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KUPINETS L.E.

Dr.Sc. (Economics), Prof.

Institute Of Market Problems And Economic&Ecological Research of the
National Academy Of Sciences Of Ukraine

Frantsuzskiy Boulevard, 29, Odessa, Ukraine

E-mail: lek_larisa@ukr.net

ORCID: 0000-0001-9251-4014

SHERSHUN O.M.

Lead engineer

Institute Of Market Problems And Economic&Ecological Research of the
National Academy Of Sciences Of Ukraine

Frantsuzskiy Boulevard, 29, Odessa, Ukraine

E-mail: olgashershunimpeer@gmail.com

ORCID: 0000-0001-8595-269X

RISK PREVENTION OF ATMOSPHERIC POLLUTION BY IMPLEMENTATION OF THE ENVIRONMENTAL MANAGEMENT SYSTEM AT THE HEAT ENERGY FACILITIES

Topicality. The problem of anthropogenic impact reducing on atmospheric air is especially relevant to date. Ukraine ranks one of the first places in the world of mortality rate from environmental pollution and one of the main sources of pollution is the operation of coal installations.

Most of the equipment of the large power plants of Ukraine is in the pre-critical state, it is morally and physically obsolete. Unsatisfactory condition of environmental technologies and non-compliance with international requirements of the cleaning of atmospheric air emissions from the thermal power plants are the urgent issues of the current international economic and environmental policy of the country.

Aim and tasks are to determine the prospects of introducing and improving the environmental management system at Large Combustion Plants in Ukraine in the context of the National Plan for Reducing Emissions to reduce the environmental risks posed by pollutant emissions from heat power plants and the entry of Ukraine into the international stage in the field of ecology and energy.

Research results. The article examines the main environmental risks caused by the operation of heat energy facilities and international requirements that Ukraine must fulfill in the near future. Also reviewed are the possible risks faced by the objects of heat power in the path of environmentalization.

Based on the research, implementation of the ecological management system at Large Combustion Plants of Ukraine in the context of the National Plan for Reducing Emissions is proposed in order to reduce the potential risks of environmentalization and rational use of the resource potential of heat power sector enterprises. The possible ways of introducing the ecological management system and the impact of such modernization of heat power engineering objects on the international status of Ukraine as a country that has joined the international initiatives are determined. An example of a successful introduction of the environmental management system at the heat energy project of Ukraine related to large combustion plants and its compliance with the requirements of the National Plan for Reducing Emissions is given.

Conclusions. The introduction of the environmental management system will enable heat energy facilities to rapidly and rationally transition to new technologies, fulfill international requirements and, in turn, reduce to a minimum the risks associated with atmospheric air pollution.

Key words: energy, environmental protection, Large Combustion Plants, sustainable development, emission reduction technologies.

КУПІНЕЦЬ Л.Є.

д-р екон. наук, проф.

Завідуюча відділом

Інститут проблем ринку та економіко-екологічних досліджень НАНУ

Французький бульвар, 29, м. Одеса, Україна, 65044

E-mail: lek_larisa@ukr.net

ORCID: 0000-0001-9251-4014

ШЕРШУН О.М.

Провідний інженер

Інститут проблем ринку та економіко-екологічних досліджень НАНУ

Французький бульвар, 29, м. Одеса, Україна, 65044

E-mail: olgashershunimpeer@gmail.com

ORCID: 0000-0001-8595-269X

ПОПЕРЕДЖЕННЯ РИЗИКІВ ВІД ЗАБРУДНЕННЯ АТМОСФЕРИ В КОНТЕКСТІ ЗАПРОВАДЖЕННЯ СИСТЕМИ ЕКОЛОГІЧНОГО МЕНЕДЖМЕНТУ НА ОБ'ЄКТАХ ТЕПЛОЕНЕРГЕТИКИ

Актуальність. Проблема зменшення антропогенного впливу на атмосферне повітря на сьогоднішній день є особливо актуальною. Україна займає одне з перших місць у світі по рівню смертності від забруднення навколишнього середовища, а одним із головних джерел забруднення являється функціонування вугільних установок.

Більшість устаткування потужних теплоелектростанцій та теплоелектроцентралей України знаходиться в передкритичному стані, є морально і фізично застарілими. Незадовільний стан природоохоронних технологій та невідповідна міжнародним вимогам очистка викидів в атмосферне повітря від об'єктів теплоенергетики є нагальними питаннями сучасної міжнародної економічної та екологічної політики країни.

Мета та завдання полягає у визначенні перспектив введення та удосконалення системи екологічного менеджменту на великих спалювальних установках України в контексті Національного плану скорочення викидів задля зменшення екологічних ризиків, які спричинені викидами забруднюючих речовин від об'єктів теплоенергетики та виходу України на міжнародну арену в галузі екології та енергетики.

Результати. У статті дослідженні основні екологічні ризики, що спричинені функціонуванням об'єктів теплоенергетики та міжнародні вимоги, які Україна повинна виконати найблищим часом. Також розглянуті можливі ризики з якими імовірно зіткнуться об'єкти теплоенергетики на шляху екологізації.

На основі проведеного дослідження запропоновано впровадження системи екологічного менеджменту на великих спалювальних установках України в контексті Національного плану скорочення викидів задля зменшення можливих ризиків екологізації та раціонального використання ресурсного потенціалу підприємств теплоенергетичної галузі. Визначені можливі шляхи запровадження системи екологічного менеджменту та вплив подібної модернізації об'єктів теплоенергетики на міжнародний статус України, як країни що приєдналась до міжнародних ініціатив. Наведено приклад успішного введення системи екологічного менеджменту на об'єкті теплоенергетики України, що відноситься до великих спалювальних установок, та відповідність її виконання вимогам Національного плану скорочення викидів.

Висновки. Введення системи екологічного менеджменту дозволить об'єктам теплоенергетики здійснити швидкий та раціональний перехід на нові технології, виконати міжнародні вимоги і, в свою чергу, скоротити до мінімуму ризики, пов'язані із забрудненням атмосферного повітря.

Ключові слова: енергетика, охорона навколишнього середовища, великі спалювальні установки, сталий розвиток, технології скорочення викидів.

Problem statement and its connection with important scientific and practical tasks. Energy, energy efficiency, and sustainable use of nature are priority areas for the development of science and technology [1], therefore, at the present stage of Ukraine's existence, one of the priority issues is to ensure sustainable development of the energy sector of the economy and the implementation of international requirements for the functioning of energy facilities. This is possible if proper management of the environment will be introduced, scientific and technological progress will be used and Ukraine in the framework of modern socio-economic realities.

Analysis of recent publications on the problem. Scientists of the Institute of General Energy of the National Academy of Sciences of Ukraine study the problems of the structural development of the energy sector of the country and the key directions of development of its fuel and energy complex taking into account environmental requirements. Researches in the field of modeling, forecasting and means of reducing the man-caused pollution of the environment by the objects of energy are carried out at the G. E. Pukhov Institute of Modelling Problem in Power Engineering. At the Coal Energy Technology Institute of the National Academy of Sciences of Ukraine, methods of diagnostics and reduction of pollutant emissions from energy objects are developed.

Issues of environmental engineering of energy objects are considered by foreign institutions such as the Institute of Energy Studies (Washington, USA), the Institute of Energy (London, Great Britain), the Aberdeen Institute of Energy (Scotland).

Allocation of previously unsolved parts of the general problem. Since at present in Ukraine, low number of enterprises have implemented and confirmed the system of environmental management (SEM, hereinafter referred to as the Standard), especially in the field of heat power engineering, and the National Plan for Reducing Emissions from Large Combustion Plants (NPRE, hereinafter referred to as the Plan) has been developed and approved only in 2017, there are currently no data on the effectiveness of the introduction of SEM in the framework of the NPRE.

Formulation of research objectives (problem statement). The purpose of the article is to determine the prospects for the introduction and improvement of the environmental management system at Large Combustion Plants of Ukraine in the context of the National Plan for Reducing Emissions to reduce the environmental risks posed by emissions of pollutants from the thermal power plants.

An outline of the main results and their justification. The issue of atmospheric air pollution has recently been particularly acute. According to a September 27, 2016 issue, in the newspaper The Guardian, which referred to a study by a group of scientists at the World Health Organization (WHO), Ukraine ranks first in mortality rate by air pollution. In absolute terms, Ukraine ranks 6th behind China, India, Russia, Indonesia and Pakistan [2]. In addition, the study showed that one of the main sources of pollution is the functioning of coal plants.

Also, according to the world map of coal-fired power plants developed by the Carbon Brief site (the site highlights recent developments in the field of climate science, climate and energy policy), all Ukrainian thermal power plants, which are presented on the map, are in a subcritical state [3]. For comparison, some European countries are planning to shut down a part of a power plant in a similar technical condition in the near future, and countries such as France, Great Britain, Italy, Australia and Canada have plans to shut down all their TPPs at all. Since Ukraine has chosen a different policy, namely, the reconstruction and environmentalization of energy facilities, its activities should be regulated by international requirements.

It is important to note that one of the main goals of the Energy Strategy of Ukraine for the period up to 2035 "Security, Energy Efficiency, Competitiveness" is the integration of gas and electricity markets and relevant transport networks as well as Ukraine's oil transportation system into the EU energy space [4]. That is, the problem of emission reductions is not only an issue of Ukraine's environmental security, but also an urgent issue of European integration.

Ukraine, which was a member of the Energy Community since February 1, 2011, [5] committed itself to complying with the terms of the Treaty establishing the Energy Community and its annexes. According to Annex II to the Treaty, all Large Combustion Plants were to comply with the requirements of Directive 2001/80 / EC on limitations of emissions of certain pollutants into the air from large combustion plants after 31.12.2017. Similar requirements are put forward in the order of the Ministry of Environmental Protection of Ukraine dated October 22, 2008 No. 541 "On Approval of Technological Norms for Permitted Emissions of Pollutants from Heat-Power Installations with a Nominal Heat Capacity of which exceeds 50 MW" [6].

Directive 2010/75 / EU on industrial emissions (hereinafter referred to as Directive 2010/75/EU), as amended by Directive 2001/80 / EC, introduced significant changes to existing EU legislation for large combustion plants. One of the most important changes is the more stringent emission limit values for sulfur dioxide, nitrogen oxides and dust emitted by large combustion plants. These requirements came into force in the EU for new combustion plants from January 1, 2016 [7, 8].

According to directive 2010/75/EU, operators who service incinerators should carry out the environmentalization of their own enterprises for their own funds, this factor and significant volumes of work did not allow Ukraine to fulfill the requirements of directives on time.

As the current situation with the operation of large combustion plants does not meet the European requirements, the National Plan for Reducing Emissions from Large Combustion Plants was developed by the Ministry of Energy and the Coal Industry. The final draft of the Plan was developed in March 2015. Finally, the project, with some changes, was approved by the Cabinet of Ministers on November 8, 2017, and on June 13, 2018, was approved the plan of measures for the current implementation of the National Plan for emission reductions from large combustion plants.

The main objective of the Plan is to reduce emissions of pollutants from large combustion plants such as dust, sulfur dioxide and nitrogen oxides.

The impact of such emissions was considered in the report - "Europe's dark cloud. How coal-burning countries are making their neighbors sick". According to the report [9]:

–EU’s currently operational coal-fired power plants were responsible for about 22,900 premature deaths in 2013: this can be compared to 26,000 deaths in road traffic accidents in the EU the same year;

–The coal plants were responsible for 11,800 new cases of chronic bronchitis and 21,000 hospital admissions in 2013;

–The health impacts of EU coal created an overall bill of 32,4 to 62,3 billion Euros.

The risks associated with the operation of the heat power facilities are presented in Figure 1.

Analyzing Figure 1, we can conclude that most of the risks caused by the operation of heat energy facilities are related to the release of pollutants into the atmosphere.

It should also be concluded that the reduction of emissions from Large Combustion Plants is not only a question of compliance with international requirements, but also a socio-economic problem, since increased morbidity, mortality and loss of working days can affect the demographic and economic performance of the country.

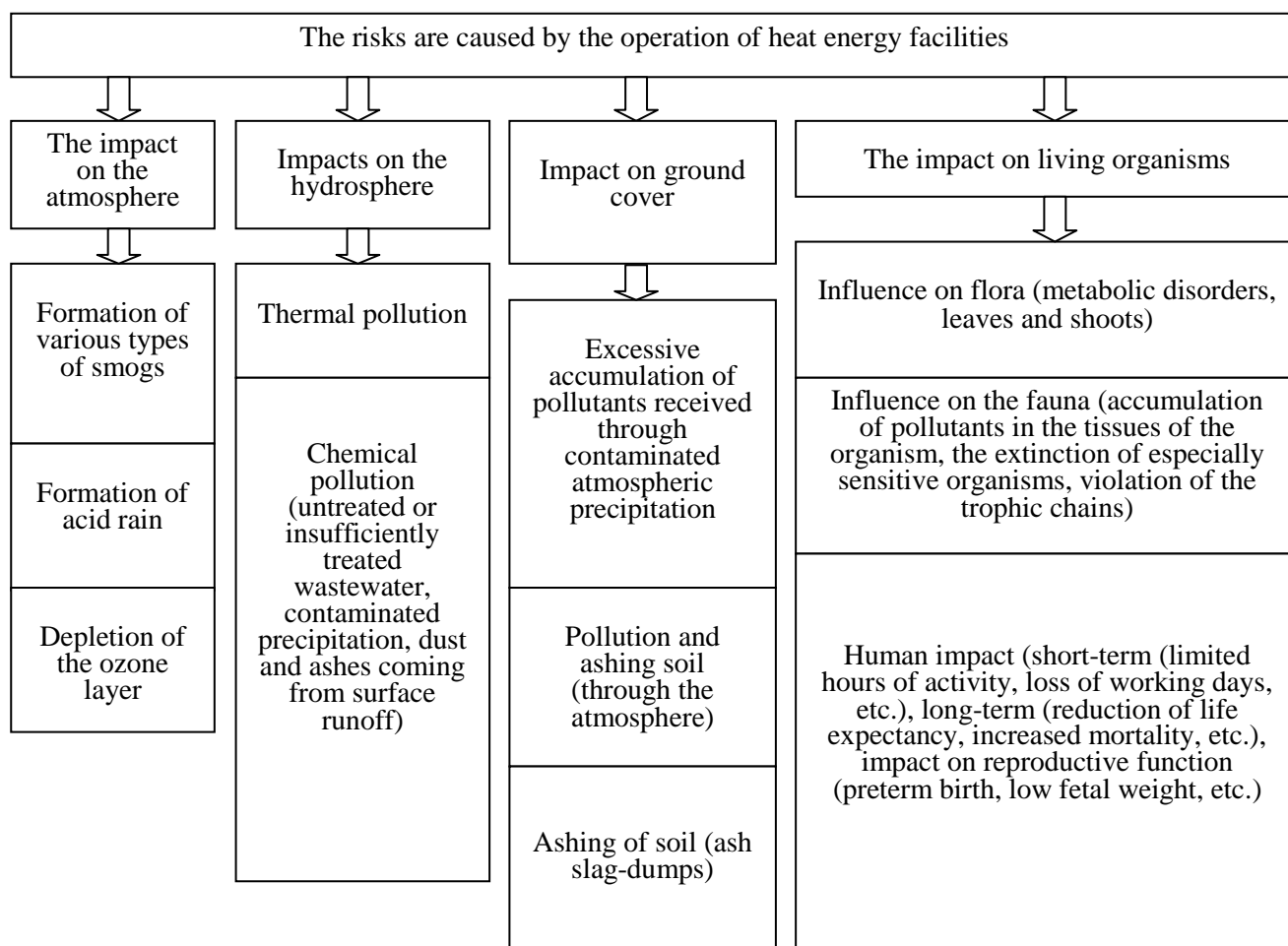


Fig. 1 - Environmental risks caused by the operation of heat energy facilities

Source: developed by the author according to [9, 10]

Figure 2 shows the aggregate limits of gross emissions of plants in the Plan from December 31, 2018 to December 31, 2033. As can be seen from the figure, the emission reductions of nitrogen oxides are observed throughout the all period of the Plan, while emissions of dust and sulfur dioxide should be minimized until December 31, 2028. It should also be noted that the highest emission reductions are observed for sulfur dioxide.

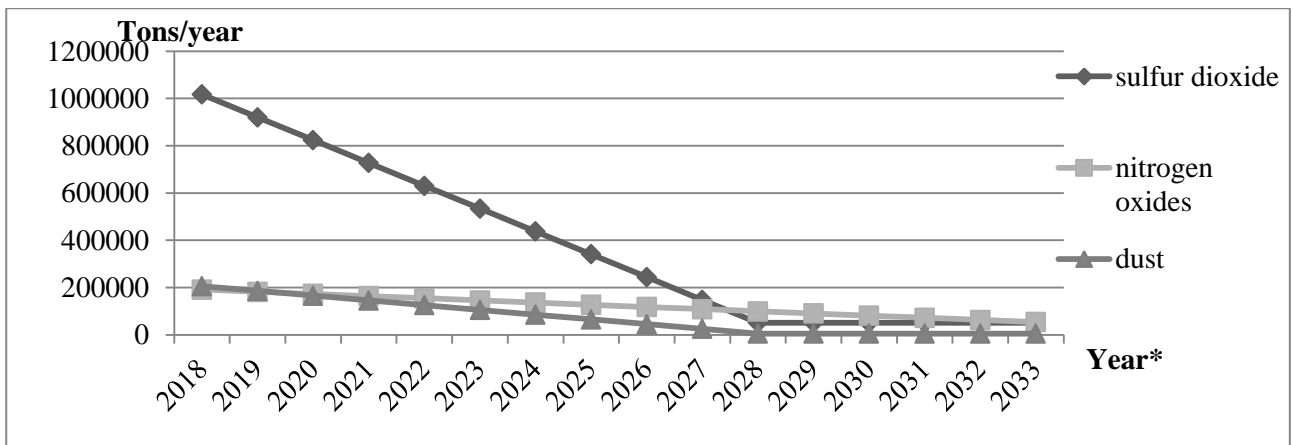


Fig. 2 - Cumulative limits of gross emissions of installations in the national emission reduction plan
 Source: developed by the author according to [6].
 Notes: *data are presented at the end of the year.

Since the main purpose of the Plan is to reduce the negative impact of Large Combustion Plants on the environment (primarily on atmospheric air), as well as to bring the functioning of the Ukrainian large combustion plants to the European requirements, it can serve as a trigger mechanism for the establishment and development of the environmental management system on the above-mentioned installations and introduction ISO 14000 standards that promote:

- minimizing the negative impact of the organization's activities on the environment;
- functioning of the enterprise in the framework of the current legislation, in compliance with the rules and other environmentally-oriented requirements;
- continuous improvement of the existing system of ecological management;
- exchange of useful information.

All standards of this family have been developed in such a way that they can be used both together and independently of each other. The basic standard in the ISO 14000 series is ISO 14001 Environmental Management Systems – Requirements with guidance for use.

The purpose of the Standard is to provide organizations with a regulatory framework for environmental protection and answers to changing environmental conditions considering socio-economic interests.

A systemic approach to environmental management can provide information to achieve success over the long term and create opportunities for sustainable development through:

- protection of the environment by preventing or reducing the negative impact on it;
- reduction of the possible negative impact of environmental conditions on the organization;
- assistance to the organization in fulfilling the mandatory requirements;
- improvement of environmental indicators;
- control or influence the ways in which products and services the organization designed, produced, consumed and disposed of using the concept of life cycle that can prevent unintended shifting environmental impact at other stages of the life cycle;
- achievement of financial and operational advantages, which can be the result of the implementation of environmentally-friendly initiatives that strengthen the market positions of the organization;
- exchange of environmental information with stakeholders.

This International Standard is based on the methodology known as Plan-Do-Check-Act (PDCA). PDCA can be briefly described as follows [11]:

- Plan: establish the objectives and processes necessary to deliver results in accordance with the organization's environmental policy;
- Do: implement the processes;
- Check: monitor and measure processes against environmental policy, objectives, targets, legal and other requirements, and report the results;
- Act: take actions to continually improve performance of the environmental management system.

In general, the methodology describes a plan of action similar to that described in the National Plan for Reducing Emissions. Figure 3 shows the scheme of interchangeability of the concepts presented in ISO 14001 and the National Plan for Reducing Emissions from Large Combustion Plants.

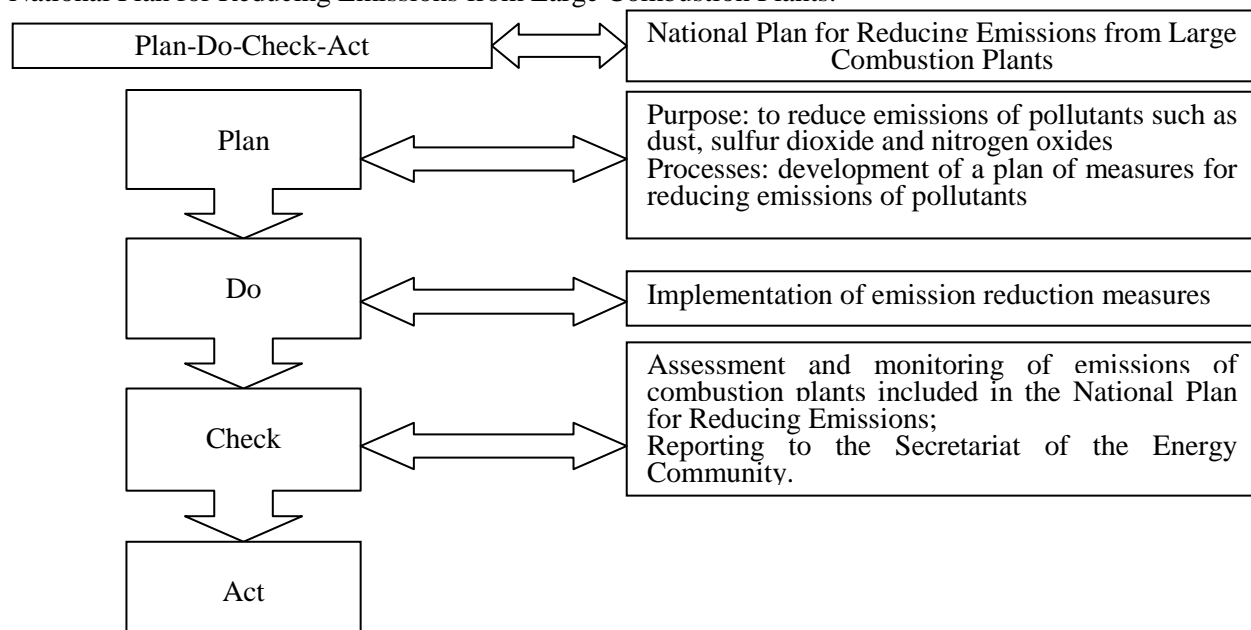


Fig. 3 Scheme of interchangeability of the concepts presented in ISO 14001 and in the National Plan for Reducing Emissions from Large Combustion Plants

Source: author's development

The only one missing in the National Plan for Reducing Emissions is possible directions for improving the implementation of emission reduction measures from large combustion plants. The introduction of the ISO 14001 standard will enable the Large Combustion Plants included in the Plan to evolve in this direction, as it will allow for international consultation with organizations and enterprises that have already introduced and refined their environmental management system.

According to the Plan, there are currently 223 Large Combustion Plants in Ukraine, of which 90 are included in the Plan, and which are expected to reduce pollutant emissions by implementing appropriate technologies (Table 1).

Table 1

Emission reduction technologies

№	Name of technology	Short name	The presence of operators of equipment installation in Ukraine
1	Fabric filter	FF	is not available
2	Wet desulfurization	WD	is not available
3	Semi-dry desulfurization	SDD	is not available
4	Selective non-catalytic reduction	SNCR	is not available
5	Selective catalytic reduction	SCR	is not available
6	Newest integrated desulphurization	NID	is not available
7	Electrofilter	E	available

Source: generalized on the basis of [6].

For most of the emission reduction technologies presented in the National Plan for Reducing Emissions, there are no enterprises or organizations that develop, sell or install the necessary equipment within Ukraine. This means that Large Combustion Plants must cooperate with the countries of the near abroad and use experience of the representatives of the heat energy sector, which has already been certified according to ISO 14001. Also, these technologies are quite costly. According to the national emission reduction plan, the total financial resources needs for gas purification will amount to 2,615 million euros, while the total cost of a large-scale modernization of Ukrainian thermal power will exceed 23,5 billion € [6].

Sources of financing of environmental measures in the energy sector are indicated in the Plan [6]:

- investment state funds;
- the return to energy companies of a part of payments (more than 80%) for emissions for the implementation of environmental projects;
- own funds of enterprises and funds of investors;
- international borrowing;
- other sources.

In particular, it is necessary to allocate such a source of financing as international borrowing, since the need for funds exceeds the capacity of both operators of Large Combustion Plants and the state as a whole, therefore, without the help of foreign investors, the implementation of the Plan will become impossible.

Over the last decade in the world, much attention has been paid to the environmental aspect of the operation of enterprises, and internationally, first of all, attention is drawn to the level of compliance of organizations with international requirements, which necessitates the introduction of the standard ISO 14001. This gives operators of Large Combustion Plants a competitive edge. This, in turn, can have a positive impact on the development of activities and lead to increased loyalty of foreign investors, which will enable to reach international relations and find sources of financing necessary for the environmentalization of energy facilities.

At present, from the 90 Large Combustion Plants, only 32 operators provide information on planned measures to reduce emissions (type of measure, implementation period) (Table 2). The operators of these LCPs are:

- DTEK Vostokenergo (Zuyevska TPP (power units 1, 2, 3, 4), Luhansk TPP (power units 9, 10, 11, 13, 14, 15), Kurakhovskaya TPP (power units 3, 4, 8, 9);
- DTEK Donetskoblenergo (Mironivska TPP);
- DTEK Dneproenergo (Zaporizhzhya TPP (power units 1, 2, 3, 4), Pridneprovskaya TPP (power units 11, 13), Krivoy Rog TPP (power units 1, 3, 4, 6, 10);
- DTEK Zakhidenergo (Burshtyn TPP (power units 8, 9, 10, 11, 12), Dobrotvirskaya TPP (blocks, boilers 11, 12), Ladyzhinskaya TPP (power units 1, 2, 3, 4, 5, 6);
- Tsentrenergo (Vuglegirskaya TPP (power units 1, 2, 3, 4), Zmiyiivska TPP (power units 1, 2, 7, 8, 9, 10), Trypillya TPP (power units 1, 2, 3, 4);
- Donbassenergo (Slovianskaya TPP (power unit 7), Starobeshivska TPP (power units 4, 5, 8, 9, 10, 11, 12, 13);
- EURO-RECONSTRUCTION COMPANY (Darnitsa EPP (boilers 5 - 10);
- PJSC Cherkassy Khimvolokno VP Cherkasska EPP (Cherkassy EPP (boilers 5 - 9);
- Ltd. TehNova CEP Chernigiv EPP (Chernigiv EPP (boilers 1 - 4).

As can be seen from the table, some of the TPPs should start modernizing their power units from 2015 onward, and finding ways to environmentalization these objects for their operators is a top priority.

Table 2

Plan of measures for the reduction of pollutant emissions from coal-fired Large Combustion Plants included in the National Plan for Reducing Emissions

№	Installation name	Unit №	Emission reduction technologies and year of commissioning					
			dust		SO ₂		NO _x	
			type	year	type	year	type	year
1.	Zuyevska TPP (power units 1,2,3,4)	1	E	2028	WD	2028	SNCR+SCR	2031
		2	E	2028	WD	2028	SNCR+SCR	2030
		3	E	2027	WD	2027	SNCR+SCR	2027
		4	–	–	WD	2027	SNCR+SCR	2026
2.	Luhansk TPP (power units 9,10,11)	9	FF	2026	SDD	2026	SNCR+SCR	2026
		10	FF	2028	SDD	2028	SNCR	2028
		11	E	2019	–	–	SNCR	2024
3.	Luhansk TPP (power units 13,14,15)	13	–	–	–	–	SNCR	2024
		14	FF	2025	SDD	2025	SNCR+SCR	2025
		15	E	2022	–	–	SNCR	2022
4.	Kurakhovskaya TPP (power units 3,4)	3	FF	2027	SDD	2027	SNCR	2027
		4	FF	2024	SDD	2024	SNCR	2024

№	Installation name	Unit №	Emission reduction technologies and year of commissioning					
			dust		SO ₂		NO _x	
			type	year	type	year	type	year
5.	Kurakhovskaya TPP (power units 8,9)	8	–	–	–	–	SNCR	2022
		9	E	2016	SDD	2023	SNCR	2022
6.	Mironivska TPP		FF	2021	SDD	2021	SNCR	2021
7.	Zaporizhzhya TPP (power units 1,2,3,4)	1	–	–	WD	2024	SCR	2027
		2	E	2024	WD	2024	SCR	2024
		3	E	2015	SDD	2022	SNCR	2028
		4	E	2022	SDD	2022	SNCR	2022
8.	Pridneprovskaya TPP (power units 11)	11	FF	2026	SDD	2026	SNCR+SCR	2026
9.	Pridneprovskaya TPP (power units 13)	13	E	2023	SDD	2023	SNCR	2023
10.	Krivoy Rog TPP (power units 1)	1	E	2017	SDD	2027	SNCR+SCR	2027
11.	Krivoy Rog TPP (power units 3,4)	3	FF	2028	SDD	2028	SNCR+SCR	2029
		4	FF	2024	SDD	2024	SNCR+SCR	2024
12.	Krivoy Rog TPP (power unit 6)	6	FF	2025	SDD	2024	SNCR	2025
13.	Krivoy Rog TPP (power unit 10)	10	FF	2026	SDD	2026	SNCR+SCR	2026
14.	Burshtyn TPP (power units 9,10,11,12)	9	E	2023	WD	2023	SCR	2023
		10	E	2018	WD	2023	SCR	2023
		11	FF	2027	SDD	2027	SNCR+SCR	2027
		12	FF	2028	SDD	2028	SNCR+SCR	2029
15.	Burshtyn TPP (power unit 8)	8	E	2026	WD	2026	SCR	2026
16.	Dobrotvirskaya TPP (power units 11,12)	7	E	2022	SDD	2022	SNCR	2022
		8	E	2015	SDD	2021	SNCR	2021
17.	Ladyzhinskaya TPP (power units 1,2,3)	1	E	2022	WD	2028	SCR	2028
		2	E	2024	WD	2028	SCR	2023
		3	E	2024	WD	2028	SCR	2032
18.	Ladyzhinskaya TPP (power units 4,5,6)	4	E	2020	WD	2024	SCR	2022
		5	E	2023	WD	2024	SCR	2023
		6	E	2025	WD	2024	SCR	2025
19.	Vuglegirskaya TPP (power units 1,2,3,4)	1	E	2025	WD	2025	SCR	2031
		2	E	2023	WD	2025	SCR	2033
		3	E	2024	WD	2025	SCR	2029
		4	E	2026	WD	2025	SCR	2026
20.	Zmiyivska TPP (power units 1,2)	1	E	2020	SDD	2021	SCR	2031
		2	E	2021	SDD	2026	SCR	2031
21.	Zmiyivska TPP (power units 7,8)	7	E	2023	WD	2028	SCR	2028
		8	E	2021	WD	2028	SCR	2033
22.	Zmiyivska TPP (power units 9,10)	9	E	2020	WD	2027	SCR	2030
		10	E	2027	WD	2027	SCR	2032
23.	Trypillya TPP (power units 1,2,3,4)	1	E	2028	WD	2028	SCR	2028
		2	E	2020	SDD+FF	2020	SCR	2031
		3	E	2021	WD	2024	SCR	2031
		4	E	2024	WD	2024	SCR	2024
24.	Slovianskaya TPP (power unit 7)	7	E	2020	NID	2020	SNCR+SCR	2020
25.	Starobeshivska TPP (power unit 4)	4	E	2025	–	–	–	–
26.	Starobeshivska TPP (power unit 5)	5	E	2025	NID	2025	SNCR+SCR	2025
27.	Starobeshivska TPP (power units 8,9,10)	8	E	2021	NID	2021	SNCR+SCR	2021
		9	E	2019	NID	2022	SNCR+SCR	2022
		10	E	2019	NID	2023	SNCR+SCR	2023

№	Installation name	Unit №	Emission reduction technologies and year of commissioning					
			dust		SO ₂		NO _x	
			type	year	type	year	type	year
28.	Starobeshivska TPP (power units 11,12,13)	11	E	2024	NID	2024	SNCR+SCR	2024
		12	E	2015	NID	2020	SNCR+SCR	2020
		13	E	2015	NID	2019	SNCR+SCR	2019
29.	Darnitsa EPP (boilers5-8)		E	2021	WD	2024	SNCR+SCR	2033
30.	Darnitsa EPP (boilers9,10)		E	2019	WD	2022	SNCR+SCR	2032
31.	Cherkassy EPP (boilers5-9)		FF	2024	SDD	2024	SNCR+SCR	2033
32.	Chernigiv EPP (boilers 1-4)		E	2026	SDD	2026	SNCR+SCR	2032

Source: generalized on the basis of [6].

Also, the implementation of the ISO 14001 standard at large combustion plants can raise the status of Ukraine on the international scene. At the moment, according to the ISO Survey of Certificates to Management System Standards in 2017, 223 certified companies were registered, with the total number of enterprises in the same year in the country totaled 338254 units [12, 13]. That is, the share of enterprises certified according to ISO 14001 is about 0,07%.

In a European scale, the country is also not competitive. In absolute index of certified enterprises Ukraine in 2017 took 35th place out of 50. From 36th to 50th place, countries such as Luxembourg, Iceland, Albania, Azerbaijan, Liechtenstein, Malta, Monaco, Andorra, Montenegro, Georgia, Republic of Moldova, Republic of San Marino, Armenia, Gibraltar (Great Britain), Kosovo, that is, countries without a pronounced heavy industry [12]. According to the percentage ratio of certified enterprises in Ukraine to the total number of certified enterprises in Europe, despite the large territory and the significant total number of organizations that have an impact on the environment, at present, the country does not make a significant contribution to the number of objects what certified on ISO 14001 [13]. For the period from 2008 to 2017 this indicator has not risen above 0,4%.

Large Combustion Plants that want to demonstrate conformity with this International Standard can do this by:

- making a self-determination and self-declaration, or
- seeking confirmation of its conformance by parties having an interest in the organization, such as
- customers, or
- seeking confirmation of its self-declaration by a party external to the organization, or
- seeking certification/registration of its environmental management system by an external organization.

For example, the external, interested party may be: consumers, communities, suppliers, controlling organizations, non-governmental organizations, investors and employees.

As an option, the certification can be carried out by a territorial community because people must be interested in sufficiently clearing the emissions into the air to ensure safe conditions for their own life.

It should also be noted that the adoption of this standard does not guarantee the best results in the field of ecology.

In Ukraine, some large combustion plants have already introduced a system of environmental management, for example, Zaporizhzhya TPP, which carried out the modernization of the electrofilter at block number 3 in 2014. Thanks to the new electrofilter, the output gases are filtered according to European standards. Thus, in Zaporizhzhya TPP was implemented and improved the ecological management system in accordance with the requirements of the international standard ISO 14001 [14, 15]. Such reconstruction consistent with the requirements of the National Plan for Reducing Emissions, therefore it is safe to assert that the simultaneous introduction of the environmental management system during the implementation of the Plan can serve as a good basis for the proper environmentalization of energy facilities and further reduce the risks from atmospheric pollution.

Conclusions and perspectives of further research. This study reviewed the environmental management system and the certification of ISO 14001 «Environmental Management Systems. Requirements and guidelines for application» not only as an annex to the general management system of the organization, but also as a crucial point for the sustainable development of the energy sector of the economy. The introduction of the environmental management system and the ISO 14001 standard will enable heat energy facilities to make a

rapidly and rationally transition to new technologies, meet international requirements and reduce the risks associated with atmospheric air pollution. Also, it will allow Ukraine to become a worthy representative of ecology in the international stage.

In the continuation of this study, it is necessary to consider in detail the mechanism of financial support for the implementation of the National Plan for Reducing Emissions from Large Combustion Plants. It is also necessary, using the experience of developed countries and enterprises that have already implemented ISO 14001, to develop a detailed project of full environmentalization of one type of thermal power engineering, to identify potential operators that are able to establish approved technologies and leverage of influence in Plan, which the state should encourage the implementation and improvement of the ecological system management at large combustion plants in Ukraine in the context of the National Plan for Reducing Emissions.

ЛІТЕРАТУРА

1. Закон України «Про пріоритетні напрями розвитку науки і техніки» від 11.07.2001 № 2623-III). [Електронний ресурс] – Режим доступу: <http://zakon.rada.gov.ua/laws/show/2623-14>
2. The Guardian: China tops WHO list for deadly outdoor air pollution. [Електронний ресурс] – Режим доступу: <https://www.theguardian.com/environment/2016/sep/27/more-than-million-died-due-air-pollution-china-one-year>
3. Carbon Brief. Mapped: The world's coal power plants. [Електронний ресурс] – Режим доступу: <https://www.carbonbrief.org/mapped-worlds-coal-power-plants>
4. Енергетична стратегія України на період до 2035 року «Безпека, енергоефективність, конкурентоспроможність», 2017. – 66 с.
5. Договір про заснування Енергетичного Співтовариства від 25.10.2005. [Електронний ресурс] – Режим доступу: http://zakon5.rada.gov.ua/laws/show/994_926
6. Національний план скорочення викидів від великих спалювальних установок. Київ, 2015. – 78 с.
7. Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants// Official Journal of the European Communities. EN. – 27.11.2001. – L. 309/1–21
8. Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) Text with EEA relevance// Official Journal of the European Communities. EN. – 24.11.2010. – L. 334/1–17
9. Europe's dark cloud. How coal-burning countries are making their neighbours sick, 2016. – 56 с.
10. Сафранов Т.А. Еколого-економічні основи природокористування: навчальний посібник / Т. А. Сафранов, О. Р. Губанова, Д. В. Лукашов. - Львів: "Новий світ-2000", 2013. – 350 с.
11. ISO 14001:2015 Системы экологического менеджмента – Требования и руководство по их применению. Для учебных целей. Перевод В. А. Качалова от 11.02.2016. – 20 с.
12. ISO Survey of certifications to management system standards. [Електронний ресурс] – Режим доступу: <https://isotc.iso.org/livelink/livelink?func=ll&objId=18808772&objAction=browse&viewType=1>
13. Державна служба статистики України: Кількість підприємств за видами економічної діяльності з розподілом на великі, середні, малі та мікропідприємства у 2017 році. [Електронний ресурс] – Режим доступу: <http://www.ukrstat.gov.ua/>
14. Запорізька ТЕС інвестувала 57 млн грн у виконання екологічної програми 2014 року. [Електронний ресурс] – Режим доступу: <https://ecotown.com.ua/news/Zaporizka-TES-investovala-57-mln-hrn-u-vykonannya-ekologichnoyi-prohramy-2014-roku/>
15. Офіційний сайт ДТЕК. Сталий розвиток. Охорона довкілля. [Електронний ресурс] – Режим доступу: https://energo.dtek.com/sustainable_development/environment/

REFERENCES

1. *Zakon Ukrainy` «Pro priory`tetni napryamy` rozvy`tku nauky` i teknyky`» vid 11.07.2001 № 2623-III) [Law of Ukraine “On Priority Areas of Science and Technology Development” from 11.07.2001 № 2623-III]. Retrieved from: <http://zakon.rada.gov.ua/laws/show/2623-14> [in Ukrainian].*
2. The Guardian: China tops WHO list for deadly outdoor air pollution. Retrieved from: <https://www.theguardian.com/environment/2016/sep/27/more-than-million-died-due-air-pollution-china-one-year> [in English].

3. Carbon Brief. Mapped: The world's coal power plants. Retrieved from: <https://www.carbonbrief.org/mapped-worlds-coal-power-plants> [in English].
4. Energetychna strategiya Ukrainy na period do 2035 roku «Bezpeka, energoefektyvnist, konkurentospromozhnist» [Energy Strategy of Ukraine until 2035«Safety, Energy Efficiency, Competitiveness»], 2017. – 66 p. [in Ukrainian].
5. Dogovor pro zasnuvannya Energetychnogo Spivtovarystva vid 25.10.2005[Treaty establishing the Energy Community, 25.10.2005]. Retrieved from: http://zakon5.rada.gov.ua/laws/show/994_926 [in Ukrainian].
6. Nacionalnyj plan skorochennya vykydiv vid velykyx spalyvalnyx ustanovok [National Plan for Reducing Emissions from Large Combustion Plants]. Kiev, 2015. – 78 p.[in Ukrainian].
7. Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants// Official Journal of the European Communities. EN. – 27.11.2001. – L. 309/1–21 [in English].
8. Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) Text with EEA relevance// Official Journal of the European Communities. EN. – 24.11.2010. – L. 334/1–17 [in English].
9. Europe's dark cloud. How coal-burning countries are making their neighbours sick, 2016. – 56 p. [in English].
- 10.Safranov T. A., Gubanova O. R.,&Lukashov D. V. (2013) *Ekologo-ekonomichni osnovy pryrodokorystuvannya: navchalnyj posibnyk [Ecological-economic bases of nature use: textbook] . - Lviv: "Novyi-svit-2000", – 350 p. [in Ukrainian].*
- 11.Internationalstandard. ISO Environmental management systems — Requirements with guidance for use. Second edition 2004-11-15. – 20 c. [in English].
- 12.ISO Survey of certifications to management system standards. Retrieved from: <https://isotc.iso.org/livelink/livelink?func=ll&objId=18808772&objAction=browse&viewType=1> [in English].
- 13.Derzhavna sluzhba statyky Ukrainy: Kil'kist' pidpryemstv za vydamy ekonomichnoyi diyalnosti z rozpodilom na velyki, seredni, mali ta mikropidpryemstva u 2017 roci [*State Statistics Service of Ukraine: Number of enterprises by type of economic activity with distribution to large, medium, small and micro enterprises in 2017*]. Retrieved from: <http://www.ukrstat.gov.ua/> [in Ukrainian].
- 14.Zaporizka TES investovala 57 mln grn u vykonannya ekologichnoyi programy 2014 roku [Zaporizhzhya TPP invested UAH 57 million in implementation of the 2014 ecological program]. Retrieved from: <https://ecotown.com.ua/news/Zaporizka-tes-investovala-57-mln-hrn-u-vykonannya-ekologichnoyi-prohramy-2014-roku/> [in Ukrainian].
- 15.Oficijnyj sajt DTEK. Stalyj rozvytok. Oxorona dovkillya [DTEK official website. Sustainability. Environmental protection]. Retrieved from: https://energo.dtek.com/sustainable_development/environment/ [in Ukrainian].