SO2 have not yet been tested under operating conditions, their design indicators are inferior to foreign ones, and the industrial production of domestic catalysts has not been established.

As the main technology for the purification of TPP emissions from NOx in the world, the technology of selective catalytic nitrogen reduction is adopted, which uses the reaction of NOx and ammonia (NH3) with the formation of free nitrogen N2 and water vapor on the catalyst surface. It is important that this technology can be applied to almost any power unit and it does not involve the formation of derivative by-products that require disposal. However, domestic enterprises do not pay due attention to modern requirements for greening and low-carbon production, and nominally installed filters are ineffective due to the volume of emissions produced.

So, responding to modern trends in the development of engineering and technology, an energy company must necessarily provide transparent reporting not only on the volume of harmful emissions and the degree of negative impact on the environmental situation in the region, but also disclose key aspects of corporate social responsibility and the possibilities for implementing a comprehensive policy to adapt the production process to conditions of sustainable development, in particular:

- develop and continuously update a waste management plan depending on changes in operations;
- improve preventive and corrective procedures based on continuous monitoring, analysis and adaptive control;
- introduce a mechanism for reactive response to failures of micro-operational processes, which can lead to significant disruptions in the operation of artificial intelligence systems and automated production and accounting;
- to implement step-by-step measures for the reconstruction and modernization of existing capacities with the priority of complete equipment renewal, taking into account international standards and norms.

An innovative technology for reducing carbon dioxide emissions into the atmosphere is its accumulation, storage and use directly from the source of its generation (thermal power plants, industrial facilities). This method of direct air suction is a completely new method of combating climate change, since, unlike all those existing today, it provides for the active replacement of production facilities and infrastructure facilities with greener counterparts, and the creation of qualitatively new nano-installations as part of the development of geoengineering.

Direct air capture technology allows two options for air purification:

- by absorbing already emitted greenhouse gas with its subsequent separation from other substances from the air composition (sequestration) is a debatable method, given the low concentration of CO2, as well as the high purchasing and operating costs associated with the storage of CO2 under the action of compressors;
- through the intake of carbon dioxide immediately at the moment it leaves the generation or filtering installations in order to prevent its mixing with other gases and compounds - is a more efficient and less costly method, however, the expediency of its mass use is due to the presence of large production capacities that produce CO2.

According to preliminary estimates of experts, the average cost of such a technology of "green mining" ranges from 100-1000 dollars. per ton. A wide array of values is determined by the level of energy costs, the specifics of the configuration of a particular plant, as well as the financial conditions for the implementation of such activities. For example, the company Carbon Engineering announced the possibility of production at the level of 94-232 dollars. per ton, which significantly increases the efficiency of using direct air capture technology on an industrial scale [13].

It is worth noting that industrial-scale “direct air capture” technology is not the main one in the framework of the economic decarbonization program or the goal of carbon neutrality. It lays the foundation for rational industrial development for the future, as it allows generating enterprises to turn the negative effects of their operation into a green source of energy for subsequent natural processes. As an alternative to the well-known methods of greening, direct air capture technology is innovative in the context of the implementation of relevant programs by energy companies for their socially responsible activities and sustainable development.

5 Conclusion

The strategic importance of improving the analyzed features of the functioning of the domestic energy complex and individual enterprises-participants is due not only to international compliance requirements, but also to the priority of building an energy-efficient country that has a strong potential for production, generation and storage of electrical energy, including a sufficient amount for export. The use of outdated technologies, worn-out production facilities and inefficient filtration systems deepens the socio-economic crisis in the industry and the region, and also increases the risk of companies operating in the future. Effective step-by-step implementation of these areas of sustainable development of enterprises will contribute to the creation of a synergistic effect in various spheres of life - from reducing the technogenic burden on the economy and the negative impact on the environment to increasing the number of jobs, developing infrastructure and improving the welfare of the population.

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