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INTERNATIONAL EXPERIENCE OF ADAPTATION TO CLIMATE CHANGE
AND POSSIBILITIES OF ITS APPLICATION IN UKRAINE

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Abstract. Adaptation to the consequences of climate change is fitting to existing or expected conditions, early resolution of problems arising as a result of climate change. This topic has appeared quite often on the political agenda of Ukraine and the whole of Europe in the last few years. It is very important to create an effective coordination mechanism for adaptation, to define the powers and functions of state bodies in this area. It should concern the national, regional and city levels.

Keywords: climate change, prevention of climate change, adaptation to climate change, environmental security.

Introduction. Unprecedented changes in the atmosphere, hydrosphere, cryosphere, lithosphere and biosphere of our planet caused rapid changes in the surface temperature. Their main cause is technogenic human activity. Over the past decades, changes in the climate system have gone far beyond the boundaries of a scientific problem and affect not the environment only, but all the sectors of the economy, health and safety of life. The fight against climate change is a strategic Goal No. 13 „Climate action“ for sustainable development of the United Nations [1]. The main negative consequences of climate change manifested in cities include a strong increase in air temperature and heat stress, a decrease in the area and disturbance of the species composition of urban green zones, an increase in extreme weather conditions, spontaneous hydrometeorological phenomena, a change in the thermal regime and structure of precipitation, flooding, decrease quantity and deterioration of the quality

of drinking water, disruption of the normal functioning of the city's energy systems, an increase in the number of infectious diseases and allergic manifestations, etc.

During the last two decades, the change in the average annual air temperature in Ukraine was three times faster than the global temperature change. The last five years turned out to be the warmest for the entire period of instrumental weather observations [2]. As a result of such changes, the thermal regime, humidification regime and wind regime have significantly changed in Ukraine, the frequency and intensity of dangerous weather phenomena has increased. However, these changes were not the same throughout the country and had certain regional characteristics. Accordingly, there is a need to develop a plan of measures to prevent and adapt Ukrainian cities to climate change.

Results and Discussion. In 2013, the European Commission published the Strategy of the European Union (EU) on adaptation to the effects of climate change. In 2021, the European Commission adopted the Communication „Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change“ [3]. The Adaption Strategy lists the impacts of climate change, as well as specific measures and actions for adaptation to climate change, calling for specific comprehensive or sectoral adaptation measures at the level of the EU or EU countries. The strategy addresses the global impacts of climate change, such as supply chain disruptions and limited access to supplies of materials, energy and food, as well as minimise vulnerability to the impacts of climate change, in line with the Paris Agreement. The overall goal of the EU Adaptation Strategy is to increase resilience to climate change, i.e. increase readiness and ability to respond to climate change impacts at local, regional, national and EU levels. Based on the positive results of the „Adaptation Strategies for European Cities“ pilot project, the European Commission continues its policy of supporting urban adaptation strategies. Adaptation measures in cities should be developed taking into account other areas of EU policy based on the model of the the Global Covenant of Mayors for Climate & Energy.

The European Climate Adaptation Platform Climate-ADAPT was created, containing the latest information on climate change adaptation activities implemented in the EU, as well as some tools to support such policies [4].

The ISO 14090:2019 standard „Adaptation to climate change - principles, requirements and guidelines“ is the first in a series of ISO standards designed to help organizations assess the impact of climate change and develop plans for effective adaptation [5].

Currently, there are many types of adaptation of cities to climate change. Considering the fact that the development of humanity and technologies does not stand still, the development of species and adaptation mechanisms does not stand either. One of the modern and main types of adaptation to climate change is the development of a strategy. Adaptation should mainly be aimed at building the environment, infrastructure, services, strategies, concepts and plans. In general, adaptation measures can be divided into technological (gray), which involve the introduction of innovations and technological solutions, and natural (green), which are based on the use of natural elements.

Many countries of the world have developed their strategies for adaptation to climate change, positive examples of which are useful for the implementation of measures to combat climate change in Ukraine. For example:

- in France, the following projects have been developed to combat the heat: “Agroforestry: Agriculture of the future? The case of Montpellier” (pilot project on the combined use of trees and cereals in agriculture) and the „Paris Strategy to combat heat waves” (prevention and information measures for vulnerable population groups) [6];

- in Germany, a strategy for adaptation during landslides “Climate Change Adaptation of Transport Infrastructures in Germany” [7] and “Development of green corridors for the inflow of fresh air and overcoming the heat island of the Stuttgart region” program (creation of the Climate Atlas, assignment of lands to protection zones, greening the territory) [8] were adopted;

- among the most extensive in Spain are the Master Plan for the development of trees in Barcelona “Trees for living. Barcelona Tree Master Plan 2017-2037” [9] and

the case study on overcoming water scarcity in Zaragoza (information campaigns and economic incentives, pilot technologies for saving water) [10];

- in Portugal, the “Tamera project” for natural water reserves and water retention landscape at the Tamera farm was introduced (the creation of a natural water reserve was implemented in order to counteract increasing erosion, desertification and droughts) [11];

- in Denmark, the strategy “Copenhagen Climate-Resilient Neighbourhood strategy” (the introduction of bicycle paths that act as storm water channels, as well as water towers and channels that carry water from the area to the harbor), as well as the strategy for managing of heavy rains and by downpours in Copenhagen “Cloudburst Management Plan” (opening of streams, construction of new channels, creation of lakes, additional green zones, use of roads with high curbs to direct rainwater) [12, 13] has been developed;

- in Austria, within the framework of the “Green and Blue Space Adaptation for Urban Areas and Eco Towns GRABS” project, the Styria Province Climate Change Adaptation Action Plan was adopted [14];

- in Slovenia the “Radiation Protection and Nuclear Safety program” (adaptation to heat and solar activity) [15] is held annually.

The European Forest Fire Information System was implemented in the EU [16]. The purpose of its creation was to consolidate information on forest and steppe fires. The system shows operational map information about fires; the system includes data on past fires and weather conditions that preceded fires, as well as modules for calculating fire damage.

Despite the fact that mechanisms for both mitigation and adaptation to climate change must be implemented at all levels, the implementation of adaptation measures at the local level is particularly important. This is because most of the impacts of climate change can be felt at the level of cities, and the readiness of a city or region to resist or adapt to these impacts can play a decisive role. At the local level, there are usually several strategies and plans that include specific measures to reduce vulnerability to the impacts of climate change. The European experience has proven

the important role of developing a plan to create a strategy for adaptation to the effects of climate change. It should include the following basic steps:

- Step 1 – future expected impacts of climate change are determined and conditions for successful adaptation are defined;
- Step 2 – the vulnerability of the territory is assessed;
- Step 3 – directions of this strategy are determined;
- Step 4 – certain adaptation measures are selected and implemented.

The most negative potential consequences at the local level are an increase in the average annual temperature and the occurrence of heat waves; strong storms, winds and hurricanes; a decrease in the amount of precipitation and an increase in the frequency of intense torrential rains.

It is very important that the effects of climate change being understood by the general population. Thus, in 2020, organizations of the Ukrainian Climate Network conducted an all-Ukrainian sociological survey “Climate Change and Climate Adaptation”. The purpose of the survey was to assess the vulnerability to climate change of different regions of Ukraine directly from the point of view of the population and to collect community proposals on ways to adapt to the consequences of climate change, for further consideration in the creation of local and state climate adaptation programs [2]. According to the results, the most vulnerable are agriculture, forestry and water resources, which need the support of the government as a priority. The survey also showed that the general population of Ukraine understands that in order to reduce the negative impact of climate change in cities and communities, it is necessary to implement effective adaptation measures.

For consultations with the public, the Ministry of Environmental Protection and Natural Resources published its project “Strategies for environmental security and adaptation to climate change”.

Conclusions. Nowadays, Ukraine needs to align its climate policy and legislation with the European Green Deal. It is important to strengthen cooperation with the EU in the areas of energy efficiency, the development of hydrogen energy and renewable energy sources, the transformation of the coal sector, and the development

of a national system for trading quotas for greenhouse gas emissions in order to achieve a low-carbon and post-war recovery of Ukraine.

According to the assessment of experts [17], the issue of climate change, including adaptation to climate change, was not properly reflected in the legislation of Ukraine yet. There is no law in Ukraine that defines the role and powers of the state body issues of climate change and adaptation to it. The current laws of Ukraine do not define the powers of local executive authorities and local self-government in the field of adaptation to climate change.

Ukraine should implement effective monitoring of all emissions, oblige enterprises to reduce greenhouse gas emissions, increase the level of responsibility for violations of environmental legislation by increasing fines, and effectively manage forests. These measures, together with others, should be implemented within national, regional and local climate change adaptation plans.

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