APPROVED
by Decree of the Cabinet of Ministers of Ukraine
d/d 2021, №

STRATEGY
for Environmental Safety and Climate Change Adaptation until 2030

I. Description of the problems that necessitated its adoption and effective regulations in the respective areas

Ukraine ranks the 60th place in the Environmental Performance Index. Ukraine performed the worst in the following categories: air quality, conditions for biodiversity conservation, the status of ecosystem services, sanitation and waste management.

The main problems in the area of protection of the environmental and natural resources that negatively affect human health and the sustainability of ecosystems are:

environmental pollution by emissions into the air and discharges into water reservoirs by industrial enterprises;

unsustainable use of main natural resources and their depletion;

pollution of surface water, groundwater and seawater;

the insufficient forest cover of the territory of Ukraine;

degradation of land resources;

absence of an effective chemical safety system;

absence of sufficient infrastructure and effective waste management system, which entails the large-scale formation of unauthorised landfills and numerous violations of the Law of Ukraine "On Waste", and other statutory regulations;

absence of an effective system of state supervision (control) in the area of environmental protection;

insufficient areas for biodiversity conservation and resources to ensure the development of the nature reserve fund of Ukraine;

intensification of global climate change and negative consequences for a range of sectors of the economy and spheres of human life;

the negative impact of the Chornobyl disaster consequences and the temporary occupation of Ukraine's territory on the condition of the environment and human health;

insufficient integration of environmental and climate aspects into sectoral and regional policies;

lack of educational and research-and-development support to address environmental challenges in mitigation of the effects and consequences of climate change and adaptation to it.

In addition, the following cross-sectoral problems of climate change adaptation need to be addressed:

low level of prevention of climate threats and point responses aimed at eliminating the consequences of, and compensation for losses, without further medium- and long-term strategic planning of approaches to adaptation;

absence of systemic sectoral and cross-sectoral studies on risk assessment, vulnerability and climate change forecasting at the national and regional levels;

insufficient integration of the climate change adaptation matters into sectoral, regional and local development programmes;

lack of technical support to carry out the necessary measurements and observations of environmental conditions and indicators, including hydrometeorological ones;

insufficient coordination of studies and projects on matters of climate change adaptation; lack of mechanisms for systematisation, analysis and verification of the findings;

insufficient awareness of the civil society, businesses and central and local bodies of executive power and local self-government about climate change issues and the need to implement climate change adaptation measures;

insufficient consideration of climate change adaptation matters and sustainable use of natural resources in the course of the process of decentralisation development and expansion of communities' entitlement to natural resources;

lack of qualified professionals for planning in the area of climate change adaptation at the national and local levels;

lack of financial and economic mechanisms to implement climate change adaptation measures.

The Strategy has been developed to ensure the implementation of the following statutory regulations:

Law of Ukraine "On the National Security of Ukraine";

Law of Ukraine "On Ratification of the UN Framework Convention on Climate Change";

Law of Ukraine "On Ukraine's Accession to the United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa";

Law of Ukraine "On Ratification of the Association Agreement between the European Union and the European Atomic Energy Community and their Member States, of the one part, and Ukraine, of the other part";

Law of Ukraine "On Ratification of the Paris Agreement";

Law of Ukraine "On the Basic Principles (Strategy) of the State Environmental Policy of Ukraine until 2030";

Law of Ukraine "On Approval of the National Target Programme for Water Management Development and Environmental Rehabilitation of the Dnieper River Basin until 2021";

Decree of the President of Ukraine, dated September 14, 2020 № 392 "On the decision of the National Security and Defence Council of Ukraine, dated September 14, 2020 "On the National Security Strategy of Ukraine";

Decree of the President of Ukraine, dated September 30, 2019, № 722 "On the Sustainable Development Goals of Ukraine until 2030";

Decree of the President of Ukraine, dated March 23, 2021, № 111 "On the decision of the National Security and Défense Council of Ukraine, dated March 23, 2021 "On challenges and threats to the national security of Ukraine in the environmental sphere and priority measures to neutralise them";

Decree of the President of Ukraine, dated June 7, 2021, № 228 "On certain measures for the preservation and restoration of forests";

Resolution of the Cabinet of Ministers of Ukraine, dated March 3, 2021, № 179 "On approval of the National Economic Strategy until 2030" (Official Gazette of Ukraine, 2021, № 22, art. 1015);

Resolution of the Cabinet of Ministers of Ukraine, dated October 20, 2019, № 880 "On approval of the State Programme for the Development of the Ukrainian Carpathian Region for 2020-2022" (Official Gazette of Ukraine, 2019, № 86, art. 2899);

Resolution of the Cabinet of Ministers of Ukraine, dated May 12, 2021, № 465 "On approval of the State target environmental programme of material and technical re-equipment of the national hydrometeorological service for 2022-2024" (Official Gazette of Ukraine, 2021, № 40, art. 2378);

Order of the Cabinet of Ministers of Ukraine, dated April 21, 2021, № 443 "On approval of the National Action Plan for Environmental Protection until 2025" (Official Gazette of Ukraine, 2021, № 42, art. 2557);

Order of the Cabinet of Ministers of Ukraine, dated October 22, 2014, № 1024 "On approval of the Concept of combating land degradation and desertification" (Official Gazette of Ukraine, 2014, № 86, art. 2439);

Order of the Cabinet of Ministers of Ukraine, dated March 30, 2016, № 271 "On approval of the National Action Plan to combat land degradation and desertification";

Order of the Cabinet of Ministers of Ukraine, dated December 7, 2016, № 932 "On approval of the Concept of the state policy implementation in the area of climate change until 2030" (Official Gazette of Ukraine, 2016, № 99, art. 3236);

Order of the Cabinet of Ministers of Ukraine, dated November 8, 2017, № 820 "On approval of the National Waste Management Strategy in Ukraine until 2030" (Official Gazette of Ukraine, 2017, № 94, art. 2859);

Order of the Cabinet of Ministers of Ukraine, dated August 14, 2019, № 688 "On approval of the Strategy of irrigation and drainage in Ukraine until 2030" (Official Gazette of Ukraine, 2019, № 70, art. 2473);

Order of the Cabinet of Ministers of Ukraine, dated February 20, 2019, № 117 "On approval of the National Waste Management Plan until 2030" (Official Gazette of Ukraine, 2019, № 22, art. 783);

Order of the Cabinet of Ministers of Ukraine, dated January 29, 2020 № 88 "On approval of the Concept of implementation of state policy in the area of energy efficiency of buildings in terms of increasing the number of buildings with near-zero energy consumption and approval of the National Plan to increase the number of buildings with near-zero energy consumption" (Official Gazette of Ukraine, 2020, № 14, art. 580);

Order of the Cabinet of Ministers of Ukraine, dated July 19, 2017, № 489 "On approval of the action plan for the implementation of the Concept of Rural Development";

Order of the Cabinet of Ministers of Ukraine, dated December 6, 2017, № 878 "On approval of the action plan for the implementation of the Concept of implementation of state policy in the area of climate change until 2030";

Order of the Cabinet of Ministers of Ukraine, dated July 11, 2018, № 488 "On approval of the action plan for the implementation of the Concept of development and technical modernisation of a centralised system of public alert of the threat or occurrence of emergencies";

Order of the Cabinet of Ministers of Ukraine, dated October 21, 2020 № 1567 "On approval of the action plan for the implementation of the Irrigation and Drainage Strategy in Ukraine until 2030";

Order of the Cabinet of Ministers of Ukraine, dated April 7, 2021, № 321 "On approval of the action plan for the implementation of the National Transport Strategy of Ukraine until 2030" (Official Gazette of Ukraine, 2021, № 33, art. 1948);

Order of the Cabinet of Ministers of Ukraine, dated May 12, 2021 № 497 "Certain matters of implementation in 2021-2023 of the State Regional Development Strategy for 2021-2027" (Official Gazette of Ukraine, 2021, № 44, art. 2713).

II. Analysis of the current state of affairs, trends and rationale for the need to resolve the problems identified

Threats to the environmental security of Ukraine emerge through a significant level of pollution in the air, water and land resources, imperfection of the state supervision (control) system and ineffective environmental monitoring.

The actual and potential threats connected with the environmental security and climate change adaptation, in terms of the National Security Strategy of Ukraine, are as follows.

According to the 2019 UNDP report, insufficient attention to the challenges posed by climate change will exacerbate social inequality, undermine democracy, cause displacement and instability, which may ultimately diminish the possibilities for achieving the Sustainable Development Goals.

According to reports from the World Meteorological Organization, from the 1850s to 1900s, the average temperature on the planet has already risen by 1.2°C. Depending on the GHG emissions in the years to come, the further growth of the average global temperature is forecast at the level of 1.3 to 4.5°C over the pre-industrial levels by the end of the century.

The Paris Agreement sets the goal of holding the average global temperatures well below 2°C above the pre-industrial levels and exerting efforts to limit the temperature growth to 1.5°C above the pre-industrial levels, recognising that doing so will significantly mitigate the risks and consequences of the climate change.

According to the 2018 special report of the Intergovernmental Panel on Climate Change – Global Warming of 1.5°C – the implementation of the Paris Agreement to limit the rise in temperature to 1.5°C is possible on condition of achievement of the that 'net zero' greenhouse gas emissions in the world as soon as in 2050 (from 2045 to 2055).

Compared with 1880, by 2021, the average global sea level has risen by 21 to 24 centimetres, with one-third of the rise having occurred within the past 25 years.

To achieve the Paris Agreement goals, all countries are required to simultaneously take measures to reduce greenhouse gas emissions and adapt to the effects of global climate change that already exist.

Compared to the current period, over the next 20 years (by 2040) the climate change is expected to entail an increase in the average annual temperature in Ukraine within the range of 0.8 to 1.1°C (statistics on the temperature indicators in this Strategy are provided in accordance with the data of the World Meteorological Organization for 2013 and the 2021 World Bank study "Assessment of the impact, opportunities and priorities for Ukraine in connection with climate change"). In the future, until the end of the century, according to the forecast of a significant reduction in the human impact on the climate system alone, the temperature scenario will remain within the limits of natural variability, i.e. stabilise at the achieved values. According to other forecasts of human impact, the average annual temperature across the climate system will continue to rise, and by the middle of the century will grow by 1.5 to 2°C, and by the end - by 2 to

4.3°C. For all forecasts of human impact on the climate system, the maximum temperature increase during the cold period is expected in the North and North-East, and during the warm season - in the South-East and South.

Under all forecasts of human impact on the climate system and throughout the century, annual precipitations will slightly grow, by an average of 2 to 6 per cent, with a maximum value of 8 per cent under the forecast of excessive human impact. All forecasts of human impact on the climate system, however, are characterised by an increase in the redistribution of precipitation during the year within the range of ± 20 per cent, with an increase during the cold period and a decrease in the warm seasons, especially in July and August, while under the forecast of excessive human impact on the climate system – in June , with the maximum decrease in precipitation expected in the South-East and South, while and in the West and North-West, even in summer, precipitations are likely to increase.

The rise in the air temperatures will entail an increase in the number of tropical nights, when the minimum temperature at night will exceed 20°C, from a maximum of 15 to 20°C in the current period along the Black and Caspian Seas and in the Crimea, to 30 to 40°C at the end of the century under the moderate human impact scenario, and 70 to 80°C under the forecast of excessive human impact on the climate system. By the end of the 21st century, aridity is expected to intensify and the arid zone of the South to expand into the entire central region, with the forecast of excessive human impact on the climate system becoming a reality.

Ukraine's land resources are to a large degree degraded, with a high rate of plough disturbance, compared to the European countries, and land use does not fully meet the requirements of sustainable natural resources management. The reasons for this situation are complex and based on historical preconditions. In that respect, it is necessary to violation of the environmentally balanced ratio between agricultural lands, reduction of unique steppe areas and other valuable natural ecosystems, excessive ploughing of the territory and disruption of natural soil formation process; use of inadequate technologies in agriculture, industry, power engineering, transport and other sectors; focussing on achievement of short- and medium-term economic benefits, all of which carries long-term negative consequences for the environment.

The number and scale of natural and human-caused emergency situations grow as well. Excessive human impact and high level of human-caused burden on the territory of Ukraine have been brought about by the presence of a complex of mining, chemical, power-engineering facilities, which are technologically obsolete and do not have the necessary equipment to reduce pollutant discharges into water bodies.

In 2016, according to the Institute for Health Metrics and Evaluation, air pollution caused over 58 thousand deaths in Ukraine; in particular, according to the State Statistics Service (Statistical Yearbook of Ukraine for 2016), 13,840

people died of respiratory diseases. Diseases caused by high levels of pollution entail a drop in labour productivity and a decrease in the Gross Domestic Product.

There exist several regulatory and institutional reasons that cause the problem of pollution. In particular, the system for issuance of permit documents in environmental protection is currently based on a component-by-component approach to the regulation of environmental impact. Specifically, the legislation stipulates the issuance of permits for emissions of pollutants into the atmosphere by stationary sources, special water use, waste management operations. This approach does not make it possible to consider the cumulative impact of an economic entity on the environment, partially disregarding issues connected with soil protection and groundwater pollution and sustainable consumption of energy and raw materials.

Insufficient level of state supervision (control) over the observance of conditions in the permit documents in the area of environmental protection, and the ineffective mechanisms to ensure compliance with the environmental legislation, do not encourage businesses to increase investment in the environmental protection measures.

Threats to the system of chemical safety and security are caused by the Ukrainian industrial complex having 655 facilities that stored, or used in production, over 216 thousand tons of hazardous chemical substances. The area of possible chemical pollution completely or partially covers 294 administrative-territorial units where close to 7 million people reside.

The economic condition of the Ukrainian forestry industry and the environmental condition of Ukrainian forests are unsatisfactory.

The physical infrastructure of forestry needs significant updating. In many regions of Ukraine, the share of weakened and drying forests has increased, particularly derivative spruce forests of the Carpathians. An urgent solution is required to strengthen the adaptability of forest ecosystems to climate change and human impact. Therefore, forests need a substantial increase in care and implementation of measures based on ecologically sound forestry methods, close to natural ones.

Like many other countries in the world, Ukraine experiences a large-scale depletion of coniferous forests caused by climate change and lower resistance to large-scale infestation by pests, including bark beetles. For example, as of 2020, the total drying area was 395.4 thousand hectares, of which pine tree plantations cover an area of almost 200 thousand hectares, which in itself exceeds the values of the previous year.

About 0.8 million hectares of forests, including protective forest plantations of the linear type, have not been used and are kept on reserve lands in unsatisfactory condition. Significant areas are occupied by low-value and derived stands that require replacement.

The forest industry's information support system needs improvement following the modern requirements for balanced forest management, monitoring

and stock-taking of forests. It is also important to increase the efficiency and quality of forest management, with the account to the requirements for digital transformation, transparency and publicity of forestry activities.

The situation with the water resources requires considering the specifics of the aquatic ecosystems functioning as a holistic system within the entire catchment area in the course of resolution of urgent environmental problems at the local level, based on the administrative-territorial principle.

The main components of stationary and diffuse pollution of surface and groundwater are compounds of nitrogen, phosphorus, heavy metals, persistent organic matter, petroleum products and other pollutants. The main factor of negative impact on water bodies and their intensive eutrophication is the unsatisfactory level of wastewater treatment from compounds of nitrogen, phosphorus and organic complexes. Also, increasingly important becomes water pollution with microplastic, which is dangerous for natural ecosystems and human health. All those factors cause the deterioration of the environmental, organoleptic and other properties of water, excessive algae growth and large-scale water blooming.

The results of the 2016 Joint Black Sea Survey (National Pilot Monitoring Surveys and Joint Offshore Surveys in Georgia, the Russian Federation and Ukraine) conducted under the EU/UNDP project "Improving Environmental Monitoring in the Black Sea - Phase II" indicate significant seawater pollution in Ukraine. The amount of marine pollution in the Black Sea is almost two times higher that of the Mediterranean. 83 per cent of marine litter in the Black Sea is plastic: PET bottles, packaging, plastic bags. Every hour, rivers carry to the sea 6 to 50 units of garbage. The study also identified 124 chemical compounds that are harmful to the marine ecosystem and human health. Those include pesticides, biocides, pharmaceuticals, flame retardants and household chemicals.

Ukraine finds itself in a critical situation with the formation, accumulation, storage, processing, disposal, and burial of waste, further developing environmental threats. In particular, about 500 million tons of various waste (industrial, hazardous, household, agricultural, etc.) are generated annually; waste accumulation volumes exceed 13 billion tons.

The high level of waste generation and low rates of their re-use as secondary raw materials (only 6 per cent) have resulted in Ukraine annually accumulating waste in both the industrial and domestic sectors, of which only a small part is recycled, the remainder ending up in landfills and negatively affecting the environment and human health.

The lack of state supervision (control) and the necessary infrastructure in that entails the large-scale formation of unauthorised landfills and numerous violations of the Law of Ukraine "On Waste" and other statutory regulations.

Ukraine has a critically low nature reserve area: 6.8 per cent of its territory. In most European countries, the area occupied by protected areas is an average of

15 per cent. The European Green Course aims at the preserved natural ecosystems reaching up to 30 per cent.

The negative impact of the Chornobyl accident consequences persists; degradation of nature reserve areas in the temporarily occupied territory of Ukraine is observed. The situation in the area of measures to ensure the national security and defence, to repulse and deter the armed aggression of the Russian Federation in Donetsk and Luhansk Oblasts is characterised by a significant deterioration of drinking water quality, disruption of water supply systems, and uncontrolled flooding of coal mines, which causes dangerous groundwater pollution.

According to the United Nations Environment Programme, the armed aggression of the Russian Federation against Ukraine destroyed ecosystems on the area of at least 530 thousand hectares, in part, in 18 protected territories with a total area of 80 thousand hectares. United Nations data demonstrate that Donetsk and Luhansk Oblasts are on the brink of an environmental disaster caused by air, soil and water pollution from the flooding of coal mines.

One of the most likely causes of the emergency in the temporarily occupied territories in Donetsk and Luhansk Oblasts is the risk of large-scale uncontrolled flooding of mines caused by interruption of power supply to drainage systems. The rise of groundwater to the surface can result in flooding of territories, subsidence of urban development areas, railways, automobile roads, bridges; pollution of surface and groundwater catchments.

It is necessary to note that at the present time, no initial objective data are available regarding the formation of a plan of measures to assess possible threats of accidents and emergencies (human-caused) at infrastructure assets located in the temporarily occupied territories in Donetsk and Luhansk regions, the Autonomous Republic of Crimea and the city of Sevastopol, which makes it impossible to identify ways and methods of their prevention.

The Strategy identifies the following social and economic sectors that are vulnerable to climate change effects:

Biodiversity

The most vulnerable to climate change are: ecosystems and biodiversity of river valleys and coastal protection areas with sharp fluctuations in hydrological regimes; ecosystems and species located on the border of their realms or in extreme climatic conditions, especially mountain ecosystems of the Carpathians; forest ecosystems that lose stability due to changes in the hydrological regime, suffer from the spread of pests and diseases, damaged by windfalls, etc.; protected areas – due to the impossibility of ensuring the preservation of flora and fauna species and types of natural habitats that the areas were established to preserve.

Additionally, it is necessary to note threats to the loss of genetic diversity caused by both climate change and human activities. According to the World Wildlife Fund report "Living Planet 2018: Aiming Higher", climate change can affect the life cycles and breeding seasons of species in ecosystems, including the

emergence of new invasive species that can cause changes in an ecosystem as a whole.

The main risks to natural systems are the deterioration of biodiversity caused by floods and droughts.

Aquatic resources

Ukraine is one of the least water-sufficient countries in Europe. Particularly significant is the reduction of spring water flow, which is the main part of the annual volume of river flow. At the same time, floods become more frequent, causing catastrophic flooding of large areas and resulting in significant economic losses. The overall decrease in the water content of rivers aggravates pollution and entails deterioration in water quality. Rising temperatures and swamp draining, practised earlier, continue to cause wetlands and lakes in the Polissya area and in the north of Ukraine to dry up, which causes more frequent fires and worsens air quality. The reduction in precipitations (including outside Ukraine) during the summer may cause the surface runoff of rivers may reduce by half, entailing significant water shortages.

In the north of Ukraine, annual water runoffs may grow by 15 to 25 per cent. The winter runoffs will increase, and the spring runoffs, decrease. In the south and south-east of Ukraine, the annual runoff of large rivers may fall by 30 to 50 per cent, and medium and small rivers are very likely to disappear.

In the South and South-East, surface water quality will deteriorate, requiring additional water treatment measures and, possibly, water deliveries to those regions. In case of surface water insufficiency, it may be necessary to extract water from deep underground aquifers. If adjacent reservoirs have insufficient influx from the Dnieper River, water supply restrictions may have to be introduced.

The Ukrainian Black Sea coast is the most vulnerable to the risk of water shortages, as it uses surface water and is a popular tourist destination. The outdated water supply and sewerage infrastructures in the region also aggravate threats.

Power engineering

The expected effects of climate change threaten the reliable energy supply for any type of consumer.

According to the International Atomic Energy Agency (IAEA), energy infrastructure is susceptible to a number of climate threats. Seasonal decrease or increase in demand for energy resources at the consumer level, caused by climate change, will produce a negative effect on the balancing of the United Energy System of Ukraine. The following threats to the power engineering sector may be identified:

at the level of natural gas production and supply – disruptions in the operation of gas distribution infrastructure caused by floods.

at the level of generation and supply of electricity:

- increased demand for switching capacities in the United Energy System of Ukraine;

- decreased electricity generation at nuclear and thermal power plants due to potential restrictions on the supply of water resources for cooling;

- uncertain conditions and volumes of electricity generation, potential decreases in production volumes and switching capacities of hydroelectric power plants caused by droughts; increasing water losses to evaporation;

- exacerbation of daily fluctuations in electric load and the growth of the general need for electric energy in summer caused by the development of air conditioning and cooling systems;

- lower efficiency of electricity transmission due to higher air temperatures;

- growing frequency of accidents in electrical networks (damage, outages) caused by weather conditions;

at the level of heat production and distribution - uncertainty regarding changes in thermal energy demand.

Public health

Climate change, rising air temperatures, sharp fluctuations in atmospheric pressure, pollution of water sources, air and soil trigger the emergence of non-communicable diseases, the spread of infectious diseases and exacerbation of chronic illnesses.

One of the consequences of the negative impact that climate change produces on the population is the formation in different climatic and geographical regions of the country of favourable environmental conditions for the development of vectors of infectious diseases, and, as a result, higher incidence of infectious diseases.

Rising ambient temperatures and prolonged heat affect the production and supply of food products and the deterioration of drinking water quality, which can cause food poisoning.

A long-term increase in temperature entails an increase in the volumes of toxic algae in water bodies, particularly those used by households and for drinking. That directly affects the quality of drinking water supplied to the population.

Over the recent years, the civilian population in Ukraine, similarly to many developed countries, have experienced a growing toxic burden. Epidemiological indicators of cases of acute poisoning over the last decade amount to 20 to 40 cases per 10,000 population, with a trend towards growing.

The probability of occurrence and prevalence of allergic diseases is also expected to grow higher due to changes in the vegetation seasons of allergenic plants and higher concentrations of pollen in the air.

Extreme weather phenomena and natural disasters may increase the frequency of injuries and deaths through injuries and the number of cases of

temporary disability and their duration. In particular, according to the SES, in 2019, seven people died, and 13 were injured in emergencies caused by adverse weather conditions. In 2020, the respective numbers were 25 and 143.

Forestry sector

The expected impacts of climate change on the forests in Ukraine are multidirectional, depending on the climatic zone, location and type of forest, and encompass the following: fluctuations in the hydrological regime and shifts in the climatic zone boundaries, which affects the areas of forest-forming species; reduced resilience and viability of forest ecosystems; higher frequency and intensification of manifestations of adverse natural phenomena (large-scale outbreaks of diseases and multiplication of pests, spread of forest fires, etc.); deterioration of the quality of ecosystem services; changes in the productivity of forest stands and non-timber forest products.

Coastal areas

The expected sea-level rise, changes in water temperature, water pollution, higher frequency and intensity of storms and floods all necessitate the adaption of coastal areas, especially those where cities are located. Due to the sea level rise by the end of the century, about 650,000 hectares of land are projected to be flooded, and with the account to surges (storm tides), up to 1 million hectares; 590 cities and towns in Ukraine may be flooded completely or partially; some assets of the nature reserve fund (including the Black Sea and Danube Biosphere Reserves, national nature parks: "Nyzhnyodniprovsky", "Dzharylhatsky", "Biloberezhya Svyatoslava", "Meotida", "Pryazovsky", "Azovo-Syvasky", "Tuzlovslki Lymany", etc.) suffer from significant negative changes. Rising sea levels could exacerbate current environmental problems due to flooding of industrial enterprises, landfills, cemeteries, agricultural lands and other assets.

Fishery sector

The fishery sector is affected by a range of factors connected with climate change, such as the rising water temperatures in water bodies, changes in rainfalls and water runoffs, drying of small water bodies, the spread of parasites and, as a result, changes in species composition of fish and other aquatic biological resources. Rising surface water temperatures change both the species composition of aquatic biological resources and other aquatic organisms. Rising temperatures threaten the extinction of cryophile species. The reduction of populations of aquatic biological resources in water bodies is to be expected and the emergence of uncommon thermophilic species.

Agriculture and soils

Agriculture becomes vulnerable to the climate change effects due to extreme weather phenomena. The positive impact of climate change in agriculture in Ukraine include the extension of the vegetation season (according to the UN Food and Agriculture Organization (FAO), longer growing seasons will improve the distribution of individual species and open opportunities to cultivate new, more warm-weather species or secondary crops); the natural climatic zones shifting to

the north, which makes it possible to grow more warm-weather loving crops and potentially higher grain crop yields due to higher concentration of carbon dioxide in the air. Particularly sensitive to the increase in carbon dioxide in the atmosphere are wheat, barley, sunflower, soybeans, rice.

The main threats to the agricultural sector include the reduction of interphase periods from blooming to ripening, which will negatively affect yields; the spread of pests, diseases and weeds leading to crop losses and more intensive use of pesticides and veterinary medicines.

Urgent solutions are required to the problem of land degradation and desertification, restoration of human-altered ecosystems, improvement of the structure of agricultural lands and areas of economic activity in order to form a balanced ratio of agricultural lands and ensure environmental safety and balance of territories.

Negative consequences of climate change in Ukraine, notably higher frequency and intensity of extreme weather phenomena, may include lower soil fertility, lower crop productivity, the need to breed and introduce new varieties that are more resistant to droughts and high temperatures and expansion of irrigation methods. An urgent solution is required for the problem of wind and water erosion, desertification, and salinisation of soils. Droughts become more frequent, resulting in the absent or insufficient replenishment of groundwater, which can increase wind erosion of soils. Higher air temperatures, combined with changes in the essence of precipitations, entail lowering the humidity factor. Water supply for soils and plants deteriorates, and the amounts of organic carbon and humus matter in the soils decrease. The soil microbiota and the content of organic matter in it significantly depend on the temperature. The numbers of pests and alien species grow, and their multiplication throughout the year intensifies. Due to changes in the nature of precipitations, soils cannot fully absorb water, moisture in the soil is not retained, and the fertile layer of soil is washed away.

In the South and South-East, the frequency of both spring-and-summer and summer-and-autumn droughts increases, making it necessary to resume and expand irrigation.

According to the UN Food and Agriculture Organization of the United Nations (FAO), climate changes will decrease livestock breeding in Ukraine due to the declining productivity of many livestock breeds, the spread of diseases, reduced pasture areas, and water shortages.

Territorial communities

In Ukraine, close to 70 per cent of the population live in cities. Urban dwellers are in climate change risk areas, according to the 2014 "National Climate Vulnerability Assessment: Ukraine" study, conducted by experts from the Climate Forum East and the NGO Working Group on Climate Change. Among those, the most significant are as follow: heatstroke and the associated effect of local overheating; higher demand for room cooling during the warm season; vulnerability associated with quality and availability of drinking water; increased

risks of flooding, poor adaptation of urban sewage systems to larger rainfall volumes. The vulnerability of various population groups in cities to climate change is exacerbated by the insufficient greenery areas in Ukraine and the rapid growth of urban development, and the increase in the area of heat-absorbing surfaces. Populations in cities and towns are vulnerable to water shortages and lower rainfall amounts, drying rivers, lower groundwater levels, the growing frequency of extreme weather phenomena.

Transport and infrastructure

More frequent days with very high temperatures and adverse weather phenomena will destroy and damage the transport infrastructures. Automobile roads will suffer from deformation of asphalt pavement, bridges, formation of unwanted wheel tracks, and higher needs for additional repair works (according to the 2016 study of the International Transport Forum (ITF) "Adapting Transport to Climate Change and Extreme Weather: Implications for Infrastructure Owners and Network Managers"). Higher energy costs will be required in the transport sector for vehicle cooling (air conditioning).

Short-term and large-volume precipitations cause flight delays and cancellation of regular traffic and damage bridges and highways. A particular problem is the poor adaptation of the sewerage system and tunnels to significant amounts of precipitation.

Strong winds and storms are expected to cause complications for sea and water transport operation, damage to fencing structures, roads, bridges, and road infrastructure elements, which may entail a higher frequency of accidents.

Adverse weather conditions can destroy buildings. A significant increase in temperature entails more intensive evaporation of chemical substances, especially at industrial and commercial facilities, and also negatively affects the nature of the dispersion of harmful substances in the atmosphere from emission sources, causing higher concentrations of pollutants.

Tourism

Climate is an important tourist factor. The popularity of many tourist destinations depends on the number of sunny or snowy days. The shorter period of stable snow cover in the Carpathians may trigger negative consequences. Due to rising sea levels, resorts located on the sea coasts may suffer partial of complete flooding. The quality of beaches will also deteriorate due to water erosion, the spread of pathogens, insects and other organisms.

The main threats to tourism connected with climate change and extreme weather phenomena may be summarised as follows: lower numbers of tourists due to extremely hot weather; reduction of the winter season for ski resorts due to the reduction of the intensity and duration of stable snow cover, as well as higher risks of avalanches; reduction of the tourists' average stay due to worse accessibility of tourist routes, lack of water, and substandard accommodation conditions caused by extreme weather phenomena (risks of flooding in certain nature reserves and loss of their recreational value).

III. Strategic Goals

The Strategy is intended to improve environmental security and mitigate the impacts and consequences of climate change in Ukraine.

Its strategic goals are as follows :

reduce industrial pollution;

create an effective chemical safety system;

ensure the sustainable use of natural resources;

achieve "good" environmental condition of waters;

ensure sustainable forest management and improve the ability of forest ecosystems to adapt to climate change;

create legal and economic grounds to introduce a waste management hierarchy;

increase the efficiency of the state system of environmental impact assessment and state supervision (control) in the area of environmental protection;

preserve biodiversity and ensure the development of nature reserves in Ukraine;

strengthen the adaptability and resilience of social, economic and environmental systems to climate change;

achieve the ecological balance in the temporarily occupied territories in Donetsk and Luhansk Oblasts, the Autonomous Republic of Crimea and the city of Sevastopol after the restoration of the territorial integrity of Ukraine within its internationally recognised state borders;

include environmental safety measures and climate change adaptation in nation-wide and regional strategies, river basin management programmes and action plans;

raise awareness of representatives of central and local bodies of the state power and local self-government, authorised to make environmental policy decisions regarding climate change mitigation and adaptation.

IV. Objectives aimed at achieving the goals, stages of their implementation, expected results

The main objectives of the Strategy are as follows:

introduce a system of permit procedures for the industry in accordance with the European standards (integrated permits);

ensure collection of detailed and verified data on greenhouse gas emissions at the installation level;

promote the achievement of "good" ecological status of the Black and Azov Seas and river basin areas;

reform the environmental finance system to incentivise the reduction of environmental pollution;

build new, and reconstruct and upgrade treatment facilities;

conduct a nation-wide forest inventory-taking;

strengthen the resilience of forest ecosystems to pests and new climatic conditions, implement measures for prevention of fires and prompt response to them;

reduce continuous logging systems in the Carpathian region;

introduce timber sales exclusively through auctions;

strengthen chemical safety;

reform the waste management system, establish a waste management information system, and introduce the principle of extended producer responsibility;

introduce restrictions on the use of disposable plastics;

decommission the Chornobyl NPP and convert the Shelter object into an environmentally safe system;

develop an air quality monitoring and management system in zones and agglomerations;

ensure digitalisation of administrative services and information on the environmental conditions;

reform the system of state supervision (control) in the area of environmental protection;

ensure the development of organic agriculture, application of practices of sustainable land cultivation with preservation and augmentation of soil organic matter;

simplify the procedure to build the boundaries of nature reserves on location;

ensure the collection of information on environmental risks and losses in the temporarily occupied territories in Donetsk and Luhansk Oblasts, the Autonomous Republic of Crimea and the city of Sevastopol;

engage international organisations (experts) in the monitoring (permanent supervision) of the condition of potentially dangerous objects located in the temporarily occupied territories in Donetsk and Luhansk Oblasts, the Autonomous Republic of Crimea and the city of Sevastopol;

conduct sectoral studies on risk assessment, vulnerability and climate change forecasting in the areas of water management, biodiversity conservation, forest resources, power engineering, public health, agriculture and soils, transport and infrastructure, tourism;

form action plans for climate change adaptation in the areas of water resources management (within river basin management plans), conservation of

biodiversity, forest resources, power engineering, public health, agriculture and soils, transport and infrastructure, tourism;

ensure that current and projected climate change effects are taken into account in strategic planning at the national, regional and local levels, as well as in the course of construction of infrastructure assets;

revise state construction codes with account the current and projected climate change effects;

analyse climate change effects on cultural heritage and tourism assets; plan and implement respective measures for the preservation of those assets;

conduct technical update and development of hydrometeorological observation and forecasting systems;

raise public awareness of environmental issues and climate change effects;

increase the educational level, and research-and-development support for management decisions on environmental issues and implementation of climate change adaptation measures;

conduct a financial assessment of the implementation of climate change adaptation measures.

Stages of the Strategy implementation

The goals of the state policy on environmental security and climate change adaptation will be achieved in two stages:

by 2025, the environmental situation is expected to stabilise through the implementation of the European environmental regulations and standards in the area of industrial pollution, waste management, air quality, forest management, water management, biodiversity and chemical safety, risk and vulnerability assessments of social and economic sectors and natural components to climate change effects and the formation of priority adaptation measures, the introduction of a financial and economic mechanism to incentivise environment- and climate-oriented structural changes in the economy, dissemination of environmental and climate knowledge, as well as environmental awareness and preparedness to respond to natural disasters triggered by climate change;

by 2030, significant breakthroughs are expected to be made in improving environmental security and adaptation to climate change effects by increasing the country's preparedness to prevent climate threats and respond to them, achieving a balance between social and economic needs and objectives in the area of environmental security and climate change, integration of climate-related matters into the processes of formation of sectoral policies, social and economic development strategies, ensuring continuous and immediate environmental and climate monitoring, ensuring the development of effective partnerships between the state, businesses, the public and academia on matters of environmental protection and low-carbon development, which will be an additional incentive to the social and economic development of Ukraine.

The Strategy will be implemented by fulfilment of the measures defined in:

operational plans for the implementation of the for Environmental Security and Climate Change Adaptation until 2030, to be approved by orders of the Cabinet of Ministers of Ukraine for three-year periods;

the National Environmental Action Plan until 2025, approved by order of the Cabinet of Ministers of Ukraine, dated April 21, 2021, № 443, and the National Environmental Action Plan until 2030.

Expected results

Implementation of the Strategy provisions is expected to improve environmental safety and adaptation to climate change effects in Ukraine.

Environmental safety and the environmental condition will improve through the reduction of emissions and discharges of pollutants. Therefore, by 2030, emissions of pollutants into the atmosphere from stationary sources in Ukraine must drop by 22.5 per cent of the 2105 emissions. Discharges of polluted wastewater into water bodies in 2030 are expected to decrease to 5 per cent of the total discharges, compared to 15.7 per cent in 2015.

As a result of the Strategy implementation, by 2030, the level of non-communicable diseases will decrease, contributing to the decreased mortality from diseases caused by the negative impact of environmental factors.

The waste generation will significantly decrease by separate collection, disposal and removal, and compliance with environmental safety requirements in handling and management.

To ensure sustainable forest management, all permanent forest users and forest owners must use an electronic timber accounting system in their operations. At the same time, information on forestry will be in public access in the format of open data and through planning and approval of felling with the use of a unified state information system ("Forest Portal"). By 2030, the country's forest area is expected to grow to 18 per cent through state and municipal self-seeding forest lands, assistance in the restoration of forest belts and a tool to promote afforestation of degraded unproductive lands.

It is planned that by 2030 Ukraine will ensure the transition to forestry methods that are close to natural processes, the introduction of environmentally friendly logging technologies, increased resilience of forests to climate change, and less frequent forest fires.

In water management, conditions are envisaged to be created to incentivise business entities to introduce automated accounting of water intake and use, state supervision (control) over the quality and quantity of return waters and pollutants discharged into water bodies and water quality.

The implementation of the provisions of the Strategy will ensure the sustainable use of marine natural resources and the reproduction of the natural environment of the Azov and Black Seas and contribute to the achievement of the "good" environmental status of the Black and Azov Seas.

Introduction of integrated permit documents in the area of environmental protection, ensuring public access to reliable and accurate data of object monitoring of industrial pollution and reporting by operators of industrial installations, timely provision of bodies of the state power with reliable monitoring information to make balanced management decisions in the area of environmental protection, as well as the introduction of the best available technologies and management methods, decommissioning of technologically obsolete equipment, will significantly upgrade environmental safety in Ukraine, as well as alleviate the industrial burden on the environment.

Implementation of the Strategy will contribute to the adaptation of society and the national economy to the effects of global climate change, in particular, by reducing risks and scale of natural disasters triggered by climate change; the use of climate information in economic sectors obtained through modern climate data collection in the area of climate change, as well as upscaling investment in projects for decarbonisation and climate change adaptation through the creation of an effective state mechanism to support and raise funds from international financial organisations.

In addition, the Strategy implementation will contribute to achieving a neutral level of land degradation, reducing biodiversity loss, ensuring the preservation of bio- and landscape diversity, forming a comprehensive and representative network of protected areas, increasing the area of the state nature preserves.

Also, after restoring Ukraine's territorial integrity within its internationally recognised state borders, an increase in the level of environmental security will be ensured in the temporarily occupied territories in Donetsk and Luhansk Oblasts, the Autonomous Republic of Crimea and the city of Sevastopol.

The implementation of the Strategy is financed from the state and local budgets and other sources that are not prohibited by law.

V. Procedure for monitoring and evaluation of the Strategy implementation results, and reporting

The bodies that ensure the implementation of this Strategy are central and local bodies of executive power and local self-government.

Organisational support and monitoring of the Strategy implementation and coordination of activities by central and local bodies of executive power are provided by the MENR.

On a quarterly basis, by the 5th day of the following month, ministries and other central and local bodies of executive power shall submit to the MENR their reports on the status of implementation of the measures in the respective operational plan for the Strategy implementation assigned to them.

The MENR shall analyse and summarise the information submitted by ministries and other central and local bodies of executive power pertaining to the

progress in the implementation of the respective operational plan, and prepare an annual Strategy implementation report, to be submitted every year, starting on March 1, 2023, to the Cabinet of Ministers of Ukraine, and published on its official website.

Experts, civil society organisations, and research institutions may be engaged in the preparation of the annual report on the Strategy implementation progress.

The achievement of the Strategy goals is assessed carried out by the MENR, based on the results of the first and second stages in 2026 and 2031, in the course of preparation of annual reports on the Strategy implementation in the respective years. Based on the assessment results, proposals are formed to further implement the state policy on environmental safety and climate change adaptation.

APPROVED
by Decree of the Cabinet of Ministers of Ukraine
d/d 2021, №

OPERATIONAL PLAN
for the implementation of Environmental Security and Climate Change Adaptation Strategy **until 2030, for a three-year period**

Description of measures	Responsible entity	Period of implementation, years	Indicator of completion
1. Analysis of the institutional and legal frameworks for climate change adaptation and preparation of a report	Ministry of Environmental Protection and Natural Resources (MEPNR)	2021	Summary report placed on the official website of the MEPNR
2. Development of guidelines for risk assessment and vulnerability of social and economic sectors and natural components to climate change	MEPNR Ministry of Energy (MoEn) Ministry of Regional Development (MRD) Ministry of Energy (MoE) Ministry of Agricultural Policy (MoAP) Ministry of Infrastructure (MoIFS) Ministry of Culture (MinCult) State Emergency Services of Ukaine (DSNS) Ministry of Health (MoH) National Academy of Sciences (upon consent)	2021—2022	Methodology recommendations placed on the official website of the MEPNR

Description of measures	Responsible entity	Period of implementation, years	Indicator of completion
	National Academy of Agrarian Sciences (upon consent) National Academy of Medical Sciences (upon consent)		
3. Development of methodology recommendations on the inclusion of climate change adaptation in the programmes of social and economic development of administrative-territorial units, regional development strategies and action plans for their implementation, as well as action plans for climate change adaptation that may be approved by bodies of local self-government	MEPNR MRD National Institute for Strategic Studies (upon consent)	2021—2022	Methodology recommendations placed on the official websites of the MRD and MEPNR
4. Development of methodology recommendations to take into account the climate component in the state planning documents and in the course of implementation of strategic environmental assessment and environmental impact assessment	MEPNR	2022	Methodology recommendations placed on the official website of the MEPNR
5. Development of a list of indicators of impact and response to climate change for social and economic sectors and natural components	MEPNR MoEn MRD MoE MoAP MoIFS	2021—2022	MEPNR Order issued

Description of measures	Responsible entity	Period of implementation, years	Indicator of completion
	MinCult DSNS MoH National Academy of Sciences (upon consent) National Academy of Agrarian Sciences (upon consent) National Academy of Medical Sciences (upon consent) National Institute for Strategic Studies (upon consent)		
6. Assessment of the risks and vulnerabilities of the population to climate change	MoH MEPNR National Academy of Sciences (upon consent) National Academy of Medical Sciences (upon consent)	2022	Summary report placed on the official websites of the MoH and MEPNR
7. Assessment of the risks and vulnerabilities of agriculture to climate change	MoAP MEPNR National Academy of Sciences (upon consent) National Academy of Medical Sciences (upon consent)	— “ —	Summary report placed on the official websites of the MoAP and MEPNR
8. Assessment of the risks and vulnerabilities of forests and forestry to climate change	State Forestry Agency MEPNR National Academy of Sciences	2021	Summary report placed on the official websites of the State Forestry Agency and the MEPNR

Description of measures	Responsible entity	Period of implementation, years	Indicator of completion
	(upon consent)		
9. Assessment of the risks and vulnerabilities of biodiversity to climate change	MEPNR National Academy of Sciences (upon consent) National Academy of Agrarian Sciences (upon consent)	2022—2023	Summary report placed on the official website of the MEPNR
10. Assessment of the risks and vulnerabilities of water resources to climate change	State Water Management Agency MEPNR National Academy of Sciences (upon consent) National Academy of Agrarian Sciences (upon consent)	2022—2024	Summary report placed on the official websites of the State Water Management Agency and the MEPNR
11. Assessment of the risks and vulnerabilities of the transport sector and infrastructure to climate change	MoIFS MEPNR National Academy of Sciences (upon consent)	— “ —	Summary report placed on the official websites of the MoIFS and the MEPNR
12. Assessment of the risks and vulnerabilities of the energy sector to climate change	MoEn MEPNR National Academy of Sciences (upon consent)	— “ —	Summary report placed on the official websites of the MoEn and the MEPNR
13. Assessment of the risks and vulnerabilities of fisheries to climate change	State Agency for Fisheries MoAP MEPNR National Academy of Sciences (upon consent)	— “ —	Summary report placed on the official websites of the State Agency for Fisheries, the MoAP and the MEPNR

Description of measures	Responsible entity	Period of implementation, years	Indicator of completion
14. Assessment of the risks and vulnerabilities of coastal areas to climate change	MEPNR National Academy of Sciences (upon consent)	— " —	Summary report placed on the official website of the MEPNR
15. Assessment of the risks and vulnerabilities of human settlements to climate change	Council of Ministers of the Autonomous Republic of Crimea Oblast, Kyiv and Sevastopol City State Administrations bodies of local self-government (upon consent)	2022—2024	Summary report placed on the official websites
16. Assessment of the risks and vulnerabilities of the tourism industry to climate change	State Agency for Tourism Development MoIFS MEPNR National Academy of Sciences (upon consent)	2024	Summary report placed on the official websites of the State Agency for Tourism Development, the MoIFS and the MEPNR
17. Analysis of a possible economic mechanism to promote the return of low-yield and degraded agricultural lands to natural ecosystems	MEPNR MoAP State GeoCadastre Ministry of Economy (MoE)	2023	Summary report placed on the official websites of the MEPNR and the MoAP
18. Making amendments to the Law of Ukraine "On Environmental Protection" pertaining to the inclusion of climate change issues in the scope of that Law	MEPNR	2022	Draft law submitted to the Verkhovna Rada of Ukraine
19. Development of a National Strategy for the Management of Invasive Alien Species of Flora and Fauna in Ukraine until 2030, with	MEPNR MOH National Academy of Sciences	2021—2022	Statutory act approved by the Cabinet of Ministers of Ukraine

Description of measures	Responsible entity	Period of implementation, years	Indicator of completion
account to climate change adaptation	(upon consent) National Academy of Agrarian Sciences (upon consent)		
20. Development of the State Target Research and Development Programme in the area of climate change until 2030	MEPNR MOH National Academy of Sciences (upon consent)	2021—2022	Statutory act approved by the Cabinet of Ministers of Ukraine
21. Development of a plan of measures to adapt the population to climate change for 2021 to 2023	MoH National Academy of Medical Sciences (upon consent)	— “ —	— “ —
22. Development of an action plan for adaptation of agriculture and fisheries to climate change	MoAP State Agency for Fisheries National Academy of Sciences (upon consent) National Academy of Agrarian Sciences (upon consent)	2023—2024	— “ —
23. Development of the second action plan for the implementation of the National Transport Strategy of Ukraine until 2030, with account to climate change adaptation	MoIFS	2022	— “ —
24. Identification of land plots in state and municipal ownership that are naturally reforested and suitable for forestation	State Forestry Agency MEPNR	2021—2022	Summary report placed on the official websites of the State Forestry Agency and the MEPNR
25. Development of regional and local strategies for climate change adaptation or inclusion of matters of climate change	Council of Ministers of the Autonomous Republic of Crimea Oblast, Kyiv and Sevastopol City	on the permanent basis	Regional and local strategic documents approved, as well as action plans for their

Description of measures	Responsible entity	Period of implementation, years	Indicator of completion
adaptation in development strategies of regions and territorial communities, and action plans for their implementation, as well as for social and economic development programmes of regions	State Administrations bodies of local self-government (upon consent)		implementation
26. Accession of Ukraine to the Declaration on Inclusion of Climate Change Adaptation in Development Cooperation, approved on April 4, 2006 by the Ministers for Environment and Development of the Member States of the Organization for Economic Cooperation and Development	MEPNR	2022	Statutory act approved by the Cabinet of Ministers of Ukraine
27. Creation of specialized educational programmes and courses on climate change mitigation and adaptation for teachers, students, representatives of central and local bodies of power and local self-government	MOH MEPNR National Academy of Sciences (upon consent) National Academy of Pedagogical Sciences (upon consent) National Academy of Agrarian Sciences (upon consent) National Academy of Medical Sciences (upon consent) higher education institutions (upon consent)	2021—2024	Respective education programmes approved
28. Analysis of the relationship between migration, climate change and the environment	MEPNR State Migration Service (SMS)	2021—2022	Summary report placed on the official websites of the MEPNR and the SMS