Ukraine's
Climate Change Adaptation Communication
to UNFCCC

27 May 2024

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EXECUTIVE SUMMARY

Ukraine is pleased to submit its First Adaptation Communication (AdCom) to the United Nations Framework Convention on Climate Change (UNFCCC). This Adaptation Communication was prepared in recognition of Article 7 of the Paris Agreement, Decision 9/CMA.1, and will inform the synthesis reports developed for the Global Stocktake (GST).

This AdCom provides information on national circumstances, including institutional arrangements; highlights climate risks, vulnerabilities, and impacts in Ukraine; and elaborates on ongoing and proposed adaptation measures and actions to the planning and implementing of climate adaptation, and highlights the support needed for Ukraine to deliver on its adaptation priorities.

Adaptation is the priority in Ukraine, a country that is already experiencing the impacts of climate change including increased intensity and frequency of extreme weather events. Among the climate hazards faced by the country are droughts, floods, heatwaves, wildfires, and invasive species. The government has established several policies, strategies, and action plans to encourage adaptation action, including its national adaptation plan (NAP), the Environmental Security and Climate Change Adaptation Strategy of Ukraine by 2030 (NAS 2030).

Ten sectors for priority adaptation action were identified in NAS 2030: Biodiversity, Water resources, Energy, Public health, Fisheries, Agriculture and soils, Forestry, Cities and Territorial Communities, Transport and infrastructure, Coastal areas, and Tourism. Moving forward to implement adaptation action in these priority sectors requires strengthening institutional and human resource capacities, establishing subnational legal and policy frameworks, monitoring, and reporting on adaptation action, accessing climate finance, engaging the private sector, determining subnational climate risk and vulnerabilities, establishing early warning systems, as well as developing and implementing subnational and sector specific adaptation strategies.

The AdCom provides an overview of the actions taken by Ukraine to address the impacts of climate change, such as climate-proofed infrastructure and strengthening protected areas. Government departments, non-government organizations (NGOs), civil society organizations (CSOs) and the private sector have helped develop and implement the adaptation actions.

Ukraine requires international funding and support to continue to build the adaptive capacity and climate resilience necessary to reduce the vulnerability of populations and communities. Meeting the country's adaptation goals is conditional upon receiving external support, including finance, technology development and transfer, and capacity building.

ABBREVIATIONS AND ACRONYMS

COP	Conference of the Parties
CRVA	Climate Change Risk and Vulnerability Assessment
GDP	Gross Domestic Product
GHG	Greenhouse Gas
L&D	Loss and Damage
M&E	Monitoring and Evaluation
MEPNR	Ministry of Environmental Protection and Natural Resources
MoAP	Ministry of Agricultural Policy
MoE	Ministry of Energy
MoH	Ministry of Health
MoIFS	Ministry of Infrastructure
MRD	Ministry of Regional Development
NAS	Environmental Security and Climate Change Adaptation Strategy of Ukraine by 2030
NC	National Communications
NDC	Nationally Determined Contribution
NDP	National Development Plan
OECD	Organization for Economic Cooperation and Development
SDG	Sustainable Development Goals
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
URC	Ukraine Recovery Conference

1. INTRODUCTION

Climate change has had a negative effect on Ukraine, her people and the country's development goals. Adaptation is of primary importance to the country and is high on the government's agenda to guarantee the welfare of the people while reducing risks and building resilience. The country has a significant role to play in ensuring that its population is protected from the negative effects of climate change and that it continues developing in a sustainable manner while meeting its reporting obligations.

With the adoption of its Strategy for Environmental Security and Adaptation to Climate Change until 2030 (NAS 2030), the country is prioritizing adaptation measures as reported in the submitted national reports and highlighted in this Adaptation Communication (AdCom). Under the Paris Agreement (Article 7), Parties were implored to submit and periodically update an adaptation communication, which may include information on the country's priorities, implementation and support needs, plans, and actions. The guidance in the submission of the national AdCom was further agreed to by Parties in Katowice, Poland under decision 9/CMA.11.

This AdCom comes at a time when the Intergovernmental Panel on Climate Change Sixth Assessment Report indicates that the country will experience increased likelihood of hydrological, agricultural, and ecological drought.[1]

Scope and Coverage

Ukraine has prioritized the implementation of adaptation measures in its 10 most vulnerable sectors: Biodiversity, Water resources, Energy, Public health, Fisheries, Agriculture and soils, Forestry, Cities and Territorial Communities, Transport and infrastructure, Coastal areas, and Tourism. Information for this AdCom is mainly sourced and repackaged from the following documents to avoid duplication and an additional reporting burden:

- Update to the First Nationally Determined Contribution (NDC) in 2021 (the original NDC was submitted in 2015)
- National Inventory Report in 2021 and 2022.
- Sixth National Communication and addendum in 2013, which includes a preliminary Climate Change Vulnerability and Adaptation Assessment section.
- NAS 2030 in 2021.
- Low Emission Development Strategy to 2050 in 2018.

The NDC outlines major mitigation options, including the co-benefits of adaptation, for the country to reach its target towards achieving the common worldwide goal of limiting global warming. They also outline the means of implementation to reach these targets. The documents report on the existing vulnerabilities in the country, as well as the risks and threats and their mitigation. This AdCom outlines some of these areas of assessment, including the climate, environment, and socio-economic conditions in Ukraine prior to the Russian invasion.

National Adaptation Reporting Under the UNFCCC and the Paris Agreement

Ukraine ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1997 and proceeded to adopt and implement policies and measures designed to mitigate the adverse effects of

[1] IPCC, 2023: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee, and J. Romero (eds.)]. IPCC: Geneva, Switzerland

climate change on the environment. Ukraine also ratified the Paris Agreement in 2016, which reinforces the international framework for adaptation action by establishing a global adaptation goal of enhancing adaptive capacity, strengthening resilience, and reducing vulnerability. In the preparation and submission of its National Communications (NC), Ukraine provided information on the scope of its vulnerability and adaptation assessment, including identification of the most critical and vulnerable areas as encouraged by Paragraph 32 the Paris Agreement. Ukraine has prepared and submitted six NCs, twenty National Inventory Reports to the UNFCCC, and two NDCs to the Paris Agreement.

1.1. COUNTRY CIRCUMSTANCES

Geography

Ukraine occupies the southwestern portion of the East European Plain (also known as the Russian Plain). The country consists almost entirely of level plains at an average elevation of 175 m above sea level. Mountainous areas such as the Ukrainian Carpathians and Crimean Mountains occur only on the country's borders and account for barely 5% of its area. The Ukrainian landscape is nevertheless diverse: its plains are broken by highlands—running in a continuous belt from northwest to southeast—as well as by lowlands.

The rolling plain of the Dnieper Upland, which lies between the middle reaches of the Dnieper (Dnipro) and Southern Buh (Pivdennyy Buh, or the Boh) rivers in west-central Ukraine, is the largest highland area; it is dissected by many river valleys, ravines, and gorges, some more than 300 m deep. On the west the Dnieper Upland is abutted by the rugged Volyn-Podilsk Upland, which rises to 471 m at its highest point, Mount Kamula. West of the Volyn-Podilsk Upland, in extreme western Ukraine, the parallel ranges of the Carpathian Mountains—one of the most picturesque areas in the country—extend for more than 240 km. The mountains range in height from about 600 m to about 2,000 m, rising to 2,061 m at Mount Hoverla, the highest point in the country. The northeastern and southeastern portions of Ukraine are occupied by low uplands rarely reaching an elevation of 300 m.

Among the country's lowlands are the Pripet Marshes (Polissya), which lie in the northern part of Ukraine and are crossed by numerous river valleys. In east-central Ukraine is the Dnieper Lowland, which is flat in the west and gently rolling in the east. To the south, another lowland extends along the shores of the Black Sea and the Sea of Azov; its level surface, broken only by low rises and shallow depressions, slopes gradually toward the Black Sea. The shores of the Black Sea and the Sea of Azov are characterized by narrow, sandy spits of land that jut out into the water; one of these, the Arabat Spit, is about 113 km long but averages less than 8 km in width.

The southern lowland continues in the Crimean Peninsula as the North Crimean Lowland. The peninsula—a large protrusion into the Black Sea—is connected to the mainland by the Perekop Isthmus. The Crimean Mountains form the southern coast of the peninsula. Mount Roman-Kosh, at 1,545 m, is the mountains' highest point.

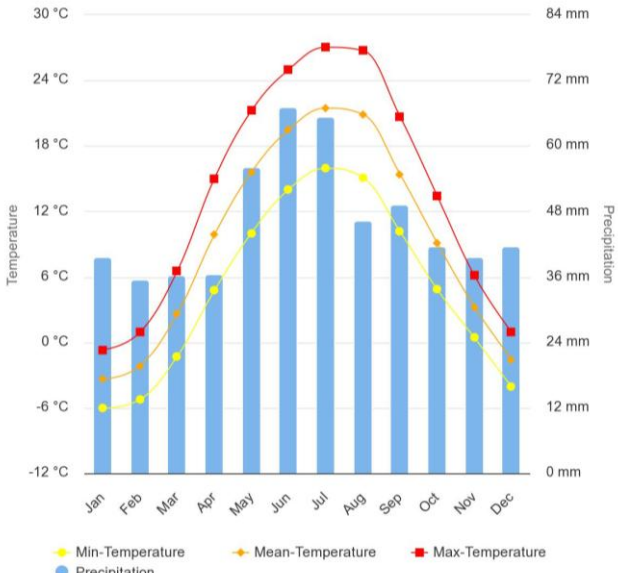
Almost all the major rivers in Ukraine flow northwest to southeast through the plains into the Black Sea and the Sea of Azov. The Dnieper River, with its hydroelectric dams, huge reservoirs, and many tributaries, dominates the entire central part of Ukraine. The longest river in the country is the Dnieper, of which 609 miles (980 km) are in Ukraine. Like the Dnieper, the Southern Buh, with its major tributary, the Inhul, flows into the Black Sea. To the west and southwest, partly draining Ukrainian territory, the Dniester (Dnistro) also flows into the Black Sea; among its numerous tributaries, the largest in Ukraine are the Stryy and the Zbruch. The middle course of the Donets River, a tributary of the Don, flows through southeastern Ukraine and is an important source of water for the Donets Basin (Donbas). The Danube River flows along the southwestern frontier of Ukraine. Marshland, covering almost 3% of Ukraine, is found primarily in the northern river valleys and in the lower reaches of the Dnieper, Danube, and other rivers.

Ukraine has a few natural lakes, all of them small and most of them scattered over the river floodplains. One of the largest is Lake Svityaz, 28 km^2 in area, in the northwest. Small saltwater lakes occur in the Black Sea Lowland and in Crimea. Larger saline lakes occur along the coast. Known as limans, these bodies of water form at the mouths of rivers or ephemeral streams and are blocked off by sandbars from the sea. Some artificial lakes have been formed, the largest of which are reservoirs at hydroelectric dams—e.g., the reservoir on the Dnieper upstream from Kremenchuk. The Kakhovka, Dnieper, Dniprodzerzhynsk, Kaniv, and Kyiv reservoirs make up the rest of the Dnieper cascade. Smaller reservoirs are located on the Dniester and Southern Buh rivers and on tributaries of the Donets River. Small reservoirs for water supply also are found near Kryvyy Rih, Kharkiv, and other industrial cities. Three large artesian basins—the Volyn-Podilsk, the Dnieper, and the Black Sea—are exceptionally important for municipal needs and agriculture as well.

Climate

Ukraine has a primarily temperate climatic zone influenced by moderately warm, humid air from the Atlantic Ocean. Winters in the western portion of the country are considerably milder than those in the east. In summer, on the other hand, the eastern portion of the country often experiences higher temperatures than the west. Average annual temperatures range from 5–6ºC in the northeast to 9–11ºC in the southwest. Precipitation is uneven, with two to three times as much falling in the warmer seasons as in the cold. On average, up to 1200 mm of rain fall annually in the mountains, though 300 – 700 mm of rainfall in the plains, with decreasing amounts from the north/northwest to south/southeast.[2]

Figure 1: Monthly minimum temperature, mean temperature, maximum temperature & precipitation for the 1991–2020 period in Ukraine



Source: World Bank Climate Knowledge Platform 2023

The average temperature in January, the coldest month, is about –3ºC in the southwest and about −8ºC in the northeast. The average in July, the hottest month, is about 23ºC in the southeast and about 18ºC in the northwest. Maximum precipitation generally occurs in June and July, while the minimum falls in February. Snow falls mainly in late November and early December; accumulation varies in depth from a

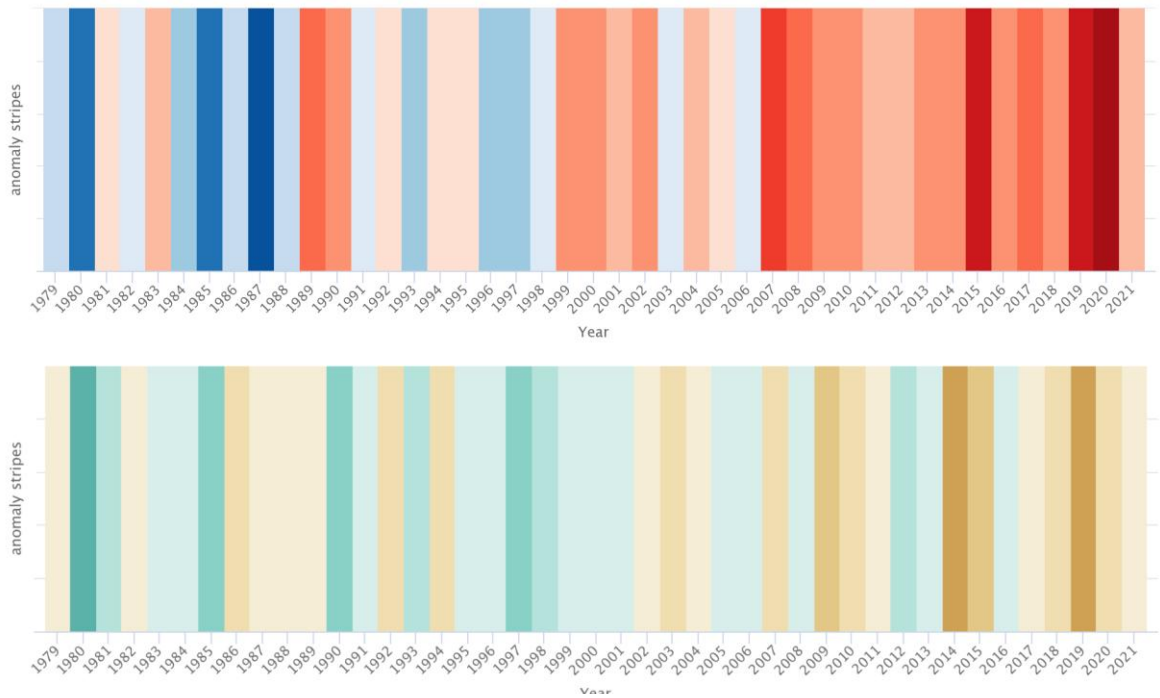
[2] Bernoux, M. et al. 2014. Ukraine – Soil fertility to strengthen climate resilience. World Bank; Bogovin, A.V. 2001. Country Forage / Pasture Resource Profile: Ukraine. FAO; and Climate Forum East (CFE) and NGO Working Group on Climate Change. 2014. National Climate Vulnerability Assessment: Ukraine

few inches in the steppe region (in the south) to several feet in the Carpathians. Western Ukraine, notably the Carpathian Mountains area, receives the highest annual precipitation—more than 1,200 mm. The lowlands along the Black Sea and in Crimea, by contrast, receive less than 400 mm annually. The remaining areas of Ukraine receive 400 to 600 mm of precipitation.

In the past 60 years, Ukraine's climate has changed significantly, with temperatures rising at an increasing rate. Since the late 1990s, the mean annual air temperature has been consistently higher than those of the 1961—1990 period. Since 2007, temperatures have exceeded the norm by 1.5ºC. The last decade, especially the years since 2015, were the warmest ever in Ukraine (and in the Northern Hemisphere in general). In some years, the increase in mean annual air temperature surpassed 2.0ºC (2.2ºC in 2007, 2.3ºC in 2015, and 2.7ºC in 2019). The daily minimum temperature rise is largest in the cold seasons, while maximum daily temperature increases the most in summer. Such changes have led to a decrease in the duration of the cold season, the number of frost days, and the severity of winters. These changes have also resulted in a longer and hotter growing season, an increased number of summer days, and a longer recreation season. The number of hot days and the duration of the hot spells, heat load, and heat stress on the human body are also increasing.

The precipitation regime in Ukraine has also changed: While total annual precipitation has not changed, there has been a redistribution of precipitation levels among the different seasons. Increases in precipitation levels are observed in autumn, and decreases in winter, with even greater decreases in the summers. The unevenness of precipitation and its intensity have increased, causing an extension in the duration of the dry periods. Rising air temperatures and uneven precipitation have resulted in lower accumulations of moisture in the soil, leading to an increase in the frequency and intensity of droughts (Figure 2). Drought episodes have almost doubled in the last twenty years, especially in the Polissya eco-region and in the northern regions of the forest-steppe.[3]

Figure 2: Graphic representation of changes in the average annual temperature (top) and average precipitation (bottom) in the 1979–2021 period



Note: In the top graph, each colored stripe represents the average temperature for a year (blue for colder and red for warmer year). In the lower graph, each colored stripe represents the total precipitation of a year (green for wetter and brown for drier

[3] World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

years)

Loss and damage (L&D) from climate impacts increased in the 2016–2020 period, with losses exceeding 1.3 billion USD (47.5 billion hryvnias). During this period 32 flooding events occurred and caused L&D of more than 100 million USD (3.7 billion UAH), while the 2020 drought caused agricultural yields to decrease by 718,000 ha with L&D at 640 million USD (23.4 billion UAH), the majority of which was for loss of winter crops. These events also caused the loss of 17,563 ha of forest with L&D of more than 500 million USD (18.8 billion UAH).[4]

Ecosystems

Ukraine is part of a broader region stretching across Central and Eastern Europe sometimes referred to as the "Green Heart of Europe". Though much of Ukraine's original plant cover has been cleared for cultivation, three large agro-ecological zones – the Polissya mixed forest zone in the north, a Forest–Steppe zone to the south and a Steppe zone in the south and southeast are still distinguishable. The Carpathian Mountain region in the west and the Crimean Mountains in the far south add to the habitat diversity. As a result, Ukraine possesses 35% of Europe's biodiversity though it occupies less than 6% of its area. Biota (over 70,000 species) includes many rare, relict, and endemic species, including rare steppe ecosystems, coastal wetlands, alpine meadows, ancient beech forests, and extensive peatlands. The latest edition of the Red Book of Ukraine, from 2021, contains 858 species of flora and 687 species of fauna.[5] Many of the ecosystem services provided by the country's natural ecosystems are facing increasing pressure from habitat change, pollution, invasive species, climate change, illegal use, and exploitation.

Ukraine is crossed by several large rivers, including the Dnipro, the Dniester, the Pivdenny Buh, as well as the Danube, the second-largest river delta of continental Europe. These rivers are mostly attributed to the river basins of the Black and Azov Seas, which cover most of the Ukraine's territory.[6] The major rivers in the country, including the Dnieper, the Dniester, the Inhul, and the Donets, are polluted with chemical fertilizers and pesticides from agricultural runoff and with poorly treated or untreated sewage. Coastal water pollution in the Sea of Azov and the Black Sea has necessitated the closing of beaches and has led to a dramatic reduction in fish catches. The freshwater flow into the Sea of Azov has been largely diverted for irrigation purposes, leading to a sharp increase in salinity.

The forest coverage of the territory of Ukraine amounts to approximately 16%. Forest landscapes are in the lead in the structure of nature and reserve fund of the state making up a third of its territories. In virtually all regions, the share of preserved area in the forests is higher than the public share.[7] Since 2015, Ukraine has increased its natural protected (reserve) territory by about 200,000 hectares and expanded its European network of protected areas by 2 million hectares.[8] As of May 2021, Ukraine had 5,622 protected areas reported in the World Database on Protected Areas (WDPA), and the total area of the Nature Reserve Fund of Ukraine (protected areas) amounts to over 41,000 km^2, which corresponds to 6.8% of the area of Ukraine.[9]

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[4] Government of Ukraine. Information guide regarding damages caused to the state as a result of adverse hydrometeorological conditions during 2016-2020 with regard to hydrometeorological disasters associated with atmospheric precipitation

[5] Order of the Ministry of Environment No. 29 dated 19 Jan 2021 "On approval of lists of animal species included in the Red Book of Ukraine (animal world) and animal species excluded from the Red Book of Ukraine (animal world)"

[6] Government of Ukraine. 2015. Fifth Report of Ukraine to the Convention on Biological Diversity

[7] Government of Ukraine. 2015. Fifth Report of Ukraine to the Convention on Biological Diversity

[8] Key biodiversity areas do not have national status though most are part of the Nature Reserve Fund (protected areas), Emerald sites, and Ramsar sites, which are recognized by Ukrainian legislation

[9] Aichi Biodiversity Target 11 Country Dossier: UKRAINE. Available at: https://www.cbd.int/pa/doc/dossiers/ukraine-abt11-country-dossier2021.pdf

Demographics and Social Characteristics[10]

According to the 2001 Ukrainian census (the most recent census), the State Statistics Service of Ukraine estimated the total population of the country (excluding Crimea) on 1 January 2022 at around 41 million. During the war, the Ukrainian government lost control of portions of the Donbas region. Additionally, due to the Russian invasion in 2022, one-third of Ukrainians have been forced to flee their homes to locations either within Ukraine or outside it. The next census is planned to take place following the end of the Russo-Ukrainian War.

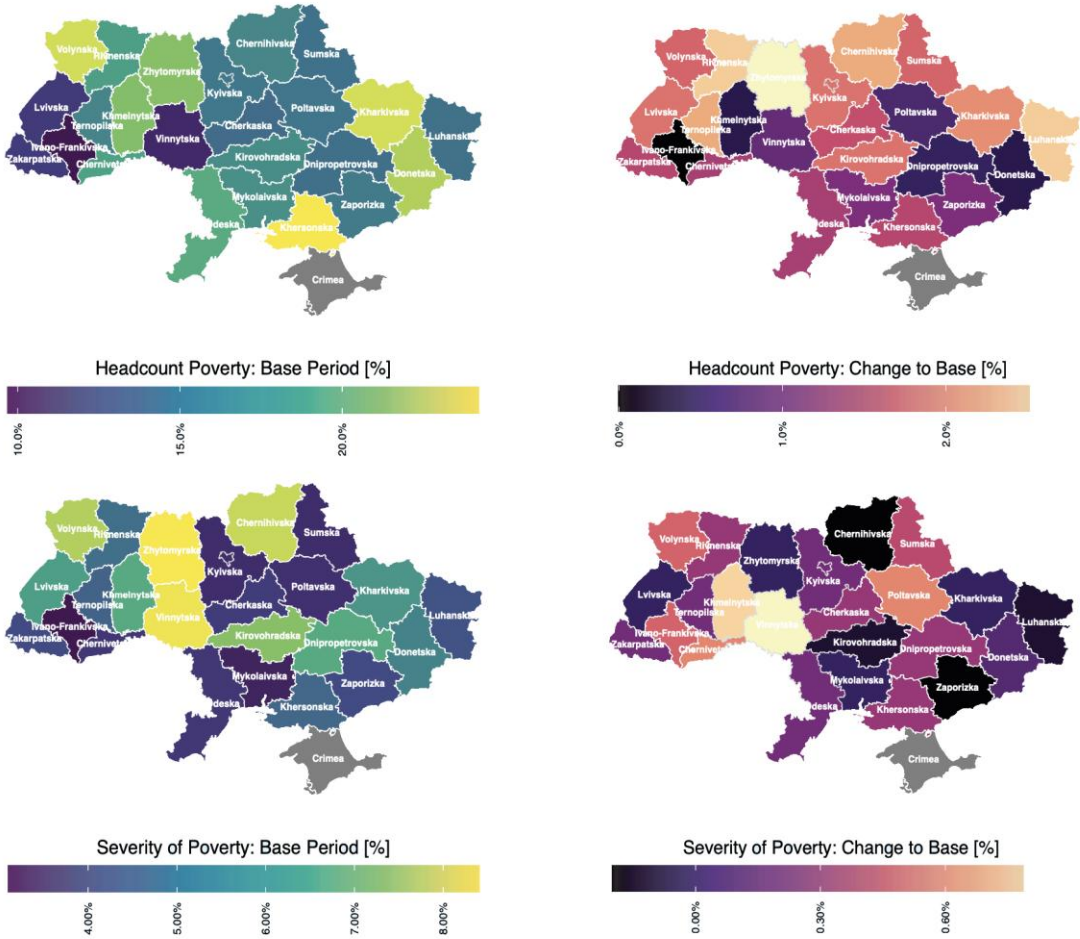
As of January 1, 2021, the age composition of the Ukrainian population indicates that 65% of the population is between 15 and 64, and 48% is younger than 17 years of age. In the under 18 population, males account for 51.5% and females for 48.5%. In the general population, 53.7% of the population are women, and 46.3% are men. The sex ratio is almost equal among the 35–39 population cohort, while women dominate in older population cohorts. A total of 68% of Ukraine's population lives in urban areas.

According to a 2021 study from the World Bank, climate change will have a greater impact on some oblasts due to its impact on agricultural production, and the resultant impact on poverty indicators. By these criteria, the five oblasts that will experience the highest impact by 2030 (in absolute terms) on agricultural production are Cherkaska, Khersonska, Kirovohradska, Poltavska, and Vinnytska. The most significant loss in household incomes and the highest increase in poverty and inequality due to lower agricultural production values is projected to be in Kharkivska, Kirovohradska, Lvivska, Luhanska, and Zhytomyrska oblasts. These oblasts are particularly susceptible to the rise in food prices and reduction of income from agricultural production caused by the warming climate.[11]

[10] [1] State Statistics Service of Ukraine. Demographic Yearbook Population of Ukraine, 2021. Available at: http://db.ukrcensus.gov.ua/PXWEB2007/ukr/publ_new1/2022/zb_nasel%20_2021.pdf; [2] State Statistics Service of Ukraine. Statistical Collected Book Number of Present Population of Ukraine, as of January 1, 2022. Available at: http://db.ukrcensus.gov.ua/PXWEB2007/ukr/publ_new1/2022/zb_Chuselnist.pdf; [3] BBC News article "How many Ukrainians have fled their homes and where have they gone?" 4 July 2022, Available at: https://www.bbc.com/news/world-60555472 ; and [4] World Bank, Government of Ukraine, and European Commission. 2022. Ukraine Rapid Damage and Needs Assessment

[11] World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

Figure 3: Projected changes in the values of headcount poverty and severity of poverty [in %] by 2030 relative to the baseline period (1991–2010) based on RCP 4.5 scenarios



Source: World Bank (2021)[12]

During the Soviet period, rapid industrialization, intensive farming, and a lack of effective pollution controls combined to seriously degrade the environment in Ukraine. Some of the most polluted areas in the world are now found there. The coal-burning industries of eastern Ukraine, which emit high levels of sulfur dioxide, hydrocarbons, and dust, have created severe air pollution throughout the region. Air quality is particularly poor in the cities of Dnipropetrovsk, Kryvyy Rih, and Zaporizhzhya. Lightly industrialized cities in the west, such as Uzhhorod and Khmelnytskyy, face pollution caused by vehicular emissions.

Macroeconomic Context Prior to the War of Russian Aggression[13]

Since the unprecedented shocks of 2014– 2015, Ukraine undertook a wide range of reforms to stabilize the economy, reduce large imbalances, and cushion the impact of the shocks on the population. Structural reforms included (i) moving to a flexible exchange rate; (ii) undertaking significant fiscal consolidation; (iii) reforming energy tariffs to reduce a key quasi-fiscal deficit and strengthening the social safety net to cushion the impact on the poor; (iv) stabilizing the banking sector by putting in place

[12] World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[13] This section based on World Bank, Government of Ukraine, and European Commission. 2022. Ukraine Rapid Damage and Needs Assessment and World Bank, Government of Ukraine, and European Commission. 2023. Ukraine Rapid Damage and Needs Assessment

a framework to resolve and recapitalize weak banks and strengthen supervision; (v) taking steps to streamline the business environment; and (vi) establishing key anticorruption institutions and requiring asset disclosures for public officials. These reforms helped to stabilize confidence after two years of sharp economic contraction. Real gross domestic product (GDP) grew by 3.5% in 2018 and 3.2% in 2019, up from 2.4% in 2016–2017.

The improved macro-fiscal and financial policy fundamentals established after the 2014–2015 crisis helped Ukraine weather the Covid-19 crisis better than expected. Following a 3.8% contraction in 2020, the economy grew by 3.4% in 2021 as COVID restrictions eased and a bumper harvest lifted growth in the last quarter of 2021. Fiscal revenues performed better than anticipated, with a trade and income tax revenue boost in both 2020 and 2021. The fiscal deficit reached 6% of GDP in 2020 and remained elevated at 4% in 2021 due to the added fiscal burden from fixed household gas tariffs (amidst steep increases in international gas prices). However, 2020 experienced a slight increase in social vulnerability as 23.2% people were recorded to live below the national poverty line (up from 23% in 2019). Overall, however, the government's COVID-19 pandemic response measures helped limit the economic impact on citizens, particularly those below the poverty line. To support the economic recovery and address a lack of capital investment, Ukraine deepened reforms in 2020–2021 by increasing de-monopolization and anti-corruption institutions; strengthening of land and credit markets; and financial sector supervision improvements. Recovery was materially disrupted by a severe escalation in geopolitical tensions toward the end of 2021, and the Russian invasion in February 2022.

As a result of the invasion, Ukraine's GDP declined by 29.2% in 2022. Still, the economy contracted in 2022 by less than initially expected, as the UN-brokered Black Sea Grain deal and the return of nearly 4 million migrants helped to support economic activity in the third quarter. Proven adaptability of the private sector, which explored new logistic routes and reoriented supply to the wartime needs, also aided growth. While Ukraine's economy has gradually adjusted to the new conditions, attacks on the power infrastructure starting in October 2022 damaged the country's power grid significantly, thereby exacerbating production constraints for the key sectors. In 2023 GDP is expected to grow by only 0.5% as a recovery in domestic services and war-related industries is projected to be mostly offset by a 15% decline in agricultural output and continued low-level stagnation of metals and mining production.

According to the World Bank's preliminary estimate and based on the global poverty line of USD 6.85 per person per day, poverty increased from 5.5% in 2021 to 24.1% in 2022, pushing an additional 7.1 million people into poverty and setting back 15 years of progress. War-affected regions are expected to experience even higher poverty rates. The United Nations Development Programme (UNDP) estimates the highest monetary poverty rates in Odeska, Luhanska, Khersonska, Kharkivska, and Rivnenska, which were among the poorest oblasts before the war. High inflation, particularly food inflation, eroded purchasing power disproportionately for low- income households, given food's large share in their budgets.

The war has also generated unprecedented fiscal financing needs. The consolidated budget deficit excluding grants amounted to 26.5% of GDP in 2022. Tax revenue declined by 8% in nominal terms (30% in real terms) as proceeds from value added taxes and excises suffered sharp contractions of 13% and 39%, respectively. Expenditure grew by 65% in nominal terms (39% in real terms), with authorities prioritizing war-related spending as well as essential public and social services. By contrast, capital expenditure declined by 37%.

Going forward, Ukraine will have to balance the need to sustain the war economy in the near term with the need to create conditions for a sustainable economic recovery in the future.

1.2. National Adaptation Actions and Efforts[14]

National Policy Frameworks and Strategies on Climate Change

Adaptation to climate change presents Ukraine with an opportunity to transform the economy, strengthen the social and spatial fabric, and become more competitive in the global marketplace.

The Constitution of Ukraine does not contain any mention or provisions on climate change, mitigation, or adaptation to it, indicating that in 1996, when the constitution and Basic Law were adopted, climate change was not considered a central issue (Inclusion of relevant provisions in the Basic Law increases the political and legal weight of issues and enables the possibility of applying the constitutional mechanisms). This, though Ukraine signed onto the UN Framework Convention on Climate Change (UNFCCC) on June 11, 1992 (ratified on May 13, 1997).

As a result, political and legal tools for climate adaptation were not defined within Ukraine's laws and strategic planning on climate adaptation was very fragmented and limited. Documents that address climate change, as a rule, contain only separate provisions on adaptation, and several strategies and plans indicated the need to develop and adopt a separate strategy for climate adaptation. More recently adopted state planning documents contain a more comprehensive understanding of the issues of climate adaptation, though sectoral political and legal instruments need systematic improvement to ensure adaptation to climate change.

The first national instruments were the Presidential Decree "On the decision of the National Security and Defense Council of Ukraine" dated September 14, 2020, which placed adaptation within the scope of Ukraine's environmental security, and "On the National Security Strategy of Ukraine" dated September 14, 2010, as well as the 2017 Action Plan for the Implementation of the Concept of State Policy Implementation in the Field of Climate Change for the Period Until 2030, the National Economic Strategy for the period until 2030 from March 3, 2021, and the decree "On the approval of the plan of priority actions of the Government" from March 24, 2021. The importance of adaptation to climate change is emphasized in the Low-Carbon Development Strategy of Ukraine until 2050, which states that "in the long term in Ukraine, adaptation to climate change will have the same degree of priority as climate change mitigation."

The necessary directions of action regarding adaptation were determined, mainly, by the Concept of State Policy Implementation in the Field of Climate Change for the period until 2030 and by the Strategy of Low-Carbon Development of Ukraine until 2050. The key directions identified include increasing resilience to climate-related risks and natural disasters for the areas of health care, people's livelihoods, economic sectors and natural ecosystems; introduction of a mechanism for the formation of an adaptation policy, with priority to the most vulnerable communities and sectors; implementation of approaches and technologies that provide for balanced management of natural ecosystems; creation of a state-wide risk management system for extreme climate events; expansion of the scientific knowledge base; increasing institutional capacity; educational and public outreach; as well as implementation of cross-border climate adaptation projects together with neighboring partner countries. The key sectors highlighted were the forestry, food security, rural areas, recreation, conservation tourism and biodiversity. Several specific adaptation measures were also foreseen. These include development of recommendations for adaptation of agriculture to climate change up to 2030; development of a medium-term action plan on adaptation for the forestry industry; the inclusion of climate adaptation measures in river basin management plans; development of flood forecast maps for civil and industrial objects, engineering, and transport infrastructure on the coastal territories of the Black and Azov Seas; inclusion of climate change in the National Transport Strategy; updating state

[14] This section based on European Union (EU) and UNDP. 2021. Institutional and Legal Basis of Adaptation before Climate Change in Ukraine. Report prepared as part of the EU4Climate Project (funded by the EU and implemented by UNDP)

building regulations to include climate change; the development of adaption plans for the population; improved risk management for emergency situations; implementation of pilot projects for the development and implementation of local plans for adaptation to climate change at the level of regions, as well as cities, towns and villages; and inclusion of adaptation measures in nature reserve fund projects and areas.

In addition, the connection of adaptation to climate change with the Sustainable Development Goals (SDGs) is noted in strategic documents, but without any details (for example, the Decree of the President of Ukraine "On the Sustainable Development Goals of Ukraine for the period until 2030" dated Sept 30, 2019).

Ukraine also has four national policies that include or address climate change issues, and most address climate mitigation:

- National Transport Strategy of Ukraine until 2030. The strategy was approved by order 430-3/2018. In April 2021, the Government endorsed the order "On approval of the Action Plan for the implementation of the National Transport Strategy of Ukraine for the period up to 2030."
- Decree 179/2021 approving the National Economic Strategy for the period up to 2030. The National Economic Strategy notably aims to ensure the appropriate level of welfare, self-realization, security, and the rights and freedoms of every citizen of Ukraine through innovative economic growth. It sets a net zero goal to 2060. The strategy is to be revised in 2024.
- National Action Plan on Implementation of the Kyoto Protocol, originally adopted through Resolution 346-p of the Cabinet of Ministers in 2005 and amended in 2009 to present a revised time frame for implementation of the National Plan for the Implementation of the Kyoto Protocol.

The "Environmental Security and Climate Change Adaptation Strategy of Ukraine by 2030" (NAS 2030), and its associated "Operation Plan for 2021–2024," endorsed by the Government of Ukraine on 20 October 2021, is the first strategic national document on climate adaptation. It provides a framework and overarching national strategy for the development, implementation, and monitoring and evaluation of climate adaptation activities in Ukraine and establishes essential steps to assess climate impacts on society, economy and nature, for integrating adaptation in sectoral and local policies, and ensuring the better use of climate data, with a focus on the 10 most vulnerable sectors: Biodiversity, Water resources, Energy, Public health, Fisheries, Agriculture and soils, Forestry, Cities and Territorial Communities, Transport and infrastructure, Coastal areas and Tourism.

The guiding principles of the NAS 2030 include mainstreaming climate change into policy, legal frameworks, and development planning; ensuring that actions are country- driven and country-specific; encouraging stakeholder participation in the policy's implementation; and promoting transparent planning and decision-making to make Ukraine a more environmentally safe and climate-resilient country, ready to meet the already unavoidable impacts of the global climate crisis.

The NAS 2030 aims to reduce the impact of the consequences of climate change and increase the level of environmental safety in Ukraine. It has the following goals:

- Strengthening the adaptive capacity and resilience of social, economic, and ecological systems to climate change.
- To develop and implement appropriate strategies and actions that will lower the vulnerability of Ukrainians and reduce the vulnerability of socio-economic sectors to the impacts of climate change.
- To promote the development and inclusion of climate adaptation measures in national, regional, local, and sectoral policies, strategies, action plans, and risk management.
- To effectively integrate climate change into existing policy, institutional and development frameworks in recognition of its cross-cutting nature.

- To create the organizational prerequisites and scientific and methodological support for the implementation of the state policy of adaptation to climate change.
- To enhance education and awareness, increasing awareness of decision-makers, and increase human and institutional capacity for climate adaptation, climate mitigation and early warning.

Sectoral Policy Frameworks and Strategies on Climate Change

Sectoral legislation (in particular, codes and laws), at present, does not establish specific political and legal instruments for adaptation to climate change, and sectoral laws and legislation, with some exceptions, contains only isolated references. For example, water sector legislation incorporates adaptation into basin management, while forestry legislation notes "the introduction of a forestry management system based on the balanced provision of economic, ecological, and social functions by forests, taking into account the need for adaptation to climate change, preservation of biodiversity, public participation in decision-making and transparency."[15] The agriculture sector provides for the "application of climate-oriented methods of agricultural management"[16] while urban planning requires the "preservation, creation and restoration of recreational, nature protection, health-improving territories and objects, landscapes, forests, parks, squares, separate green spaces."[17] Legislation for other sectors needs improvement (e.g., the tourism sector), or complete revision (e.g., coastal zones).

International Commitments

To meet its international commitments, and in addition submission of its national adaptation plan (NAS 2030) in 2021, Ukraine has also developed and submitted:

- Update to the First Nationally Determined Contribution (NDC) in 2021 (the original NDC was submitted in 2015).
- National Inventory Report in 2021 and 2022.
- Sixth National Communication and addendum in 2013. which includes the Climate Change Vulnerability and Adaptation Assessment section.
- Low Emission Development Strategy to 2050 in 2018.

1.3. INSTITUTIONAL ARRANGEMENTS TO SUPPORT NATIONAL ADAPTATION ACTION

Adaptation to climate change is comprised of various actions by government, agencies, the private sector, and civil society and at the household level. It involves improving society's ability to cope with the resulting impacts, meaning both positive and negative climatic conditions across time and policy scales.

The Ministry of Environmental Protection and Natural Resources (MEPNR) is responsible for drafting and implementing national policies and strategies on environmental issues, including climate change. MEPNR is also the ministry that provides coordination for climate change related policies and activities. The National Focal Point to the UNFCCC reports on climate change activities to the UNFCCC. MEPNR monitors, tracks, and follows Conference of the Parties (COP) decisions on adaptation and mitigation, including funding possibilities, and transmits these to the relevant ministries and institutions in Ukraine. Sectoral activities rest with the respective ministries.

[15] National economic strategy for the period until 2030, approved by the resolution of the CMU dated 03.03.2021 No. 179.

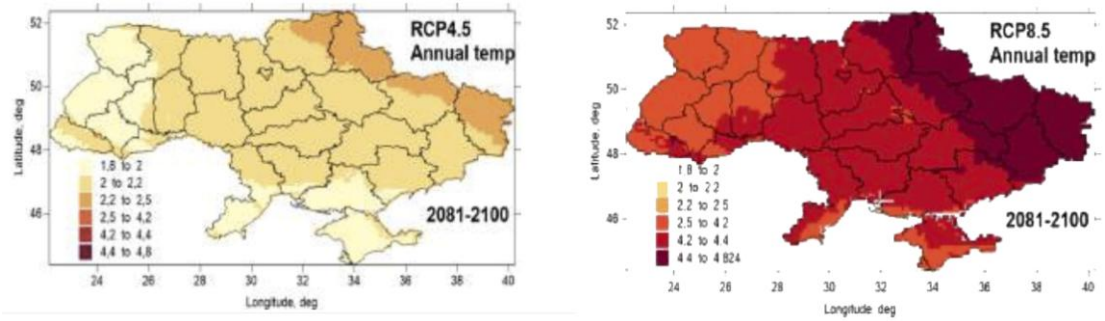
[16] Low-carbon development strategy of Ukraine until 2050. Protocol decision of the CMU of July 18, 2018 No. 28.

[17] The main principles (strategy) of the state environmental policy for the period up to 2030. Law of Ukraine dated February 28, 2019 No. 2697-VIII.

2. ADAPTATION SECTORS: CLIMATE CHANGE IMPACTS, RISKS, HAZARDS, AND VULNERABILITIES

Climate change projections show a consistent trend of increases in annual average temperature, with progressively higher increases toward the end of the century (2.1±1.8°C under RCP 4.5 and 4.3±2.1°C under RCP 8.5). The spatial distribution of rising temperature is similar over time, with the highest temperature increases in the northeast and the lowest in the west, northwest, and areas near the Black Sea coast. Rising temperatures in the summer will result in heat- waves and increased aridity in the south and east of Ukraine. The southern regions will experience an average daily maximum temperature above 34°C in July, with the southern steppe remaining the hottest until the end of the century (Figures 4).[18] The IPCC Sixth Assessment Report indicates that every additional increase of 0.5°C in global average temperature causes discernable increases in the intensity and frequency of heat extremes, such as heatwaves and ecological droughts.[19] These factors will enlarge the stock of forest fuel available for combustion in wildfire events.

Figure 4: Projected annual mean temperature increase (compared to baseline 1991–2010) under CMIP5



Source: World Bank (2021)

In all scenarios, annual precipitation in Ukraine is projected to increase, with larger increases towards the end of the century, especially under RCP 8.5. By the end of the century, changes under RCP 8.5 show not only twice higher warming but broader ranges of precipitation, suggesting strong spatial differences. The southern and central areas are characterized by the lowest increase in precipitation, with a significant decrease in warmer months exacerbating with temperature rise. Overall, the southern and central regions are projected to become drier, and northern and western oblasts wetter with rising uncertainty of the delineation between these two opposite tendencies under RCP 8.5 (Figure 5).[20]

Ukraine is also at risk of hydrometeorological hazards and natural disasters, which primarily affect the agricultural and human health sectors, through seasonal flooding and periods of drought. Threats from riverine, urban floods and wildfires are considered high. Impacts from climate change make Ukraine increasingly vulnerable to droughts, high temperatures, heat waves, heavy precipitation, mudflows, and floods. The most common natural disasters are associated with heavy rainstorms that may cause mudslides and flooding of large areas of agricultural land, houses, and industrial buildings. In recent years, the number of natural disasters has increased in the region, and in many cases, they have been considered as catastrophic, causing fatalities, and leading to significant economic losses. Climate change is expected to increase risks and severity of natural disasters in Ukraine, through more intense temperatures as well as rainfall patterns, prolonged heat waves, and water scarcity.[21]

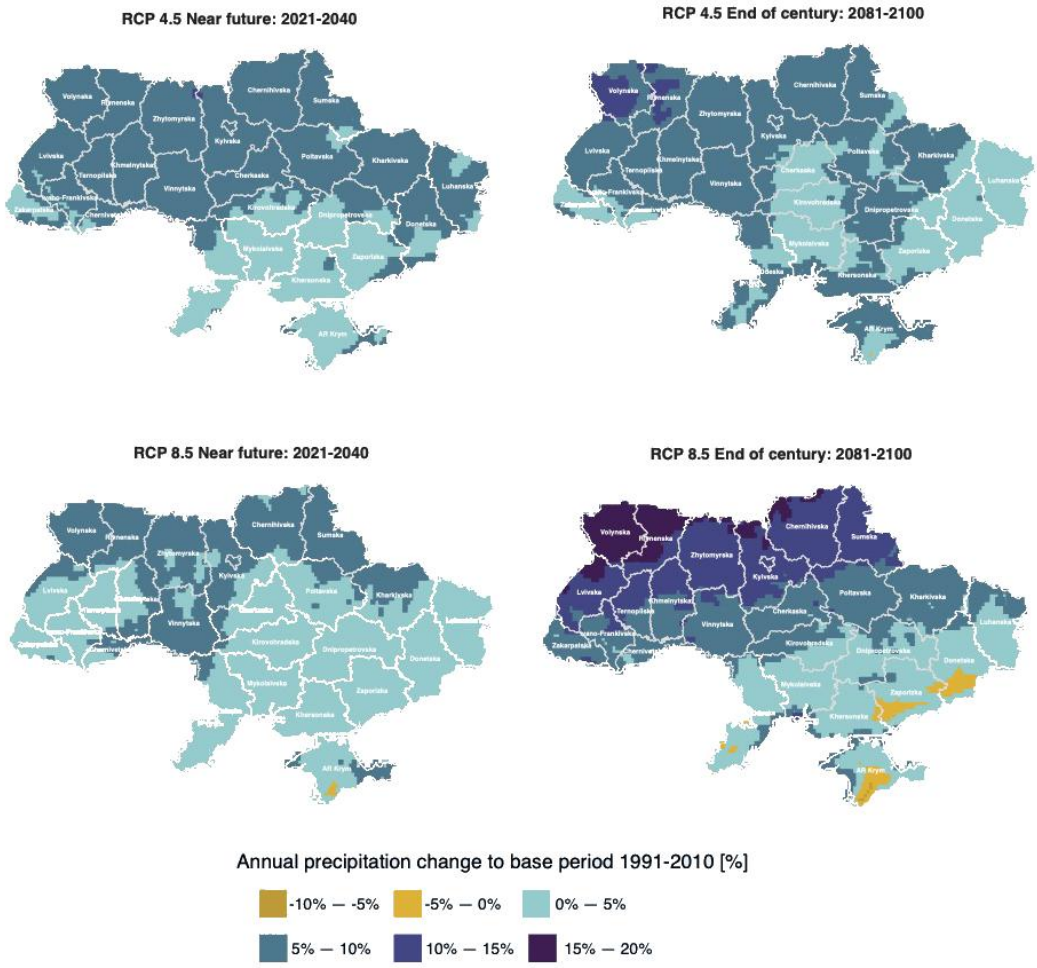
[18] World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[19] IPCC, 2023: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee, and J. Romero (eds.)]. IPCC: Geneva, Switzerland

[20] World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[21] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

Figure 5: Projected changes to annual precipitation due to climate change under CMIP5



Source: World Bank (2021)

2.1. Ecological and Socio-Economic Impacts and Risks of Climate Change

Ukraine has persistent structural inequalities, as well as skewed distributional access to industrial and productive assets. These elements, coupled with poverty and unemployment levels, reduce the capacity of most Ukrainians to cope with and mitigate the adverse impacts of climate change. Based on expert opinion, the NAS 2030 defines the 10 most vulnerable sectors and natural components in Ukraine: Biodiversity, Water resources, Energy, Public health, Fisheries, Agriculture and soils, Forestry, Cities and territorial communities, Transport and infrastructure, Coastal areas, and Tourism.[22]

Biodiversity

Home to 36% of Europe's biodiversity, Ukraine's ecosystems are varied. Impacts of climate change are of particular concern for rare species in the Danube Delta and the Carpathian Mountains. Fire risk threatens the increasingly desiccated, non-native spruce forests in the Carpathians, the forests in the Chernobyl exclusion zone and the pine forests of the Dnieper region.[23] The ecosystems most vulnerable

[22] Expert opinion summarizes the opinions of 110-member working group for NAS 2030 development

[23] Nesterenko, M., *et al.* 2014. Climate Change Adaptation Strategy and Action Plan for Danube Delta Region; and IPCC, 2023: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee, and J. Romero (eds.)]. IPCC: Geneva, Switzerland

to climate change are forest ecosystems and those located in the river valleys and coastal areas due to sharp fluctuations in hydrological regimes (both floods and droughts), as well as ecosystems and species at the edge of their physical range, especially the mountain ecosystems of the Carpathians.[24] During the 1992 – 2020 period, absolute sea levels rose by 3.3 mm/year or more, increasing the vulnerability of coastal areas to erosion and flooding. In addition, pollution, overfishing, invasive alien species, destruction of habitats and river reservoirs have reduced the industrial fishing potential of the Azov and Black Seas and damaged their marine ecosystems, masking climate change effects.[25]

Water Resources

Ukraine is one of the least water-sufficient countries in Europe and relies on dams, rivers, and aquifers for its water supply. The country has more than 4,100 lakes and reservoirs. On average 25% of drinking water samples do not meet EU quality standards. Potable water deficits leave Ukrainians, particularly in rural areas, exposed to degraded water quality and future declines in water availability. The industrial sector leads water withdrawal (48%), which is predominantly from surface water sources (80% of total water withdrawal).[26] The reduction of spring water flows, which is the main part of the annual volume of river flow, due to the changing climate is particularly significant. The overall decrease in the water content of rivers aggravates pollution and entails deterioration in water quality. At the same time, catastrophic flooding of large areas is becoming more frequent.[27] Snowfall irregularities have been observed in the Carpathians, a large tourism center, with snows interrupted by winter rains. Agriculture, industry, and households in the south and southeast are most vulnerable to current and projected droughts.[28] The Ukrainian Black Sea coast is very vulnerable to water shortages, as it uses surface water and is a popular tourist destination. The outdated water supply and sewerage infrastructures in the region aggravates the underlying vulnerabilities. The continued degradation of wetlands and lakes in the Polissya area and in the north of Ukraine, which were drained in earlier periods, combined with rising temperatures, generates more frequent fires, and worsens air quality.[29]

The continued reduction in precipitation during the summer may cause the surface runoff of rivers to reduce by half, generating significant water shortages. In the south and south-east of Ukraine, the annual runoff of large rivers may fall by 30–50%, and medium and small rivers are very likely to disappear.[30]

Energy

Anticipated climate impacts include disruptions to the production and transport of Ukraine's energy, specifically coal and natural gas and to the United Energy System of Ukraine. These impacts include flood related disruptions in the operation of natural gas distribution infrastructure; as well as decreased electricity generation at nuclear and thermal power plants due to potential water supply restrictions; increased uncertainty in the volumes of electricity generated, and increased daily fluctuations in the

[24] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[25] Nesterenko, M., *et al.* 2014. Climate Change Adaptation Strategy and Action Plan for Danube Delta Region; and IPCC, 2023: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee, and J. Romero (eds.)]. IPCC: Geneva, Switzerland

[26] FAO. 2015.Ukraine Aquastat; International Commission for the Protection of the Danube River. 2013. ICPDR Strategy on Adaptation to Climate Change; and World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[27] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[28] Nesterenko, M., *et al.* 2014. Climate Change Adaptation Strategy and Action Plan for Danube Delta Region; and IPCC, 2023: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee, and J. Romero (eds.)]. IPCC: Geneva, Switzerland

[29] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[30] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

electric load, combined with growth of electric energy consumption during the summer and increased uncertainty in thermal energy demand; lower efficiency of electricity transmission due to higher temperatures; decreased switching capacities of hydroelectric power plants due to droughts combined with increased demand for switching capacities; as well as increased frequency of accidents in electrical networks (damage, outages) due to extreme weather conditions.[31]

Renewable energy—mostly hydropower—provides about 6% of its energy needs, but the National Renewable Energy Action Plan sets a target of 25% renewables by 2035. Prior to the Russian invasion, Ukraine was also a major transit country for natural gas and petroleum liquids between Russia and Europe, but higher ambient air temperatures lower the efficiency of gas distribution systems. If shale gas exploration in Ukraine's eastern regions—interrupted by the Russian invasion in 2022—expands, it may compete for water with other needs. Coastal erosion also puts stress on oil and gas infrastructure.[32]

Public Health

Climate change is expected to exacerbate the distributional impacts of environmental and climatic changes due to the negative impacts associated with rising air temperatures, sharp fluctuations in atmospheric pressure, air, soil, and water pollution, as well as the emergence of non-communicable diseases, and the spread of infectious diseases and chronic illnesses. These include deterioration of drinking water quality, the production and supply of food, an increase in the occurrence and prevalence of allergic diseases, and a growing toxic burden. The epidemiological indicators for acute environmental poisoning have increased in the last decade (to 20 to 40 cases per 10,000 people).[33]

Ukraine's urban population is also vulnerable to heat stress, aggravated by urban heat island effects and high pollution levels. Cardiovascular disease is the leading cause of death in Ukraine—48% of deaths are attributable to heart failure alone—and heat waves add stress to cardiovascular systems. Warmer temperatures could increase incidence of diarrhea and other bacterial diseases and may also increase the range of vector-borne diseases. Prior to the Russian invasion, at least 10% of Ukraine's housing stock was considered beyond its usable life span and was ill-prepared to withstand extreme events.[34]

Extreme weather phenomena and natural disasters are also likely to increase the frequency of injuries, deaths, and temporary disabilities. Since 2019, this increase is already evident in emergencies caused by adverse weather conditions.[35]

Fisheries

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, the drying of small water bodies, the spread of parasites and, as a result, changes in the species composition of fish and other

[31] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[32] Ministry of Environment and Natural Resources. 2013. Sixth National Communication of Ukraine on Climate Change; International Renewable Energy Agency. 2022. Energy Profile: Ukraine. Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Europe/Ukraine_Europe_RE_SP.pdf ; and World Bank. 2009. Adapting to Climate Change in Europe and Central Asia

[33] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[34] UNECE. 2013. Country Profiles on Housing and Land Management: Ukraine; WHO. 2021. Ukraine: WHO Statistical Profile; Climate Forum East (CFE) and NGO Working Group on Climate Change. 2014. National Climate Vulnerability Assessment: Ukraine; and World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[35] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

aquatic biological resources. The rising temperatures also threaten the extinction of cryophile species, combined with the emergence of uncommon thermophilic species.[36]

Agriculture and Soils

Ukraine is a major wheat and barley exporter, and 69% of its land area is under agriculture. The sector is dependent on rainfall, with only 6% of cultivated land under irrigation. Ukraine's fertile black "chernozem" soil, characteristic of the long-grass steppe, is known for its high organic matter content, which is highly efficient in its use of rain to maintain soil moisture. These soils, however, have been degraded by intensive agricultural production since Soviet times, as well as by water and wind erosion. A warmer climate may benefit crop yields in Ukraine's colder and humid north, but would negatively impact fertile regions in the south, where water availability is limited. Increases in precipitation may not be correlated with the crop cycle and higher carbon may lower grains' nutritional value, offsetting potential gains in productivity.[37] The main climate related threats 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. Higher frequency and intensity of extreme weather phenomena may induce lower soil fertility and lower crop productivity. Droughts become more frequent, resulting in the absent or insufficient replenishment of groundwater, which can increase wind erosion of soils.[38] The cost of soil loss from erosion is estimated at one-third of agricultural GDP each year; soil erosion in turn impedes the sector's resilience to climate variability and extreme events.[39] Climate change is also expected to decrease livestock breeding due to declining productivity, the spread of diseases, reduced pasture areas, and water shortages.[40] The changes in agricultural production values and farm outputs will also have significant distributional implications for poverty and social inequality in some provinces.[41]

The positive impacts of climate change in the sector include the extension of the vegetation season, which will improve the distribution of individual species and open opportunities to cultivate new, more warm-weather species or secondary crops. In addition, the northward shifting of natural climatic zones will make 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.[42]

Forestry

Forests cover 16% of Ukraine's territory.[43] 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 fluctuations in the hydrological regime and northward shifts in the climatic zone boundaries (with increased areas of unsuitable zone for several, key ecosystems in the south), affecting the areas and types of forest-forming species. By mid-century, most of Ukraine will be unsuitable for forests, and the impact of climate change on forests is exacerbated by a simultaneous loss of ecosystem services. Additionally, based on some estimates, carbon sequestration by forests could decrease significantly. Overall, climate change is projected to reduce resilience and viability of forest ecosystems and includes a higher frequency and intensification of adverse natural phenomena, such as large-scale outbreaks of

[36] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[37] Bernoux, M. *et al.* 2014. Ukraine – Soil fertility to strengthen climate resilience. World Bank; FAO. 2015. Ukraine Aquastat; and World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[38] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[39] Bernoux, M. *et al.* 2014. Ukraine – Soil fertility to strengthen climate resilience. World Bank; FAO. 2015. Ukraine Aquastat; and World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[40] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[41] World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[42] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[43] Government of Ukraine. 2015. Fifth Report of Ukraine to the Convention on Biological Diversity

diseases and multiplication of pests, as well as decreases in the productivity of forest stands and non-timber forest products.[44] The number of fires classified as large on the national forest fire classification scale in the northern and eastern parts of the country is expected to increase, resulting in unprecedented environmental, social, and economic damage. Fire density, however, shows the highest concentration of incidents in the southeast regions: in Khersonska (1.9 cases per 1,000 ha of forested area), Zaporizska (1.4 cases per 1,000 ha), Dnipropetrovska (1.3 cases per 1,000 ha), Luhanska (1.1 cases per 1,000 ha), and Donetska oblasts (1.1 cases per 1,000 ha).[45]

Cities and Territorial Communities

In Ukraine, close to 70% of the population is urban. Ukraine's urban population is vulnerable to heat stress, aggravated by urban heat island effects, an insufficient urban canopy, and high pollution levels. Cardiovascular disease is the leading cause of death in Ukraine—48% of deaths are attributable to heart failure alone—and heat waves add stress to cardiovascular systems. Rapid urbanization, the increase of heat absorbing surfaces, and insufficient access to room cooling options, are additional climate risk factors. Warmer temperatures are likely to increase the incidence of diarrhea and other bacterial diseases and may also increase the range of vector-borne diseases. The urban population is also vulnerable to water shortages due to lower rainfall amounts, drying rivers, lower groundwater levels, and the growing frequency of extreme weather phenomena. In addition, prior to the Russian invasion, at least 10% of Ukraine's housing stock was considered beyond its usable life span and was ill-prepared to withstand extreme events.[46]

Transport and Infrastructure

Transport networks and infrastructure for air, vehicular and water transport are expected to experience significant impacts and physical damages. Among the main impacts are damages to physical assets (such as roads, bridges, train tracks) due to more frequent days with very high temperatures and adverse weather phenomena; disruptions to air, sea, and water transport operations; higher accident rates; as well as a shorter than planned design-lifecycle for individual assets, and an increase in annual maintenance costs. Higher GHG emissions are also expected due to increased need for vehicle cooling. A particular problem is the poor adaptation of the sewerage systems and tunnels to significant amounts of precipitation.[47]

Adverse weather conditions are also expected to increase deterioration and damages to buildings. A significant increase in temperature entails more intensive evaporation of chemical substances, especially at industrial and commercial facilities, and negatively affects the nature of the dispersion of harmful substances in the atmosphere from emission sources, causing higher concentrations of pollutants.[48]

Coastal Areas

Ukraine has no protective infrastructure for coastal storm surges, and the coastal areas are highly vulnerable to sea-level rise. The most significant drivers of climate change risks and vulnerability in the coastal areas are the modification of terrestrial climatic and hydrologic processes, ocean acidification,

[44] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030; and World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[45] World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

[46] UNECE. 2013. Country Profiles on Housing and Land Management: Ukraine; WHO. 2021. Ukraine: WHO Statistical Profile; Climate Forum East (CFE) and NGO Working Group on Climate Change. 2014. National Climate Vulnerability Assessment: Ukraine; World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry; and Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[47] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[48] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

increased sea surface temperature, sea-level rise, water pollution, and a higher frequency and intensity of storms and floods. Due to the sea level rise by the end of the century, about 650,000 hectares of land are projected to be flooded due to sea level rise, and when storm surges are accounted for, up to 1 million hectares may be flooded. In addition, some 590 cities and towns may be flooded to some degree, and some the assets of at least 10 nature reserves, including the Black Sea and Danube Biosphere Reserves, and the Nyzhnyodniprovsky, Dzharylhatsky, Biloberezhya Svyatoslava, Meotida, Pryazovsky, Azovo-Syvasky, Tuzlovslki Lymany national nature parks, suffer from significant negative changes. Rising sea levels could also exacerbate current environmental problems in low lying areas due to flooding of industrial enterprises, landfills, cemeteries, and agricultural lands.[49]

Tourism

Climate is an important tourist factor. The popularity of many tourist destinations depends on the number of sunny or snowy days. The main climate threats are related 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 accessibility of tourist routes, lack of water, and substandard accommodation conditions caused by extreme weather phenomena (such as risks of flooding in certain nature reserves and loss of their recreational value). The shorter period of stable snow cover in the Carpathians may trigger negative consequences. The quality of beaches may also deteriorate due to water erosion, the spread of pathogens, insects, and other organisms.[50]

[49] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[50] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

3. CLIMATE ADAPTATION GOALS, ACTIONS AND CHALLENGES

3.1. INTRODUCTION

The Government recognizes that many of its sectoral policies were developed before climate change emerged as a key issue for the country, and as such, these policies must be revised to better mainstream climate change into key national policies and sectoral strategies. A rapid review of national policies and sectoral strategies indicates that climate change issues have not always been mainstreamed.[51] Despite this, since 2021 the Government has increased its climate ambitions.

3.2. NATIONAL ADAPTATION GOALS AND ACTIONS

In 2021, the Government of Ukraine updated its NDC under the Paris Agreement to reduce its greenhouse gas (GHG) emissions by 65% by 2030 from the 1990 levels. (Ukraine's previous commitment was to reduce GHG emissions by only 40%).[52] The updated NDC includes the goal of climate neutrality by 2060.[53]

In October 2021, the Cabinet of Ministers of Ukraine adopted the NAS 2030. This is the first national document that creates a legislative framework for adaptation measures in Ukraine. Over 150 experts and members of the public joined the drafting of this document over the course of a year.

3.2.1. ADAPTATION IN THE 2021 NDC

The NDC 2021 provides limited information on adaptation, but the country aims to establish a baseline for adaptation and resilience measures by 2030. Ukraine is also looking to set more ambitious mitigation and adaptation targets with a focus on land use, land-use change, forestry, and transportation.

While adaptation is not officially addressed in the 2021 NDC, references to adaptation were revised, and many of the key NDC actions overlap with adaptation actions. Among these key actions are:

- Modernizing and upgrading energy infrastructure and industrial enterprises.
- Introducing energy efficiency measures in more sectors of the economy.
- Promoting thermal modernization of buildings.
- Ramping up organic agriculture and resource-efficient agricultural practices.
- Accelerating reforestation schemes and reforming forest management.

3.2.2. ADAPTATION IN THE NAS 2030

The NAS 2030 aims to reduce the impact of the consequences of climate change and increase the level of environmental safety in Ukraine by effectively integrate climate change into existing policy, institutional and development frameworks in recognition of its cross-cutting nature. As such, its goals are:

- To strengthen the adaptive capacity and resilience of social, economic, and ecological systems to climate change.

[51] European Union (EU) and UNDP. 2021. Institutional and Legal Basis of Adaptation before Climate Change in Ukraine. Report prepared as part of the EU4Climate Project (funded by the EU and implemented by UNDP)

[52] Government of Ukraine. 2021. Nationally Determined Contribution

[53] In March 2021, the Cabinet of Ministers approved the "National Economic Strategy until 2030," which outlines how climate neutrality is to be achieved by 2060

- To create the organizational prerequisites and scientific and methodological support for the implementation of the state policy of adaptation to climate change.
- To promote the development and inclusion of climate adaptation measures in national, regional, local, and sectoral policies, strategies, action plans, and risk management.
- To enhance education and awareness, increasing awareness of decision-makers, human and institutional capacity for climate adaptation, climate mitigation, and early warning.

Agriculture

Led by the State Agency for Fisheries and the Ministry of Agricultural Policy (MoAP), Ukraine completed the first climate change risk and vulnerability assessment (CRVA) for the agriculture sector in 2019 and plans to carry out the following adaptation actions in the agriculture sector by 2024:

- Develop an action plan for adaptation of agriculture and fisheries to climate change based on the sectoral CRVA.
- Analyze possible economic mechanisms to promote the return of low-yield and degraded agricultural lands to natural ecosystems.

Among the future adaptation measures under consideration are:[54]

- The need to breed and introduce new varieties that are more resistant to droughts and high temperatures.
- Expansion of irrigation methods, especially in the south and southeast.
- Conservation measures to reduce wind and water erosion, as well as salinization of soils.
- Improvement of the structure of agricultural lands and areas of economic activity.

Water Resources

Led by the Water Management Agency and the MEPNR, Ukraine completed the first CRVA for water resources in 2021 and has initiated the process of including of climate adaptation measures in river basin management plans. The following future adaptation actions in the water resources sector are being considered:

- Enhance water use efficiency and management, including reducing water loss from piped systems, water reuse, water recycling, and use of water harvesting techniques.
- Replace outdated water supply and sewerage infrastructure.
- Advance wastewater reuse and recycling technologies at the municipal and industry level.
- Improve water demand management, particularly at the local level and in the agricultural, industrial, mining and tourism sectors.
- Promote and encourage integrated water resource management.
- Water extraction from deep underground aquifers.
- Establish best practice systems for improving the efficiency of water use, particularly in irrigation.
- Coordinate the use of surface and groundwater resources and increase the recharge rate of groundwater aquifers.
- Establish nation-wide groundwater use, monitoring and management.

[54] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

- Water delivery in several water stressed regions.

Forestry

Led by the State Forestry Agency, the MEPNR, and the National Academy of Sciences, Ukraine completed the first CRVA for the forests and forestry sector in 2021 and completed identification of the suitability of land plots on state and municipal ownership for natural forestation and reforestation. Based on these the country plans to carry out the following adaptation actions in the forestry sector: [55]

- Develop a medium-term action plan on adaptation for the forestry industry.
- Strengthen institutions, policy, and planning; establish a establish a mechanism to integrate climate change action within the MoAP; and include climate risk assessment in oblast development planning (with priority focus on Kirovohradska, Zhytomyrska, and Lvivska oblasts).
- Enhance institutional capacity for collecting, maintaining, analyzing, and disseminating climate data through a National Climate Resource Center.
- Promote transition to climate-smart agriculture and forestry (with priority focus on Cherkasska, Chernivetska, Khersonska, Kirovohradska, Kyivska, Lvivska, Poltavska, Rivnenska, Vinnytska, and Zhytomyrska, oblasts), promote farmer information systems and precision agriculture technologies, improve targeting of subsidy programs, and develop insurance products for climate risks, and include agroforestry and forest management in adaptation planning.

Fisheries

Led by the State Agency for Fisheries and the MoAP, Ukraine completed the first CRVA for fisheries sector in 2022 and plans to carry out the following adaptation actions in the fisheries sector by 2024:

- Develop an action plan for adaptation of agriculture and fisheries to climate change based on the sectoral CRVA.

Biodiversity

Led by the MEPNR, Ukraine completed analysis of the institutional and legal frameworks for climate adaptation (in 2021), developed methodology recommendations to include a climate component in the state planning documents, and strategic environmental assessment and environmental impact assessments (in 2022), and developed guidelines for CRVA of social and economic sectors and natural components (in 2023). Ukraine also plans to carry out the following adaptation actions in the biodiversity sector by 2024:

- Develop guidelines for CRVA of social and economic sectors and natural components.
- Accession of Ukraine to the Declaration on Inclusion of Climate Change Adaptation in Development Cooperation, approved on 4 April 2006 by the Ministers for Environment and Development of the Member States of the Organization for Economic Cooperation and Development (OECD).
- CRVA for biodiversity sector.
- Amend the Law of Ukraine “On Environmental Protection” to ensure inclusion of climate change issues.
- Climate responsive National Strategy for the Management of Invasive Alien Species of Flora and Fauna in Ukraine until 2030.
- National targeted research and development programme on climate change.

[55] World Bank. 2021. Ukraine: Building Climate Resilience in Agriculture and Forestry

- Develop a list of indicators of impact and response to climate change for social and economic sectors and natural components.
- Inclusion of adaptation measures in nature reserve fund projects and areas.

The restoration and rehabilitation of degraded ecosystems is also among the future adaptation measures under consideration.[56]

Box 1: *Restoration of Degraded Peatlands in Nizhyn District*

The EU-funded ClimaEast Pilot Projects (http://www.climaeast.eu/), implemented and supported by UNDP, supported the development of ecosystems-based approaches to climate change by showcasing ecosystem-based approaches, which combine rural development, sustainable land management, and sustainable livelihoods, and establish community-centered solutions that demonstrate that intact ecosystems have a strong and cost-effective positive effect both on climate mitigation and climate adaptation.

In Ukraine, the focus was on restoration of neglected and degraded agricultural peatlands in the Nizhyn district of the Chernihiv region. Nizhyn is one of the ten regions in Ukraine where 95% of the country's drained peatlands are located. 2,800 hectares of degraded agricultural peatlands were restored by restoring the hydrological regime on the Smolyanka system, and the environmental protection status of the surrounding well-maintained peatlands (16,000 ha) was strengthened. As a result, groundwater levels rose by an average of 1.5 m, the risk of devastating peatland fires decreased, which contributes to the continued restoration of adjacent pastures and hayfields, and plants and animals have returned to the area. In addition, the Nizhinsky Regional Landscape Park was registered (6,100 ha), protecting over 40 endangered species. It is expected that over the 20-year period, 224,000 tons of CO2-equivalent emissions will be prevented. Overall, more than 4,500 people benefited from the project, and two cooperatives were formed (for the collection and processing of milk and for solid fuel briquette production). Numerous conservation and monitoring projects, as well as agriculture, animal husbandry, industry, tourism, commercial enterprises, are running in the region and over 4,500 individuals have improved livelihoods as a direct economic benefit.

Coastal Zones

Led by the MEPNR, Ukraine plans to carry out the following adaptation actions in the coastal areas by 2024:

- CRVA for coastal areas.
- Develop flood forecast maps for civil and industrial objects, engineering, and transport infrastructure in the coastal territories of the Black and Azov Seas

Among the future adaptation measures under consideration are:

- Introduce legislation to reduce property and infrastructure development in environmentally sensitive areas and areas at risk of sea-level rise.
- Research and monitor sea-level rise.
- Collaborate with the insurance market to guide investment in coastal areas.
- Develop an early warning system.

[56] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

- Rehabilitate wetlands and estuaries.
- Install sea walls barriers and barrages.
- Protect the coastline beaches against erosion, include with the prioritization of ecologically or biologically significant marine areas, including islands, wetlands, and riverine basins.
- Strengthen coastal beach erosion management systems.

For marine fisheries and aquaculture, among the future adaptation measures under consideration are:

- Effective environmental monitoring systems, including environmental and sanitary surveillance and warning systems along the coastline.
- Partnerships to facilitate the generation of knowledge (basic and applied) through the alliance of research institutions, public regulators, and ocean and marine industries.
- Identify and proclaim marine protected areas to conserve biologically sensitive sites.

In terms of mitigation co-benefits and the Blue Economy, Ukraine is also considering the following future adaptation activities.

- Ensure that exploration and mining within the marine protected areas comply with the environmental and economic regulatory framework.
- Enact a legal framework benchmarked against global environmental best practices to facilitate sound marine exploration and environmentally sustainable mining activities.
- Promote innovations in food processing, food loss reduction and waste reduction.
- Scale up climate-smart technologies to increase the crop, livestock, and fisheries' productivity.
- Adopt a conservation agriculture approach as the basis for sustainable coastal farming and improved food security.
- Use irrigation water-saving technologies and organic soil nutrient sources.

Public Health

Led by the Ministry of Health (MOH) and the MEPNR, Ukraine plans to carry out the following adaptation actions in the public health sector by 2024:

- CRVA for the population.
- Climate adaptation plan for population.
- Create specialized educational programs and courses on climate mitigation and climate adaptation for teachers, students, representatives of central and local bodies of power and local self-government.

The following future adaptation actions in the public health sector are being considered:

- Strengthen the capacity of health professionals in epidemic preparedness and response.
- Improve access to timely and relevant information.
- Enhance and further mainstream climate-related awareness.
- Strengthen the policies required to effectively address both slow-onset and catastrophic events.
- Develop health-centered adaptation strategies.
- Climate-proof the public health system.
- Strengthen and provide capacity-building for the water and sanitation systems.

Transport and Infrastructure

Led by the Ministry of Infrastructure (MoIFS) and the MEPNR, Ukraine plans to carry out the following adaptation actions in the transport and infrastructure sector by 2024:

- CRVA for infrastructure and the transport sector.
- Climate responsive second action plan for the National Transport Strategy of Ukraine until 2030.

Among the known adaptation gaps insufficient capacity of the stormwater and sewage systems and tunnels to manage large rainfall volumes, and a significant number of buildings and structures that need to be adapted to a changing climate to reduce the risk of dispersion of harmful substances and pollutants due to more intensive evaporation of chemical substances caused by higher temperatures and faster structural deterioration.[57]

Cities and Territorial Communities

Led by the Council of Ministers of the Autonomous Republic of Crimea Oblast, the Kyiv, and Sevastopol City State Administrations local self-government bodies, the MEPNR, the MRD, the National Institute for Strategic Studies, and the State Migration Service, Ukraine plans to carry out the following adaptation actions in the human settlements sector by 2024:

- CRVAs for the human settlements sector.
- Update state building regulations to include climate change.
- Develop methodological recommendations on the inclusion of climate adaptation in the social and economic development programs for the administrative-territorial units, local self-government bodies, regional development strategies and implementation action plans.
- Develop regional and local climate adaptation strategies/plans or include climate adaptation in the strategies of regions and territorial communities, including associated implementation action plans, and social and economic development programs (see Box 3).
- Implement pilot projects for the development and implementation of local plans for adaptation to climate change at the level of regions, as well as cities, towns and villages.
- Analyze the relationship between migration, climate change and the environment.

In addition to an insufficient urban canopy, and high pollution levels, additional adaptation gaps for cities and territorial communities include insufficient capacity of the urban stormwater management and sewage systems to manage large rainfall volumes.[58]

Box 2: *Strengthening the Capacity of Regional and Local Administrations for Adaptation Planning*

The EU-funded APENA 3 Project, provides long-term support in raising Ukrainian public authorities' capacities at local and regional level in designing and implementing key reforms stemming from the Association Agreement and Deep and Comprehensive Free Trade Area (DCFTA). Under its climate adaptation envelope, the APENA 3 project is providing capacity building, training and technical assistance in preparing and implementing regional climate adaptation strategies in three regions: Lviv, Mykolaiv, and Ivano-Frankivsk.

Two regions, Mykolayiv and Ivano-Frankivsk, have already completed climate risk and

[57] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

[58] Government of Ukraine. 2021. Environmental Safety and Climate Change Adaptation Strategy 2030

vulnerability assessments (based on pre-war data). The modelling was based on two Representative Concentration Pathways and covered potential impact of five categories of 32 in total climatic impact-drivers (e.g., heat and cold, wet and dry, snow and ice, wind speed and coastal) on several sectors and activity areas (e.g., agriculture, forestry, water resources, biodiversity, critical infrastructure, buildings, cultural heritage, tourism).

The work on the Climate Change Adaptation Strategy for Mykolayiv region is complete, while the strategies for Lviv and Ivano-Frankivsk regions are under development. The importance of addressing the climate change challenges and opportunities at the planning phase for regional development, including for post-war recovery has been emphasized.

Addition capacity building and training for local-level climate adaptation planning is occurring under the EU-funded EU4Climate and Covenant of Mayors – East projects, which have conducted a series of workshops on local-level climate adaptation planning. As part of this training, 302 representatives of municipalities from over 100 Ukrainian cities and towns were given insights and guidelines on how to analyze the impact of climate factors, and classify them, as well as how to elaborate municipal climate adaptation plans based on available sources of information.

In-person training was attended by representatives from seven Ukrainian cities – Kyiv, Vinnytsia, Khmelnytskyi, Ivano-Frankivsk, Lutsk, Zaporizhzhia (which is located near the front line), and Bucha (which was under temporary Russian military occupation in 2022). With the assistance of leading experts from the EU4Climate, Covenant of Mayors – East and APENA3 projects, workshop participants identified priority climate adaptation measures and integrated these measures into the Sustainable Energy and Climate Action Plans (SECAP) of each participating city.

Energy

Led by the Ministry of Energy (MoE) and the MEPNR, Ukraine plans to carry out the following adaptation actions in the energy sector by 2024:

- CRVA for the energy sector.

Tourism

Led by the State Agency for Tourism Development, the MoIFS, the MEPNR, and the National Academy of Sciences, Ukraine plans to carry out the following adaptation actions in the tourism sector by 2024:

- CRVA for the tourism industry.

The following future adaptation actions in the tourism sector are being considered:

- Promote sustainable tourism, including eco-tourism and agro-tourism, and provide capacity-building for climate change awareness and innovation in Ukraine's tourism sector.
- Implement community-based natural resource conservancies, tourism, and adaptation programs.
- Promote a Sustainable Blue Economy in the coastal areas.

Disaster Risk Management

While disaster risk management (DRM) is not considered an independent sector, DRM activities are mainstreamed in all priority sectors. As a result, Ukraine plans to carry out the following adaptation actions as part of resilience-building:

- Strengthen capacities for disaster risk preparedness and management, contingency planning, and risk reduction.
- Improve information flow and communications between formal structures at the national, regional and community levels.

- Improve the monitoring and documentation of extreme events.

3.3. BARRIERS, CHALLENGES AND GAPS IN THE IMPLEMENTATION OF ADAPTATION ACTIONS

Some of the recurrent gaps Ukraine is facing in the implementation of adaptation actions include lack of credible data and in-depth vulnerability studies, limited access to the latest technologies, limited coverage of systematic observations in the country, relatively low awareness of a large segment of the population and technical personnel, and, last but not least, insufficient funds to correct the gaps and barriers while enabling the country to embark on ambitious adaptation in sectors that are already strained by climate change.

Some of the key barriers are:

- Lack of access to credible and evidence-based information.
- Limited institutional capacity across all administrative levels.
- Reactive approach versus long-term planning; and
- An insufficient evidence-base for the benefits of adaptation versus its costs.

4. MEANS OF ADAPTATION IMPLEMENTATION AND SUPPORT NEEDS

Box 3: *Critical Needs*

- *Financial and technical assistance to help the MEPNR implement the NAS 2030 and to address additional adaptation planning.*
- *Technical assistance, capacity building and skills development for climate adaptation, including climate risk and vulnerability assessments, development of adaptation strategies in all sectors, and development of climate change project proposals.*
- *Studies to assess the country's climate adaptation financial needs.*
- *Private-sector resource mobilization to implement the NDC (mitigation and adaptation) and related actions to achieve the SDGs.*
- *Monitoring, evaluation and reporting of the processes and impacts of adaptation actions to track the implementation of adaptation activities and the achievement of goals.*

4.1. ADAPTATION IMPLEMENTATION AND SUPPORT NEEDS

There is no doubt that in the past several years Ukraine has made great strides in its adaptation planning efforts. However, it is also a fact that despite progress made, a lot more needs to be done to ensure climate-resilient sustainable development across sectors, contexts and at multiple levels.

Ukraine faces many institutional, capacity and financing constraints in addressing climate adaptation challenges. It needs support to implement those adaptation measures found in its NDC 2021 and those that have been, and are expected to be developed, as part of the implementation of NAS 2030, which obliges the government to build the adaptive capacity and climate resilience of vulnerable populations and communities. In addition, though the country remains committed to the adaptation cause, it is also important that current gains in adaptation planning are consolidated and leveraged, especially as part of post-war recovery, through innovative approaches for maximum benefits.

This will require more deliberate efforts; it will also require creative partnerships that bring people, communities, and institutions together from diverse backgrounds and sectors to work together to share information, deepen knowledge and to acquire new skills and insights. Indeed, adaptation planning needs to be approached not just to address climate impact problems, but also as an avenue to uncover, understand and appreciate opportunities associated with such problems and to acquire the requisite insights and skills to leverage such opportunities to the benefit of individuals, communities, institutions, and others. There is also a need for the development of new mindsets towards adaptation planning; it should also be about how people living in their communities can learn to turn problems into opportunities.

Oversight and Management Support

Ukraine has institutional management, coordination, and reporting arrangements in place. MEPNR will oversee and track the implementation of climate change issues. Ukraine is currently developing a robust transparency reporting system on its NDC, which will also act as the monitoring and evaluation (M&E) instrument for both climate adaptation and climate mitigation. This will enable the country to monitor the effectiveness of its adaptation actions, including access to the means of implementation, particularly climate finance.

Overall, the following actions are needed to strengthen capacities to manage the adaptation process and carry out M&E of adaptation actions:

- Establish a robust national monitoring, evaluation, and reporting system to track adaptation actions together with SDGs actions.
- Strengthen the technical and coordination capacity of national ministries to align development and budget planning with adaptation strategies and projects (in terms of appropriate tools for screening and analysis).

Support for Cross-cutting Issues

Priority areas for the government include enhancing education and awareness of technical experts and decision-makers, increasing human and institutional capacity for climate adaptation, climate mitigation and early warning; and to effectively integrate climate change into existing policy, institutional and development frameworks in recognition of its cross-cutting nature. This requires:

- Building the capacities of national staff to undertake costs/benefit analysis, and gender responsive CRVAs to inform future national and sectoral adaptation planning and targets.
- Enhancing the capacity of national advisers to provide guidance to sectors to formulate climate change indicators, mainstream climate actions, and identify and use related tools for data collection, data management, data storage, data retrieval and reporting.
- Strengthening the national evidence base on the costs and benefits of climate adaptation.
- Further, Ukraine currently lacks in-depth vulnerability studies for the various regions in the country. As such, the country needs additional research capacity:
    - Discipline-specific, interdisciplinary, and transdisciplinary research to inform biophysical and social vulnerability assessments for each region (oblast) in Ukraine.
    - Impact assessment and follow-up after donor-funded projects are completed, such as through committing and funding of one or two post-graduate research studies.
    - Conducting gender-sensitive research, including the collection, analysis and reporting of gender-related data, to better understand the health implications of climate change and climate policies.
    - Integrating gender analysis into CRVAs to establish the different ways in which disasters affect men and women.

Pre-Russian Invasion Estimate of Adaptation Costs

In almost all middle-income countries, climate finance comes out of aid budgets. In Ukraine, international partners, institutions and donors are already financing many adaptation projects, for example, in transport and municipal infrastructure projects. Even before the war, decarbonization was increasingly understood to be an imperative for Ukraine.

Loss and damage (L&D) from climate impacts increased in the 2016–2020 period and exceeded 1.3 billion USD (47.5 billion hryvnias). This includes L&D from flooding of more than 100 million USD (3.7 billion UAH), decreased agricultural yields by 718,000 ha with L&D of 640 million USD (23.4 billion UAH) and loss of 17,563 ha of forest areas with L&D of more than 500 million USD (18.8 billion UAH).[59]

Prior to the Russian invasion of Ukraine, a preliminary estimation of adaptation costs and needs in some of the priority sectors was done. The data indicates that during the 2016–2018 period, adaptation-

[59] Government of Ukraine. Information guide regarding damages caused to the state as a result of adverse hydrometeorological conditions during 2016-2020 with regard to hydrometeorological disasters associated with atmospheric precipitation

oriented investments accounted for less than 0.25% of the regional budget in each region (oblast).[60] During this period, close to 109.5 million USD were spent on environmental protection measures that are considered adaptive in 19 of the country's 24 regions (oblasts). Among these, 70.5% of these adaptation-oriented investments (equivalent to 77 million USD) occurred in six regions (Dnipropetrovsk, Zaporizhzhia, Lviv, and Donetsk). Most of these expenses were dedicated to updating sewerage systems (42%), followed by the cleaning of riverbeds 16%, and the updating water protection structures 14%.

In addition, in parallel to the NAS development process a preliminary and indicative assessment of adaptation needs in four priority sectors was conducted.[61] This information is summarized in Table 1 and reflects pre-war estimates. Table 1 indicates that preliminary key adaptation needs in just four sectors (agriculture, water, energy and urban) will require an investment of more than 2,747 billion USD by 2030.

Table 1: Estimation of adaptation costs in four key sectors (in million USD)

Sector	Adaptation measures	Costs	
		By 2030	By 2050
Agriculture	Update of irrigation systems	5	
	Update of operational drainage systems	694	
	Updating non-working drainage systems	2.5	
	Climate smart agriculture	2.4	3.4
	Update of rural roads	30.5	68
Water	Strengthening the coastline of the Black and Azov Seas (construction of protective infrastructure)	170,000 – 250,000	
Energy	Update of the gas transport system	219,000	
	Update of transmission system and trunk lines	2,358,000	
Urban	Urban canopy and greening of cities	19.8	

Source: Trypolska (2020)[62]

Further, a recent review estimated that about 20% of the total climate investment needs identified in the National Development Plan (NDP) 2021–2030 are not funded (Figure 6).[63] Given the ongoing war conditions, there is a high probability that the NDC investment goals will not be met.

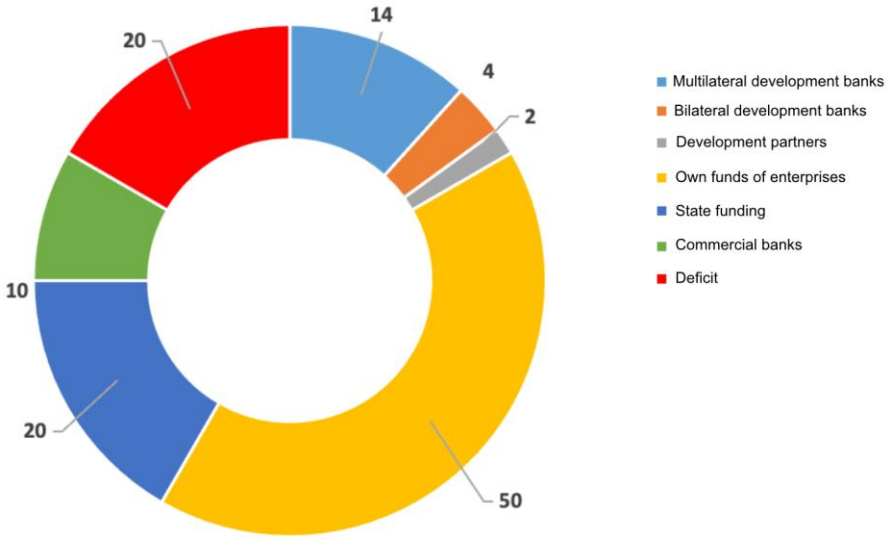
[60] Trypolska, G. Assessment of costs on the adaptation to climate change in Ukraine, in Ekon. prognozuvannâ 2020; 4:60-71. Available at: https://doi.org/10.15407/eip2020.04.060

[61] Trypolska, G. Assessment of costs on the adaptation to climate change in Ukraine, in Ekon. prognozuvannâ 2020; 4:60-71. Available at: https://doi.org/10.15407/eip2020.04.060

[62] Trypolska, G. Assessment of costs on the adaptation to climate change in Ukraine, in Ekon. prognozuvannâ 2020; 4:60-71. Available at: https://doi.org/10.15407/eip2020.04.060

[63] Maslichenko, S. 2022. Financial strategy of the Ukrainian National Bank of Ukraine. Developed as part of EU4Climate project

Figure 6: Climate financing of the NDC and its deficit for 2021-2030, by finance source (%, in USD billion)



Note: The deficit of climate financing is calculated based on the available statistical information on the amount of financing by donors, multilateral and bilateral development banks, the state budget, own capital expenditures of enterprises, as well as existing investment plans of national and external donors

Source: Maslichenko (2022)

Due to Russia's invasion of Ukraine, projected climate finance needs will now compete with much-needed rebuilding considerations, making the identification of the "additionality" of climate finance investments extremely difficult due to the scope of the national rebuilding of systems and individual infrastructure that is needed. The continuing hostilities (as of September 2023) are also affecting the projected costs of both rebuilding and adaptation. At the same time, the projected level of rebuilding also presents an opportunity to rebuild systems and infrastructure in a more climate resilient manner in several sectors.

Ukraine's Post-War Recovery Plan

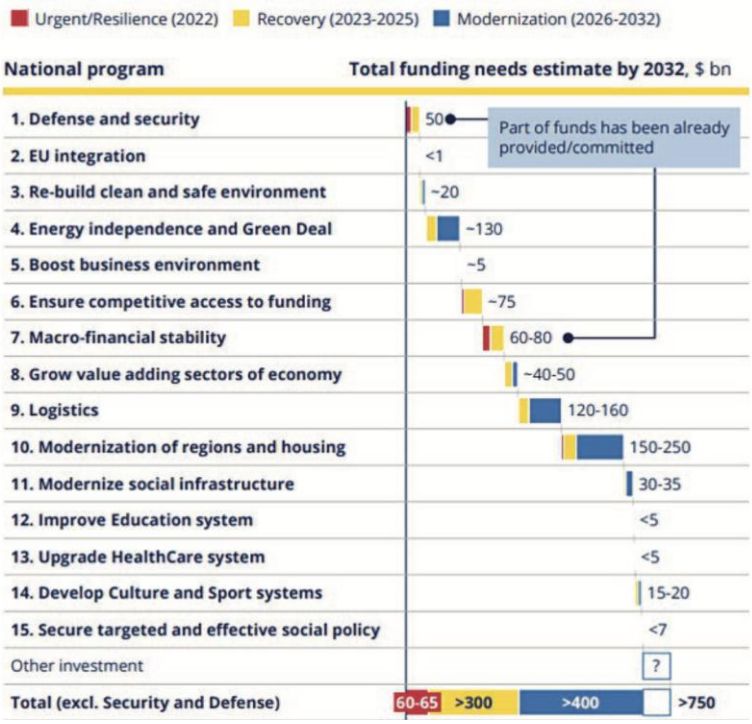
On July 4, 2022, the Ukraine Recovery Conference (URC) held its fifth conference in Lugano, Switzerland, and adopted the Lugano Declaration and the Lugano Principles.[64] The meeting was attended by various governmental representatives, advocacy groups, academic institutions, representatives from the private sector, and international organizations, which later endorsed the Lugano Declaration. The URC was structured under five recovery pillars: smart recovery architecture, infrastructure recovery, social recovery, environmental recovery, and energy security.

At the 2022 conference, Ukraine presented a 10-year USD 750 billion Recovery Plan (Figure 7). Under the Ukraine recovery vision, USD 150–250 billion is envisaged for restoration and modernization of housing and infrastructure in a three-stage recovery plan: Stage 1 is a recovery plan blueprint; Stage 2 is a recovery plan drill-down and roadmap; and Stage 3 is implementation. The Recovery Plan has set targets for 2032: to accelerate sustainable economic growth (with a plan for 7% annual GDP growth and an increase in investments); to reach the top-25 economies in the Economic Complexity Index and the

[64] URC. 2022. Lugano Declaration. The Lugano Declaration's principles include partnership, reform focus, transparency, accountability, and rule of law; democratic participation; multistakeholder engagement; gender equality and inclusion; and sustainability. Available at: https://uploads-ssl.webflow.com/621f88db25fbf24758792dd8/62c68e41bd53305e8d214994_URC2022%20Lugano%20Declaration.pdf

World Bank Human Capital Index; and to achieve a 65% reduction in CO_2 emissions from 1990. The Recovery Plan will be implemented in a region-focused and parameter-based approach.

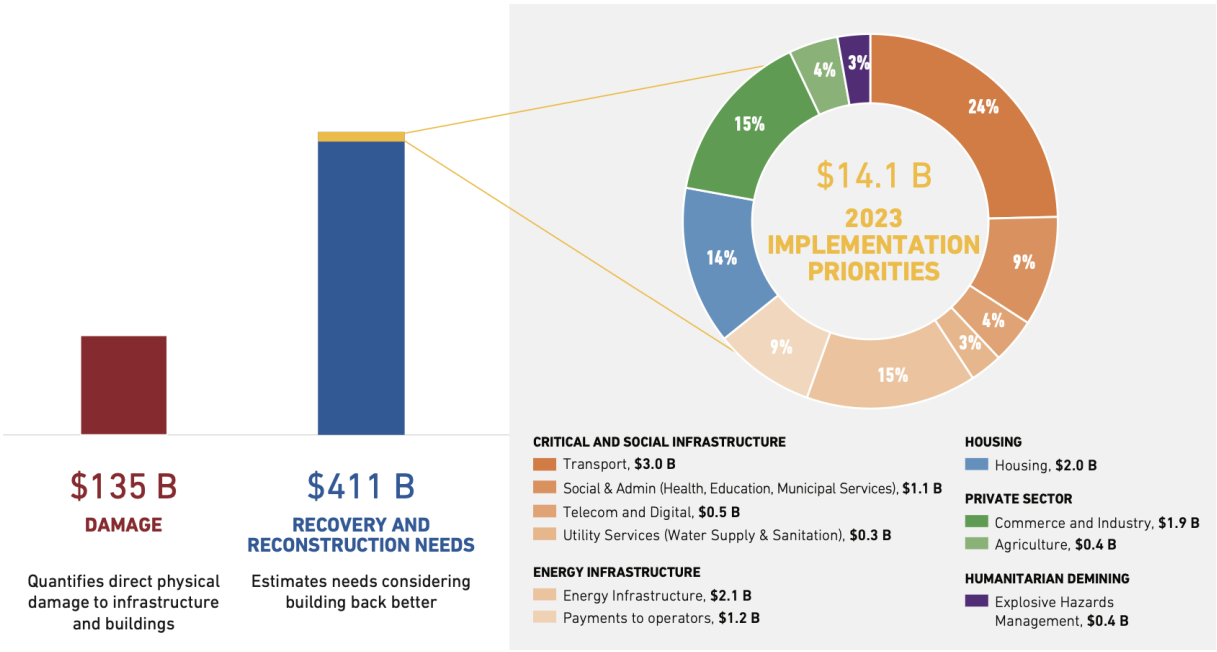
Figure 7: Ukraine Recovery Plan 2022



Source: URC2022, Recovery Plan (2022)

Due to the continuation of the war as of February 24, 2023, reconstruction, and recovery needs are estimated at about USD 411 billion (Figure 8). Integrated into these needs are critical steps toward becoming a modern, low-carbon, disaster- and climate-resilient country that is aligned with EU policies and standards in view of being ready to join the EU, and where the population's vulnerabilities are addressed, and people live in prosperity.

Figure 8: Needed investments in government-prioritized sectors for reconstruction (in USD billions)

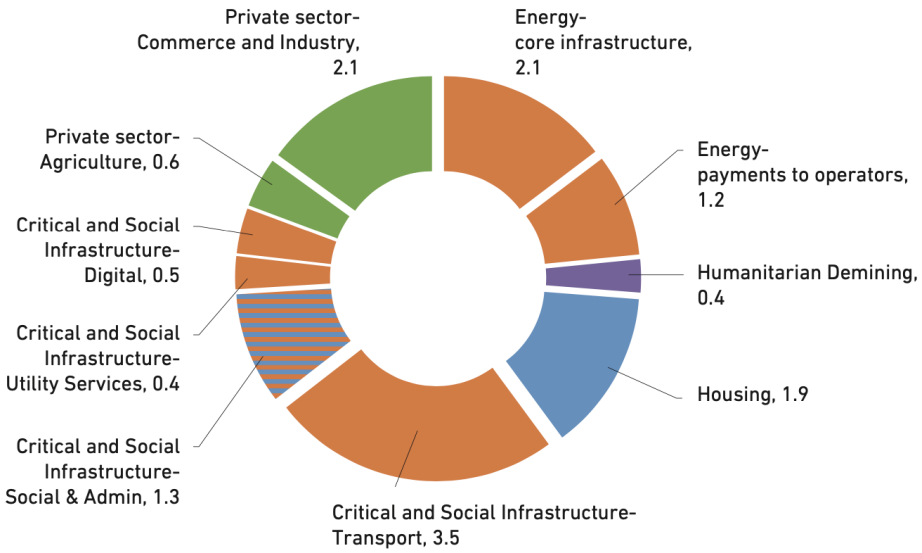


Source: World Bank (2023)

The implementation priorities for 2023 are estimated at around USD 14 billion (Figure 9). These are focused on the most urgent needs, including restoration of energy, housing, critical and social infrastructure, basic services for the most vulnerable, explosive hazard management, and private sector development. Around USD 9 billion in direct government expenditure will lay the groundwork for a safe, prioritized, achievable, and efficient reconstruction and recovery. This will be complemented by investments by state-owned enterprises and support to sustain and catalyze the private sector, including de-risking investment and trade. While the government has already taken steps to meet some of these needs. An additional USD 11 billion in financing, including around USD 6 billion in further funding of the government budget and close to USD 5 billion to facilitate critical investments by state-owned enterprises and the private sector are also needed.[65]

[65] Government of Ukraine, World Bank, European Union, and United Nations. March 2023. Ukraine Rapid Damage and Needs Assessment

Figure 9: Priority reconstruction investments for 2023 (in USD billions)



Source: World Bank (2023)

Climate adaptation as a specific and discrete issue is not mentioned in the reconstruction plans, though low carbon development is.

Investment and Technological Support

International support is required in the form of finance, technology transfer, technical assistance, and capacity-building. Improving access to public and private financing sources is, therefore, a high priority for Ukraine. Meeting the additional, climate specific investment and financial flows will require a combination of:

- Commitments by developed countries to provide additional financial assistance to lower-middle income countries, such as Ukraine.
- Appropriate national policies to encourage private investment and domestic government investment in climate mitigation and climate adaptation measures.
- New sources of predictable funds that provide additional external financial flows to lower-middle income countries.
- An updated Technological Needs Assessment is needed to take into consideration appropriate adaptation technologies, climate technology financing, climate resilient infrastructure and other development projects.

4.2. PLAN FOR IMPROVEMENT AND NEXT STEPS

Through the development of this AdCom, the priority areas for immediate action – in line with the NAS 2030 – are as follows:

1. **Establishment and mainstreaming of a robust national monitoring, evaluation, and reporting system** to track adaptation actions together with SDGs actions. It is important that adaptation action networks are created among and between sectors for the documentation and easy reporting of new adaptation actions. Such an approach will aim at making adaptation reporting an on-going process supported by active sources of data and new information.
2. **Capacity building on adaptation:** There is need for national and subnational adaptation capacity building on agenda setting, resource mobilization, research, information sharing, innovation

diffusion, education, training that builds individual, community and institutional capacity to initiate and lead adaptation actions at various levels. This should include: Strengthening the technical and coordination capacity of national ministries to align development and budget planning with adaptation strategies and projects; Strengthen the national evidence base on the costs and benefits of climate adaptation; Build capacities of national and subnational staff to undertake costs/benefit analysis, and gender responsive CRVAs to inform future national and sectoral adaptation planning and targets; Enhance capacity of national and subnational staff to provide guidance to sectors to formulate climate change indicators, mainstream climate actions, and identify and use related tools for data collection, data management, data storage, data retrieval and reporting; and Deepen interdisciplinary, and transdisciplinary research capacity to inform biophysical and social vulnerability, as well as impact assessments for each region (oblast).

3. **Climate financing skills and competencies:** There is need for continuous awareness creation, education, and training to build capacity at national and subnational levels to facilitate access to climate financing to support both national and subnational projects and programs.
4. **Conscious and more targeted risk and vulnerability assessments processes** in the different ecological zones and various regions, at multiple scales, will provide deeper insights into the nature of risks and more importantly, enhance appreciation of differences in risks, vulnerabilities, and opportunities in different the different zones and places.
5. **Utilize local government structures and the national decentralization policy:** Effective adaptation planning can only happen when local governance and decentralization structures are use. Current efforts are not enough, especially when local government capacities are relatively low in terms of climate adaptation.
6. **Improve access to place-based climate services:** Both climate impacts and adaptation actions are place-based, requiring sufficient knowledge, and understanding of local level climate data. Such a function is critical to support adaptation actions. However, access to climate information, particularly at the local level, remains a challenge and one which impedes proactive adaptation decision-making. Improved direct access will connect local people and the places where climate impacts happen to the needed information, with wider access and in-depth analysis available to local researchers, technical experts, policy- and decision-makers.
7. **Ensuring, new sources of predictable funds** that provide additional external climate finance flows, for activities during the current hostilities, and for those beyond the direct recovery funds being discussed to enhance the “additionality” aspect of a climate sensitive recovery.