DOI https://doi.org/10.30525/978-9934-26-390-3-7

DEFINING THE MAIN DIRECTIONS OF UKRAINE'S CLIMATE POLICY

Liudmyla Markina, Oleh Vlasenko, Dmytro Todchuk

INTRODUCTION

The development of climate policy directions in Ukraine is an important and relevant topic. The country is facing various challenges, such as climate change, environmental pollution, and depletion of natural resources, among others.

Ukraine has joined a number of international documents and agreements aimed at combating climate change. For example, the Paris Agreement, which Ukraine joined in 2016, sets the goal of keeping global warming below 2 °C compared to the pre-industrial period.

One of the main scientific areas of Ukraine's climate policy is the development of technological aspects and management solutions for controlling greenhouse gas emissions in the context of implementing sustainable development goals. The country has great potential in the field of renewable energy, in particular in solar and wind energy. The government supports and stimulates the development of these industries and provides grants for obtaining permits for energy production using non-conventional energy sources.

Another important area of climate policy is improving energy efficiency. Ukraine is one of the most energy-intensive countries in Europe, so the introduction of innovative energy-efficient technologies has become a priority for the government and the state. A program to reduce energy consumption is being implemented, measures are being taken to modernize the residential and public sectors, and the application and use of energy efficient technologies is being introduced and popularized.

In addition, Ukraine is increasing its participation in international climate cooperation. The country is actively cooperating with international organizations to receive financial and technical support for the implementation of projects to reduce greenhouse gas emissions and adapt to climate change.

Ukraine's national climate policy still needs to be further improved and new measures, technological processes, and decision-making mechanisms introduced. Nevertheless, the country shows some progress in the development of environmental and climate policy and shows great interest in the transition to sustainable development and environmental protection. At the same time, it should be noted that Ukraine's climate policy is constantly improving and adapting to new challenges. Implementation of climate policy requires a comprehensive approach, including legislative changes, development of new programs and projects, and attraction of funding and support from international partners.

1. The emergence of the prerequisites of the problem and the formulation of the problem

In the modern world, climate change is the biggest global issue and equally affects all countries and all people of the world, and solving this issue is becoming one of the main priorities of domestic and foreign policy of many countries.

In 1992, when the First IPCC Assessment Report was published, it was concluded that emissions of certain gases from human activities significantly increase the concentration of greenhouse gases in the Earth's atmosphere, which in turn increases the global average surface temperature, which had already increased by 0.3-0.6°C at that time (Figure 1).

Monthly global mean temperature 1851 to 2020 (compared to 1850-1900 averages)

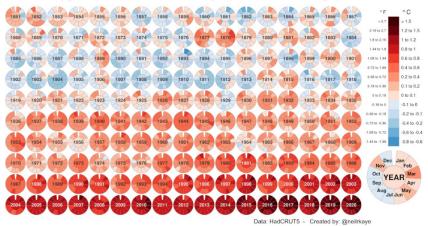


Figure 1. Monthly global average temperature compared to the average temperature for 1851–1900

Growing evidence of a global threat has forced politicians of all countries to take actions against the climate change. At present, the temperature has increased even more compared to the century before last (Figure 2).

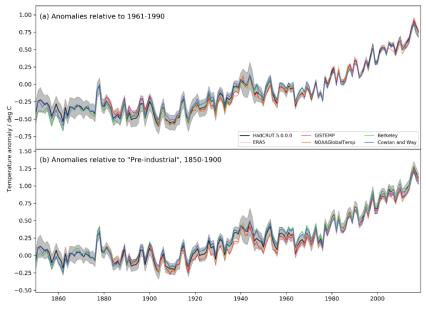


Figure 2. Change in average air temperature compared to 1961–1990 (a) and the "pre-industrial" period of 1850–1900 (b)

At the same time, the concentration of carbon dioxide (CO_2) in the atmosphere is increasing¹ (Figure 3).

Along with carbon dioxide, other gases that cause the greenhouse effect and are emitted by human activities are methane (CH₄), nitrogen oxide (N₂O), fluorine-containing gases such as hydrofluorocarbons, perfluorocarbons, hydrochlorocarbons and others.

Thus, in 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted, which was ratified by 198 countries of the world.

The main goal of the Convention was to stabilize the concentration of greenhouse gases in the atmosphere at a level that would prevent negative anthropogenic impact on the climate system of Earth. The document included also provisions for the establishment of various mechanisms and bodies that would help fulfill the main goal.

In addition, the UNFCCC established Financial Mechanism that would ensure the provision of financial resources in the form of grants or concessional loans, including for technology transfer.

¹ Data of NASA GISS, NOAA NCEI, ESRL. URL: https://ecoaction.org.ua/zmina-klimatu-ua-ta-svit.html

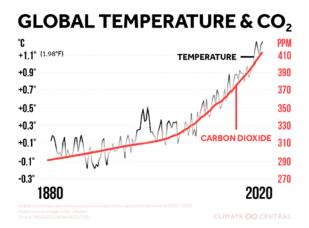


Figure 3. Trend of increasing carbon dioxide concentration and temperature

After a while it has become clear that in order to achieve the objective of the Convention, more decisive steps are needed in the fight against climate change. Thus, in 1997, the Kyoto Protocol to the UNFCCC (KP) was adopted, which entered into force in 2005. It has been ratified by 192 countries of the world.

Unlike the UNFCCC, the KP included a clear set of quantitative limits on greenhouse gas emissions for a specific list of countries and with a specific timeline. In particular, these restrictions applied to 39 countries and groups of countries of the world (Annex B to the KP), which were considered the countries with the highest amount of greenhouse gas emissions at that time.

Since the KP had a limited time period of commitments by countries to limit greenhouse gas emissions for a number of countries, the question arose before the global community: what should be the next steps to further combat climate change, and most importantly, how to better involve those countries that previously did not have restrictions on greenhouse gas emissions? Thus, as a result of lengthy negotiations, the Paris Agreement to the UNFCCC (PA) was adopted in 2015. At the moment, it has already been ratified by 196 countries of the world.

This agreement had several special features compared to previous framework documents. First, it did not introduce any quantitative indicators for reducing emissions or increasing removals, but obliged countries to choose their own commitments in the form of nationally determined contributions. Secondly, the PA introduced the provision on need to develop a global goal on climate change adaptation. Thirdly, a mechanism for compensation for losses and damages caused by the effects of climate change was introduced.

To choose their objectives, countries had the freedom to choose their objectives, sectors, measures and other aspects. That is why nationally determined contributions usually highlighted high-priority and relevant areas that, in the opinion of the political leaders of the respective countries, are best suited to achieve the goal of preventing an increase in the global average temperature.

Ukraine ratified the UNFCCC in 1996², the Kyoto Protocol in 2004 and the Paris Agreement in 2016, reaffirming its intentions to combat climate change.

Ukraine was included in the list of countries in Annex I to the UNFCCC because it had significant greenhouse gas emissions in the base 1990. In particular, according to the National Inventory Report of Ukraine for 1990–2021, emissions amounted to 911.4 million tons of CO₂ equivalent. In 2021, however, total greenhouse gas emissions amounted to 341.5 million tons of CO₂ equivalent (Figure 3)³.

In the structure of greenhouse gas emissions, the vast majority of emissions occurred in the energy sector (Figure 3).

Currently, the largest source of greenhouse gas emissions in Ukraine is still the energy sector. In 2021, this sector accounted for about 64%, excluding the LULUCF sector (Figures 4-5).

About 7.6% of emissions in this sector come from emissions in the "Fuel Combustion" category, which includes the categories "Energy Industries", "Manufacturing Industries and Construction", "Transport", "Other Industries" and "Others", as well as 24% from uncontrolled emissions in the "Fugitive Emissions from Fuels" category.

It should be noted that the share of fugitive greenhouse gas emissions in the category "Fugitive Emissions from Fuels" in total greenhouse gas emissions in the energy sector gradually increased during 1990–2000: from 17.6% in 1990 to 28.7% in 2000. This period is characterized by the aging of the country's infrastructure and industrial capital. Since 2001, the share of emissions associated with fossil fuel losses has gradually decreased to 24.0% in 2021. This is due to a decrease in fossil fuel production in Ukraine, a

² C. P. Morice, J. J. Kennedy, N. A. Rayner, J. P. Winn, E. Hogan, R. E. Killick, R. J. H. Dunn, T. J. Osborn, P. D. Jones and I. R. Simpson (in press) An updated assessment of near-surface temperature change from 1850: the HadCRUT5 dataset. *Journal of Geophysical Research (Atmospheres).* 2021. Volume 126, Issue 3. DOI: https://doi.org/10.1029/2019JD032361

³ Visualized: Historical Trends in Global Monthly Surface Temperatures (1851–2020). URL: https://www.visualcapitalist.com/global-temperature-graph-1851-2020

decrease in natural gas transit, as well as a decrease in the use of natural gas by the population due to higher prices.

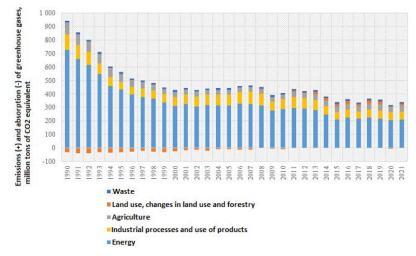


Figure 3. Structure of greenhouse gas emissions in Ukraine, 1990–2021

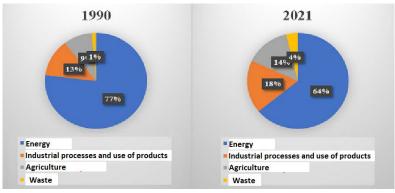


Figure 4. Structure of greenhouse gas emissions in Ukraine by sectors in 1990 and 2021

The global COVID-19 pandemic and measures against the disease slowed the economy, leading to a decrease in greenhouse gas emissions from the energy sector in 2020. Especially it affected energy, transport and other industries.

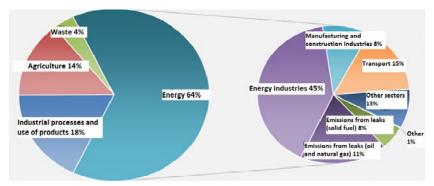


Figure 5. Structure of greenhouse gas emissions in Ukraine in 2021

The economic downturn that followed the collapse of the USSR in 1991 led to a significant reduction in production, energy consumption, and thus a decrease in CO₂ emissions. Between 2000 and 2007 there was some stabilization with a slight increase in production, and since 2008, due to the global financial and economic crisis, there has been a drop in production and CO₂ emissions consequently. In 2021, emissions from the industrial sector decreased by 50.6% compared to the base year. The key reasons for the reduction of emissions are a decrease in the level of production due to the outflow of investment capital, unstable dynamics of exports, a reduction in the domestic market, as well as discrepancies in the established relations "raw materials-production-sales" in the regions of the country. The situation in the east of the country has a significant impact on the development of industry. This is due not only to the catastrophic drop in industrial production in Donetsk and Luhansk regions. For the neighboring regions that had strong production and supply ties with the temporarily occupied industrial parts of Donetsk and Luhansk regions, it is difficult to compensate these losses with other supply chains.

2021 was characterized as an economic recovery from the global COVID-19 pandemic. In the industrial sector, this is related to the increase in emissions in the steel industry compared to the fall in 2020.

The share of the agricultural sector in total greenhouse gas emissions in 2021 was 14.4%. The main sources of emissions in the agricultural sector are enteric fermentation and agricultural soils, accounting for 15.0% and 80.0% of the sector's total emissions in 2021, respectively. Emissions in this sector decreased by 45.9% compared to the base year, but increased by 12.8% compared to the previous year, mainly due to emissions from agricultural soils.

Changes in emissions for the reporting period in the category "Enteric fermentation" (-82.1 and -5.3% compared to the base and previous years, respectively) are associated with changes in the population of livestock, herd structure and gross energy values.

Significant rate of fluctuation of methane emissions in the Manure Management category compared to emissions in other categories for the period 1990–2021 is directly related to the partial substitution of the liquid method of manure storage for solid storage in the structure of manure management at livestock enterprises: in 1990, the percentage of cattle manure in liquid suspension was 21.0% of the total volume of manure produced, while in 2021 it was only about 5.3%.

Fluctuations in methane emissions in the reporting year (compared to the base year as well as the previous year) in category Rice cultivation caused by changes in the harvest area (from 27.7 hectares in 1990 to 10.4 hectares in 2021).

The change in nitrous oxide emissions in the category "Agricultural soils" until 2021 is due to changes in the amount of fertilizers applied, the area under certain crops and their productivity.

The land use and forestry sector includes both carbon dioxide emissions and removals, as well as CH₄ and N₂O emissions. The resulting Carbon stocks in the sector in 2021 are a net source. Net CO₂ emissions in the sector in 2021 amounted to 14.2 million tons of CO₂ equivalent compared to the net removal of 31.4 million tons of CO₂ equivalent. in the base year of 1990. The main reason for this transition is the change in the agricultural management system of arable lands, which led to a change from 4.6 million tons of CO₂ equivalent removals in 1990 to 48.3 million tons of CO₂ equivalent emissions in 2021. In particular, the area, yield and structure of crops harvested from these lands, as well as fertilizers applied, have a significant impact. These factors also contributed to the rapid change in emissions compared to 2020 by 76.0%, which is associated with high crop yields in 2021⁴.

The decrease in the area and volume of peat production, which led to a decrease in greenhouse gas emissions from 12.0 million tons of CO_2 equivalent, also has a great impact in 1990 to 0.2 million tons of CO_2 equivalent in 2021⁵.

In addition, rapid land-use changes, especially those resulting in the loss of living biomass, have a significant impact on the overall level of emissions in the sector.

⁴ Data of the Nationally Determined Contribution Registry. URL: https://unfccc.int/NDCREG

⁵ C. P. Morice, J. J. Kennedy, N. A. Rayner, J. P. Winn, E. Hogan, R. E. Killick, R. J. H. Dunn, T. J. Osborn, P. D. Jones and I. R. Simpson (in press) An updated assessment of near-surface temperature change from 1850: the HadCRUT5 dataset. *Journal of Geophysical Research* (*Atmospheres*). 2021. Volume 126. Issue 3. DOI: https://doi.org/10.1029/ 2019JD032361

The contribution of the waste sector in 2021 to total emissions is 3.7%. The main sources of CH₄ emissions are landfills of municipal solid waste (MSW), and of N₂O emissions is wastewater. Compared to the base year, emissions in the sector decreased by 2.4% in 2021.

In accordance with its commitments under the Paris Agreement, Ukraine prepared and updated its first Nationally Determined Contribution in 2021. According to it, as a national commitment, the state has set a goal by 2030 not to exceed total greenhouse gas emissions of 35% of the 1990 level.

When making a decision during the update of the Nationally Determined Contribution, the project of the European Bank for Reconstruction and Development "Support to the Government of Ukraine on updating its Nationally determined contribution" carried out analytical work on the development of forecasts for the development of the country's economy and the resulting emissions and removals of greenhouse gases under different scenarios. The results of the calculations were presented in the relevant reports.

According to the results of forecasting and modeling, the greatest potential for emission reductions can be achieved in the energy and industrial sectors, as well as by increasing removals in the land use and forestry sectors⁶.

The experts of the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine identified the following priority areas of sectoral policies that will allow to achieve the goal of reducing greenhouse gas emissions⁷:

1) Electricity sector:

a. Ensuring the proper functioning of all segments of the electricity market

b. Market prices for electricity for consumers

c. Incentive regulation (RAB Tariffs) for electricity transmission and distribution system operators

d. "Smart" technologies and demand management in the electricity industry

e. Integration into the EU electricity market

f. Implementation of the National Plan for the Reduction of Emissions from Large Combustion Plants (NERP)

g. Introduction of large energy storage systems

h. Competition in the implementation of renewables (auctions for the distribution of support quotas)

i. Ensuring market activity and responsibility of renewable energy sources entities

⁶ Data of NASA GISS, NOAA NCEI, ESRL. URL: https://ecoaction.org.ua/zmina-klimatu-ua-ta-svit.html

⁷ Балабух В. О., Лавриненко О. М., Малицька Л. В. Особливості термічного режиму 2013 року в Україні. *Український гідрометеорологічний журнал*. Одеса : Видавництво ПП «TEC», 2014. № 14. С. 30–46. URL: http://nbuv.gov.ua/UJRN/Uggj_2014_14_10

2) Heat generation sector:

a. Stimulating the introduction of renewable energy sources and highly efficient cogeneration in centralized heating

b. Development of individual heat supply systems based on renewable energy sources

3) Bioenergy:

a. Introduction of sustainability criteria for biofuels

b. Supporting the development of biomass-based centralized heating

c. Creation of a biomass burge

d. Demand and supply of biogas/biomethane

e. Energy crops

f. Requirement for the blending of the biological component of the fuel

4) Industry:

a. Introduction of energy audit and energy management at industrial enterprises

b. Introduction of energy service contracts and provision of consultancy to industrial enterprises

c. Introduction of other mechanisms to stimulate industrial enterprises to implement energy efficiency measures

d. Access of Ukrainian industrial enterprises to the results of research and development work in the EU

e. Stimulating the introduction of technologies for the use of hydrogen in industry (for example, in the production of methanol and polymers, ammonia (fertilizers), etc.).

5) Production, transportation and supply of fuel:

a. Introduction of numerous leak prevention methods during the extraction and processing of natural gas, oil and coal in existing mines

b. Reduction of leaks during oil and natural gas transportation

c. Modernization of underground gas storage facilities in accordance with mandatory standards and technical requirements

d. Introduction of incentives for the use of geothermal energy from depleted oil and gas wells

e. Stimulating the introduction of conservation measures and technologies at mining sites that will reduce greenhouse gas emissions from old wells and deposits

f. Deployment of hydrogen production and transportation capabilities, including for export to the EU.

6) Building Sector:

a. Ensuring the reliable operation of the Energy Efficiency Fund

b. Introduction of energy certification of buildings

c. Introduction of energy management and information system for public and residential buildings

d. Energy efficiency investment program for public and residential buildings

e. Facilitating accurate metering of heat and hot water use and meter-based billing

7) Transport:

a. Improved CO_2 emission standards for new passenger and light commercial vehicles

b. Optimization of the structure of passenger and freight transportation in cities

c. Public transport fleet renewal support

d. Incentives and stimulation measures for electric vehicles

e. Fiscal incentives for the renewal of the private fleet

f. Electrification of road transport

g. Hydrogen technologies in the transport sector

h. Implementation of the requirements of the Directive "On the inspection of the technical condition of motor vehicles and their trailers"

8) Land Use, Agriculture and Forestry:

a. Agricultural development strategy

b. Promoting the use of conservation tillage technologies

c. Use of information and telecommunication technologies in crop production

d. Use of slow-release or controlled-release nitrogen fertilizers

e. Promotion of organic crop production

- f. Reducing greenhouse gas emissions from livestock farming
- g. Afforestation

h. Land allocation mechanism

i. Strengthening the protection of forests

9) Waste management:

a. Prevention of solid waste disposal

- b. Stimulating the production of electricity from landfill gas
- c. Stimulation of landfill gas flaring for landfills
- d. Stimulating methane recovery from wastewater management

e. Sewage sludge denitrification

f. Production of alternative fuels from solid waste in order to reduce the need for fossil fuels in the cement industry

g. Promoting a circular economy

In addition to sectoral policies, climate financial instruments are becoming widespread in the world.

A tax on greenhouse gas emissions exists in 27 countries around the world, including Ukraine. Despite the differences in application methods, spheres and activities where it is applied, the basic principle remains constant: enterprises that emit greenhouse gases into the atmosphere in the process of producing goods pay tax. Taking into account the natural tendency of businesses to minimize the cost of goods without compromising the total amount of production, there is an incentive for enterprises to increase their operational efficiency by reducing greenhouse gas emissions without harming production.

Such a mechanism is one of the simple mechanisms for the pricing of greenhouse gas emissions, as the government sets specific tax rates. At the same time, such mechanism has serious drawbacks. In particular, after certain measures to increase production efficiency, business loses the competitiveness of production in the country. Therefore, there is a risk of reducing production or moving it abroad.

A more complex mechanism for stimulating the reduction of greenhouse gas emissions is emissions trading systems (ETS). One of the most successful examples is the European system, which was created by Directive 2003/87/EC.

A prerequisite for the creation of the ETS is the development of an information infrastructure on greenhouse gas emissions at enterprises, which is called the Greenhouse Gas Monitoring, Reporting and Verification (MRV) system. This system obliges enterprises that are included in the system according to certain parameters to create and maintain processes for monitoring their greenhouse gas emissions.

After obtaining reliable data on the production of commodities and the corresponding greenhouse gas emissions, regulators provide allowances for greenhouse gas emissions to those enterprises that are part of the MRV system. However, the number of allowances granted free of charge decreases over time, creating a demand for additional emission allowances, thus forming a price for them.

Such system requires significant knowledge, skills and expert support in the process of its creation, but as a result, it can show significant results. In particular, the EU has set a goal to reduce greenhouse gas emissions by 30% by 2030 compared to 2005^8 .

According to the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their Member States, on the other hand, Ukraine took a commitment to develop national legislation in order to implement Directive 2003/87/EC⁹.

⁸ Data of the Nationally Determined Contribution Registry. URL: https://unfccc.int/NDCREG.

⁹ United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/convkp/conveng.pdf

According to this, in 2021, the Law of Ukraine "On the Principles of Monitoring, Reporting and Verification of Greenhouse Gas Emissions" came into force, as well as by-laws for its implementation¹⁰. It is expected that this legislation will become a solid basis for the creation of an ETS in Ukraine, which will be fully in line with European practice and will help Ukraine achieve its climate goals.

CONCLUSIONS

Climate change is the biggest global issue and equally affects all countries and all people of the world, and solving this issue is becoming one of the main priorities of domestic and foreign policy of many countries.

The most important for Ukraine now is to win the war and restore its sovereignty and territorial integrity. Everything else must serve this goal.

It is necessary to restore Ukraine from the consequences of the war and ensure the economic growth of the national economy. Ukraine's recovery should take into account climate goals and green transformation goals. This should be a "green" recovery with a transition to a sustainable competitive economy, taking into account the latest trends in the EU countries.

The criteria for "green" recovery should be included in the reconstruction program of Ukraine from the very beginning, because most of the existing modern technologies are more economically feasible. All sectors of Ukraine's economy need to be restored. This includes the restoration of energy infrastructure, industry, reconstruction of destroyed housing, logistics, so it is very difficult to single out one specific area, because the issue of combating climate change is complex and must be taken into account in all sectors and regions of Ukraine. The efficient functioning of the energy sector, which is the highest priority in terms of reducing greenhouse gas emissions, as well as the reconstruction of housing for citizens taking into account climate goals, will contribute not only to the achievement of Ukraine's climate goals, but also ensure energy sustainability and security.

Regarding law-making activities in the field of climate change, I would like to note that next year we plan to adopt a law on the basic principles of state climate policy, a national energy and climate plan, as well as to start preparing a national greenhouse gas emissions trading system and Ukraine's 2nd nationally determined contribution to the Paris Agreement.

An ambitious climate policy is needed to:

- address climate change

¹⁰ Ukraine's Greenhouse Gas Inventory 1990-2021. Annual National Inventory Report for Submission under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. Kyiv, 2023. URL: https://unfccc-

int.translate.goog/documents/273676?_x_tr_sl=en&_x_tr_tl=uk&_x_tr_hl=uk&_x_tr_pto=sc

- overcome the effects of climate change

- Ukraine's harmonious accession to the EU and its ambitious climate goals.

The main goal of an ambitious climate policy at the international level, both in the next and coming years, should be to increase the ambition to reduce or limit greenhouse gas emissions as much as possible at the global level. This can be achieved by a drastic reduction in the consumption of fossil fuels, in particular coal, oil and natural gas. The active development of renewable energy and the rejection of the purchase of fossil fuels will not only contribute to overcoming energy inequality and the global climate crisis, but will also contribute to achieving peace in Europe and other countries, since profits from the sale of fossil fuels often become the main financial resource of military aggressions.

SUMMARY

Growing evidence of a global threat has forced politicians around the world to take action in the fight against climate change. Thus, in 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted, which was ratified by 198 countries of the world.

The main goal of the Convention was to stabilize the concentration of greenhouse gases in the atmosphere at a level that would prevent negative anthropogenic impact on the climate system of Earth. The document included also provisions for the establishment of various mechanisms and bodies that would help fulfill the main goal.

To choose their objectives, countries had the freedom to choose their objectives, sectors, measures and other aspects. That is why nationally determined contributions usually highlighted high-priority and relevant areas that, in the opinion of the political leaders of the respective countries, are best suited to achieve the goal of preventing an increase in the global average temperature.

In Ukraine, there has also been a trend towards climate change in recent decades. In particular, scientists that analyze meteorological observations have made the conclusion that there has been a significant change in the average annual air temperature¹¹.

Also, the process of forming a vision of Ukraine's post-war recovery from the consequences of Russian aggression continues. First of all, it was presented at the Ukraine Recovery Conference (URC 2022) in Lugano on July 4-5, 2022, where the Government of Ukraine presented its vision of reforms and the Ukraine Recovery Plan. Therefore, there is undoubtedly a need for a constant transformation of the vision of Ukraine's post-war recovery

¹¹ Закон України «Про ратифікацію Паризької угоди» № 1469-VIII (14.07.2016).

and, above all, on the basis of the requirements of the Global Green Deal, since the strategic goal is to facilitate the transition to a climate-neutral or green economy, the postulates and principles of which were proclaimed by UNEP back in 2009.

Therefore, one of the important directions of the environmental policy of our country is the climate, its change and reduction of greenhouse gas emissions.

References

1. Data of NASA GISS, NOAA NCEI, ESRL. URL: https://ecoaction.org.ua/zmina-klimatu-ua-ta-svit.html

2. IPCC 6th Assessment Report, WG1, Chapter 2, Section 2.2.1, «Solar and Orbital Forcing». URL: https://www.ipcc.ch/report/ar6/wg1/ chapter/chapter-2/

3. Visualized: Historical Trends in Global Monthly Surface Temperatures (1851–2020). URL: https://www.visualcapitalist.com/global-temperature-graph-1851-2020/

4. Data of the Nationally Determined Contribution Registry. URL: https://unfccc.int/NDCREG

5. C. P. Morice, J. J. Kennedy, N. A. Rayner, J. P. Winn, E. Hogan, R. E. Killick, R. J. H. Dunn, T. J. Osborn, P. D. Jones and I. R. Simpson (in press) An updated assessment of near-surface temperature change from 1850: the HadCRUT5 dataset. *Journal of Geophysical Research (Atmospheres).* 2021. Volume 126, Issue 3. DOI: https://doi.org/10.1029/2019JD032361

6. Балабух В. О., Лавриненко О. М., Малицька Л. В. Особливості термічного режиму 2013 року в Україні. Український гідрометеорологічний журнал. Одеса : Видавництво ПП «ТЕС», 2014. № 14. С. 30–46. URL: http://nbuv.gov.ua/UJRN/Uggj_2014_14_10

7. United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/convkp/conveng.pdf

8. Закон України «Про ратифікацію Паризької угоди» № 1469-VIII (14.07.2016).

9. Закон України «Про ратифікацію Рамкової конвенції ООН про зміну клімату» № 435/96-ВР (29.10.1996).

10. Закон України «Про ратифікацію Кіотського протоколу до Рамкової Конвенції Організації Об'єднаних Націй про зміну клімату» № 1430-IV (04.02.2004).

11. Ukraine's Greenhouse Gas Inventory 1990–2021. Annual National Inventory Report for Submission under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. Kyiv, 2023. URL: https://unfccc-int.translate.goog/documents/273676?_x_tr_sl=en&_x_ tr_tl=uk&_x_tr_hl=uk&_x_tr_pto=sc 12. Закон України «Про ратифікацію Угоди про асоціацію між Україною, з однієї сторони, та Європейським Союзом, Європейським співтовариством з атомної енергії і їхніми державами-членами, з іншої сторони» № 1678-VII (16.09.2014).

13. Data of the Nationally Determined Contribution Registry. URL: https://unfccc.int/NDCREG

14. Звіт 3 / Звіт з моделювання. «Підтримка Уряду України з оновлення Національно-визначеного внеску». URL: https://mepr.gov.ua/ diyalnist/napryamky/zmina-klimatu/pom-yakshennya-zminy-klimatu/natsionalno-vyznachenyj-vnesok-ukrayiny/

15. Звіт 4 / Політики та заходи. «Підтримка Уряду України з оновлення Національно-визначеного внеску». URL: https://mepr.gov.ua/ diyalnist/napryamky/zmina-klimatu/pom-yakshennya-zminy-

klimatu/natsionalno-vyznachenyj-vnesok-ukrayiny/

16. Закон України «Про ратифікацію Угоди про асоціацію між Україною, з однієї сторони, та Європейським Союзом, Європейським співтовариством з атомної енергії і їхніми державами-членами, з іншої сторони» № 1678-VII (16.09.2014).

17. Закон України «Про засади моніторингу, звітності та верифікації викидів парникових газів» № 377-ІХ (12.12.2019).

18. Постанова Кабінету Міністрів України «Про затвердження переліку видів діяльності, викиди парникових газів в результаті провадження яких підлягають моніторингу, звітності та верифікації» № 880 (23.10.2020).

19. Постанова Кабінету Міністрів України «Про затвердження Порядку верифікації звіту оператора про викиди парникових газів» № 959 (23.10.2020).

Information about the authors: Liudmyla Markina

Doctor of Technical Sciences, Professor of the Department of Environmental Audit and Environmental Protection Technologies State Ecological Academy of Postgraduate Education and Management 35, Metropolitan Lipkivsky Str., Kyiv, 03035, Ukraine Oleh Vlasenko Research Associate, Postgraduate Student of the Department of Environmental Audit and Environmental Protection Technologies State Ecological Academy of Postgraduate Education and Management 35, Metropolitan Lipkivsky Str., Kyiv, 03035, Ukraine

Dmytro Todchuk

Postgraduate Student of the Department of Environmental Audit and Environmental Protection Technologies State Ecological Academy of Postgraduate Education and Management 35, Metropolitan Lipkivsky Str., Kyiv, 03035, Ukraine