



UKRAINE

A SUSTAINABLE ECONOMIC RECOVERY FOR PEOPLE AND NATURE



THIS REPORT HAS BEEN WRITTEN AND PRODUCED BY WWF CENTRAL & EASTERN EUROPE AND WWF-UKRAINE TOGETHER WITH THE BOSTON CONSULTING GROUP (BCG) WITHIN THE FRAMEWORK OF THE WWF-BCG GLOBAL PARTNERSHIP.

About WWF and WWF-CEE

WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

As a member of the WWF global network, WWF-CEE exists to promote WWF's mission across seven countries of Central and Eastern Europe and the Danube and Carpathian ecoregions. Member organisations include WWF-Ukraine as well as WWF-Bulgaria, WWF-Hungary, WWF-Romania, and WWF-Slovakia.

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About WWF and BCG

Since WWF and BCG started their global partnership in 2012, we have together embarked on numerous projects—globally, regionally and locally—in support of WWF's mission to stop the degradation of our planet's natural environment and build a future in which humans live in harmony with nature.

More information on: <https://wwf.panda.org/act/partner-with-wwf/corporate-partnerships/who-we-work-with/boston-consulting-group/>

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FOREWORD

On 24 February 2022, I was awoken by sirens in Kyiv. They sent me to the nearest bomb shelter and effectively cancelled my appointment at the Ministry of Agriculture to sign with the Minister a memorandum of understanding for cooperation on climate change adaptation. My dream to make the Ukrainian agriculture sector climate- and nature-positive is postponed to an undetermined date in the future.

I spent the next days like many other Ukrainians in bomb shelters before moving to greater safety in my hometown in western Ukraine. This terrible war has already caused immense suffering and loss, not only for people but also for nature. Nature is my passion, but it also is the very basis for our economy, our welfare and well-being – indeed, our future.

At WWF, we are certain that coming out of this awful war we need to work together for a sustainable future for Ukraine, not reconstruct an unsustainable past. We need to address the immediate needs of people, including security, food and shelter. But in doing so, we also need to take into account their longer-term needs, including a healthy environment on which they depend for fresh air, clean water, healthy food, and a stable climate.

We need to make our country future-proof. Even before the war, Ukraine, as the rest of the world, faced increasing environmental challenges: a shortage of freshwater, degrading soil, river and marine pollution, droughts and forest fires, among other challenges. The war in Ukraine has emphasized the depths of the environmental crisis facing us and the importance of maintaining the natural capital on which we depend.

We Ukrainians are now paying a very high price fighting for our future. But with leading international partners ready to help Ukraine with their best knowledge and resources, we have a unique opportunity to ensure that the future is not only free, but also better, more sustainable – a thriving environment for people and nature. Ukrainian civil society is ready to contribute fully to this effort.

In producing this report, WWF-Ukraine and WWF-CEE have partnered with the Boston Consulting Group to focus particularly on the economic aspects of building back better. Investment in a nature- and climate-positive recovery is investment in the future – in a sustainable and circular economy that will generate jobs and development for Ukraine for decades to come. We want this message to be heard in Ukraine and internationally by key decision makers and stakeholders in government and financial institutions, business, and civil society.

The war is still ongoing, and the challenges are complex, so this report offers our current perspectives and not definitive answers. It has been developed as a basis for discussion, planning and cooperation with decision-makers and stakeholders both inside and outside of Ukraine. We expect the analysis and ideas presented here to develop further as this dialogue unfolds.

Environmental security must be part of the security paradigm for Ukraine as it provides a basis for economic development and is the basis for our well-being and survival.

Even under the most tragic circumstances, there is hope. Every day since the war started, images and news from Ukraine reveal the extent of suffering and destruction. Yet rebuilding Ukraine will be a unique moment for the country to leapfrog its development, moving from a largely outdated economy to a modern and sustainable economy supported by a strong civil society.

The invasion of Ukraine has provoked an unprecedented movement of solidarity. At first, this movement focused on providing immediate humanitarian assistance to refugees and military assistance to the country. Now is the time to prepare for Ukraine's recovery.

With the war still ongoing, it may seem early to think about reconstruction. But the work has already started. There is no doubt that Ukraine will need support, and we cannot wait for the end of hostilities to prepare for the future. In July, Ukraine presented an initial Recovery Plan - with an impressive level of depth and detail for a country at war. International donors, development banks and private investors are already structuring their programs.

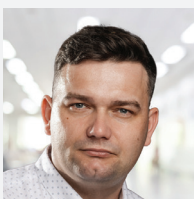
The scale of the effort is staggering. The Ukrainian government estimates that the recovery will require \$750bn over the next 10 years. This represents ~10 times the amounts committed so far by donor countries¹.

Rebuilding things as they were, at the lowest cost, may be tempting. But in this report, we show that the only way for Ukraine to reach strategic autonomy is to transition to a sustainable, resilient, low-carbon economy turned toward the EU. There is no trade-off between sustainability and economic development. Every euro invested in Ukraine must contribute to building that future.

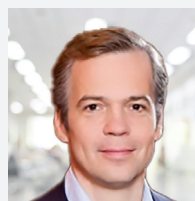
Investing money appropriately will come with massive challenges. Pre-war, Ukraine's GDP per capita was 8 times lower than the EU average. Historically, economic growth has been impeded by several factors, including outdated industrial infrastructure and poor governance. The environment is one of the most degraded in Europe due to a century of heavy industrialization and pollution. On all these aspects, the war has made things more difficult.

With WWF, our global partner since 2012, whose teams have demonstrated courage and determination to resume operations in Ukraine since the war started, we show that in each industry, climate-positive and nature-positive solutions exist. We can build the assets and infrastructure Ukraine needs for the next decades, to attract investors, be prepared for EU integration and climate change adaptation.

By laying out the challenges together with concrete recommendations, we hope that this report will contribute to this effort.



Dr. Bohdan Vykhov
CEO, WWF-Ukraine



Hubi Meinecke
Global Leader, Climate & Sustainability,
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Ukraine is one of the top global leaders in sunflower production. This bright yellow flower is often seen on the country's fields and reflects the colors of Ukraine when photographed on the blue sky.

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OUR KEY RECOMMENDATIONS

As this report goes to press, the war in Ukraine rages on — causing immense human suffering, socio-economic damage and significant harm to the natural environment. The scale of damage is enormous. All stakeholders, public and private, will have to take on the largest reconstruction plan in Europe since World War II. While circumstances are dire, if sustainability is at the core and reforms are properly implemented, this effort could be a unique chance for Ukraine. “Building back better” would generate many benefits, including enhanced security with less dependence on imports of fossil fuels; accelerated economic development based on a low-carbon industrial infrastructure and innovation; job creation; health benefits from reduced pollution; sustainable resource management based on circularity principles; nature conservation along with the ecosystem services it brings to society; better integration into the global economy; more opportunities for civil society, local communities, bottom-up innovation and entrepreneurship; as well as fulfilling Ukraine’s commitments in international legislation and accession to the European Union.

It is unclear how much time, investment and effort the reconstruction will ultimately require. At the Ukraine Recovery Conference (4-5 July 2022, Lugano), Ukraine’s leaders presented a first draft Recovery Plan. It is a tremendous effort by the administration of a country at war to assess damages, identify immediate needs and longer term investments required to recover from the war, modernize the country, and build economic, social and environmental resilience.

As of August 30th, 2022, according to the Ukraine Support Tracker, donor countries have committed €84.2bn so far, 60% of which is military or humanitarian aid². This will not be enough. Ukrainian authorities estimate more than \$750bn will have to be invested by 2032 to finance the recovery. This is nearly equivalent to the total amount of climate finance provided and mobilized by developed countries since the OECD began tracking it³.

At this scale, the green recovery plan should not simply aim to rebuild what has been destroyed, but rather focus on the future: investments must be transformative and sustainable. Starting with climate change, the plan should ensure that Ukraine can

at least deliver on, and potentially raise, its pre-war ambitions to reduce GHG emissions by 65% by 2030 vs. 1990 and reach Net Zero by 2060⁴ — all while adapting to a future with growing impacts from climate change. There is a path for Ukraine to come out of the conflict to rebuild a stronger and more resilient economy, a more equal and vibrant society, and a roadmap to adapt to a changing climate.

The natural environment is the foundation of a strong and resilient economy as well as a healthy society. In every key sector covered in this report (representing two-thirds of GDP and ~90% of exports), there are opportunities to decarbonize, reduce resource use and leverage nature-based solutions. Restoring ecosystems should be a priority for Ukraine: even before the war, its environment has been degraded by more than a century of heavy industrialization, pollution, intensive agriculture and unsustainable natural resource use.

We welcome the strong consensus among Ukraine and the international community to include sustainability as one of the key principles underpinning the Recovery Plan⁵. But the success of “building back better” depends on unprecedented mobilization of all public and private stakeholders, as well as diligent monitoring and evaluation. A transparent and inclusive governance bringing together Ukrainians and international partners will have to ensure immediate humanitarian needs are met while preparing the future. The plan and its implementation should follow strict and simple principles like the ones outlined in this report.

Critically, Ukrainian civil society must be at the center of these efforts. Restoring Ukrainian ecosystems such as forests, steppes, rivers and wetlands, improving access to affordable and safe freshwater, protecting and conserving iconic species and transitioning to a low-carbon economy fit for EU accession are essential priorities not just for the economy, but also for the welfare and cultural recovery of Ukraine and its people. With the status of EU candidate granted to Ukraine in June 2022⁶, post-war reconstruction can serve to accelerate the accession process and to align with key policies such as the European Green Deal, to which Ukraine already committed in 2020⁷.

To achieve this, today's report puts forward the following key recommendations to international and Ukrainian policy-makers, donors and businesses engaged in the recovery. Recommendations for each key industry and ecosystem are detailed in the report, and should be implemented following the

Principles for Fair, Inclusive and Transparent Implementation (see below) page 15. BCG and WWF hope that these will contribute to a better building back of Ukraine, and will continue to support all stakeholders toward a green recovery.



1

In the short-term, prioritize initiatives to restore access to basic goods and services and resume economic activity, while maintaining a “do no significant harm to the environment” commitment to ensure that temporary measures do not undermine the transition to a sustainable economy.



2

Design a recovery plan aligned with the transition to a low-carbon economy, with decarbonization trajectories for each key industry in line with the 1.5 degree goal of the Paris Agreement and a more ambitious net zero goal than the current 2060 target, including a 2030 milestone for emissions reduction.



3

Align all recovery initiatives with the 2030 Agenda for Sustainable Development, ensuring that climate and biodiversity are mainstreamed into every decision with appropriate standards and regulations.



4

Recognize the social, cultural and economic importance of Ukrainian ecosystems as foundations for the recovery by protecting 30% of Ukraine's terrestrial, freshwater and marine areas, managing freshwater and forest resources sustainably, and setting ambitious restoration targets.



5

Apply a holistic spatial and ecological approach when planning the reconstruction or replacement of building and infrastructure, ensuring that developments increase climate resilience and preserve green and blue ecological connectivity.



6

Adopt a consistent nature-positive development strategy across sectors, ensuring the lowest possible impact on the natural environment and allowing nature restoration approaches when choosing infrastructure solutions for energy, waste management and transport.



7

In each sector, deploy the best available technologies in line with EU standards and ambitions, such as low-carbon materials, circular economy, zero-emission buildings standards and low carbon mobility that reduce lifecycle costs despite higher upfront investment.



8

Support sustainable agriculture development along best-in-class international policies such as the EU Farm to Fork Strategy and eco-schemes to enhance climate resilience, reduce emissions, preserve food security and promote healthy and sustainable diets.



9

Invest in human capital, education and training to develop skills and drive local job creation, in particular through the development of tech & data capabilities, support to innovation and entrepreneurship.



10

Support Ukraine in building a climate and ecologically resilient society based on a robust environmental democracy and an exemplary model of socially inclusive public governance, in line with Principle 4 “Democratic Participation” recognized in Lugano, and the Principles for Fair, Inclusive and Transparent Implementation of the recovery plan.

SUSTAINABLE RECOVERY, AN IMPERATIVE FOR LONG-TERM DEVELOPMENT

“

**THE RECOVERY PROCESS
HAS TO REBUILD UKRAINE
IN A SUSTAINABLE MANNER
ALIGNED WITH THE 2030
AGENDA FOR SUSTAINABLE
DEVELOPMENT AND
THE PARIS AGREEMENT,
INTEGRATING SOCIAL,
ECONOMIC AND
ENVIRONMENTAL
DIMENSIONS INCLUDING
GREEN TRANSITION.”**

Outcome Document of the Ukraine
Recovery Conference URC 2022,
signed by 42 governments

‘Lugano Declaration’,
Lugano, 4–5 July, 2022²⁰

WHY SUSTAINABILITY MATTERS

The war has already caused the loss of thousands of human lives, the largest outflow of refugees in Europe since WWII (with 6.6 million people internally displaced⁸ and close to 7 million refugees across Europe⁹), massive material destruction reaching an estimated \$113.5bn¹⁰, as well as dramatic damage to the natural environment. In this context, reconstruction must address the immediate humanitarian and economic needs of Ukrainians; but in so doing, it would be disastrously shortsighted not to take into account and plan for the transition to a nature- and climate-positive future. A return to the pre-war economy and traditional energy sources in a tense geopolitical context would make the economy increasingly vulnerable to price shocks and instability, and would not prepare Ukraine to address existing and future challenges and opportunities, not least related to climate change and nature loss.

Like all countries, Ukraine is exposed to the climate crisis and the collapse of ecosystems¹¹. According to the WEF 2022 Global Risks Report¹², climate action failure, extreme weather and biodiversity loss are considered the top 3 most potentially damaging risks. The world economy is set to lose up to 18% GDP from climate change if no action is taken¹³. These global challenges are particularly relevant for a country with a large share of its economy based on agriculture (top 5 global exporter for wheat, corn, and barley¹⁴) and heavy industry (e.g. steel production alone represents around 20% of Ukraine's exports¹⁵), and with forests providing timber (50% of the timber production is exported¹⁶). The country is exposed to rising temperatures and natural risks such as floods, droughts, or dust storms¹⁷. These risks already impact agricultural output, forestry, industry, energy production and people, and are projected to increase further in the coming years^{18, 19}. Beyond environmental and economic consequences, these events would aggravate a wide array of societal risks, including youth disillusionment, health deterioration, illicit economic activity, etc. A plan for sustainable recovery is an opportunity to mitigate those risks, create a path for economic growth and facilitate EU accession.

The objective has to be to rebuild a stronger, more resilient and sustainable economy for Ukraine. The environment's current state, the need to achieve strategic autonomy from fossil fuel imports, the challenges of adapting to climate change and the prospect of EU integration create converging pressures to rebuild a modern, digital, sustainable and resilient country oriented toward the future. This would be consistent with the 2019 Presidential decree adopting UN Sustainable Development Goals for Ukraine, making the 2030 SDGs the “*guidelines for drafting of forecast and program documents, drafts of normative legal acts with the purpose of ensuring the balance of economic, social and environmental dimensions of sustainability development of Ukraine*”²¹.

PRE-WAR CONTEXT: AN ENERGY INTENSIVE ECONOMY IN A DEGRADED ENVIRONMENT

This war hit a relatively low income country with a per capita GDP that is around 8 times lower than the EU average²², and an economy still largely held back by the post-Soviet transition.



OUR ECONOMY WAS BASED ON INDUSTRIES LIKE METALLURGY, WHICH PREDOMINANTLY WAS BUILT ON TECHNOLOGIES OF THE 19TH CENTURY. WE NEED TO LEAPFROG THE ECONOMY TO NEWER SUSTAINABLE TECHNOLOGIES. THE RECOVERY PLAN IS OUR MAJOR CHANCE TO DO SOMETHING THAT WE HAVE BEEN DREAMING OF FOR THIRTY YEARS: RESTRUCTURE THE ECONOMY TO HAVE IT PRODUCE GOODS WITH MORE VALUE ADDED, USING INNOVATIVE, CLEAN AND RESOURCE-EFFICIENT TECHNOLOGIES AND PRODUCTION MODELS.”

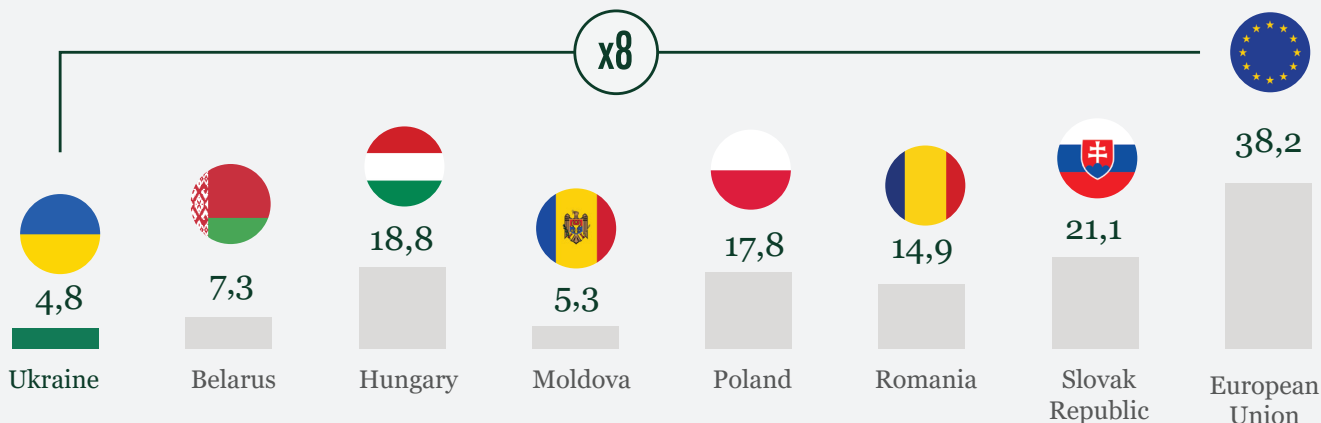
Dr Olena Maslyukivska, Associate Professor at the Department of Environmental Studies, National University of Kyiv-Mohyla Academy²⁶

Its Human Development Index (HDI) is 0.779, ranking 74th worldwide, significantly behind neighboring countries such as Romania, Albania, Belarus and Kazakhstan²³. While the country has been digitizing fast, the two primary economic sectors for exports remain manufacturing and agriculture, contributing to around 90% of the country's goods exports²⁴. These sectors are highly dependent on fossil fuels, require relatively carbon intensive energy production, and utilize conventional agricultural practices that degrade soil health, contribute to GHG emissions, and may not prove resilient in the face of climate change. The Ukrainian economy more broadly is resource-intensive, both on energy and materials. Ukraine's energy intensity is twice higher than its neighbors²⁵, showing potential for a better use of resources.

Ukraine has one of the most degraded environments in Europe, as developed in the sections below. The 2014 military conflict in Donbas further degraded the Eastern regions. Yet the environmental performance of the country has generally improved in the past 10 years: Ukraine now ranks 52nd in Yale University's Environmental Performance Index²⁷, despite challenges in public policy implementation. The country can build on these foundations for the future.

Ukraine has the lowest GDP per capita among its neighbors

GDP per capita in 2021, in \$k per year



Source: World Bank data, BCG analysis

Build Back Better

The concept of Build Back Better has been defined by the United Nations International Strategy for Disaster Reduction (UNISDR)²⁸ as *“the use of the recovery, rehabilitation and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies and the environment”*.

Preserving nature in Ukraine, the second largest European country after Russia, is essential for the continent’s ecosystems. Its land includes some of the most precious biodiversity hotspots, such as peatlands in the Rivne Nature Reserve and virgin forest in the Carpathian Biosphere Reserve, a bastion for brown bears, wolves, lynxes and critically endangered European minks. Even before the war, these areas were threatened by intensive economic development, and increasingly by climate change. According to the World Bank, *“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”*²⁹.

A MOMENT FOR PUBLIC REFORM

Recovery is hard enough with sound governance, but Ukraine also faces high levels of corruption, with a system that has been described as *“allocating resources inefficiently and in ways that do not benefit society, and increasing economic costs by reducing competition”* in large sectors of the economy³⁰.

While Ukraine has been slowly, but steadily, improving, (it is one of only 25 out of 180 countries that have improved their corruption score in a statistically significant way in the past 10 years³¹), it still ranks 122nd out of 180 countries for corruption by Transparency International³². Corruption tends to undermine efforts for recovery and environmental protection.

The Ukraine Recovery Plan, a first draft of which was presented at the Ukraine Recovery Conference in Lugano in July 2022, provides

a once-in-a-generation opportunity for public reform, inclusion and decentralization for sustainable development. For instance, good infrastructure planning requires sound Environmental Impact Assessments (EIA) in consultation with local communities and strong oversight from empowered environmental authorities. Decarbonization requires transparency on emissions monitoring, which depends on functional and skilled public authorities. The conservation of freshwater ecosystems requires multi-stakeholder approaches and trust between these stakeholders.

International donors, in particular the European Union, will have to mobilize unprecedented sums over a long period of time, at least 10 years. The political ability to sustain that effort will depend on the quality of the design and implementation in these early years. Social infrastructure - including good governance, a vibrant civil society, and transparent and participative decision-making - is crucial to ensuring that international funds are soundly invested, both for the short and the long term.



UKRAINE WILL BE IN THE LEAD. OUR ACTION WILL BE DRIVEN BY THE ASPIRATIONS AND THE DESIRES OF THE UKRAINIAN PEOPLE.”

Ursula von der Leyen, President of the European Commission³⁴

The National Recovery Plan

A two-day conference was held in Lugano from 4 to 5 July 2022 to draw the priorities and general principles for the reconstruction of Ukraine and to present an initial recovery framework, the National Recovery Plan.

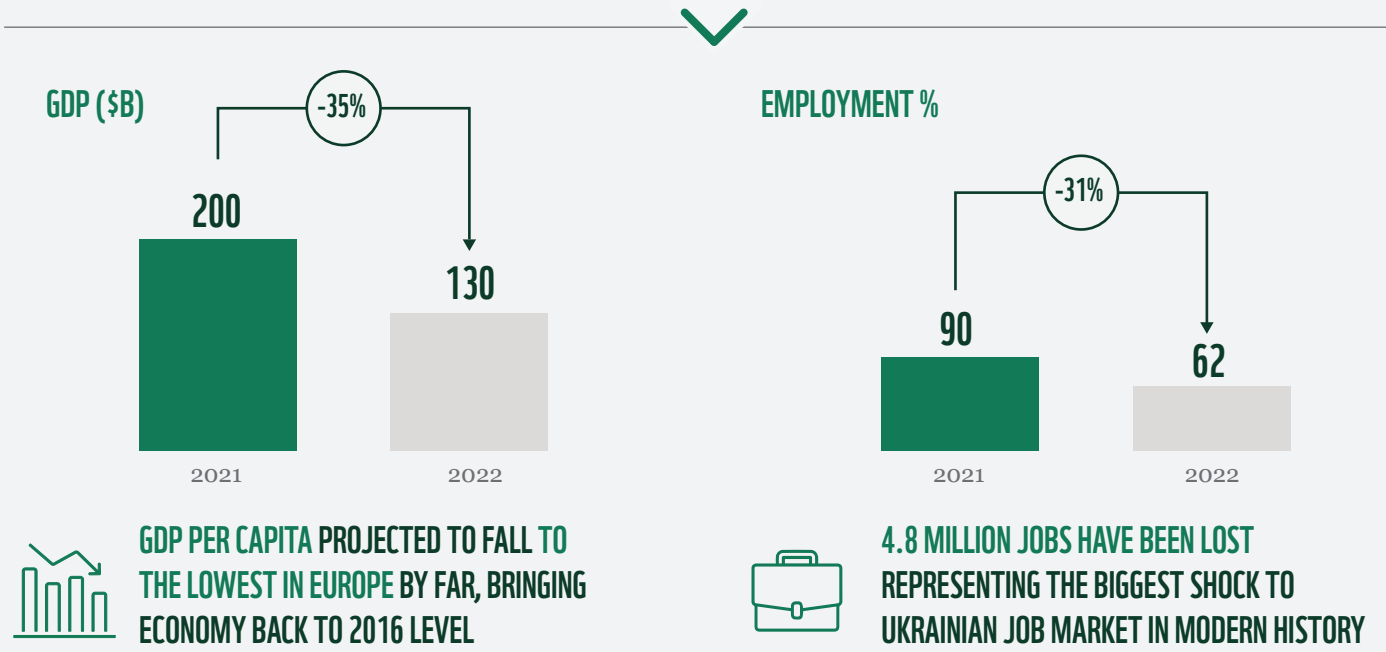
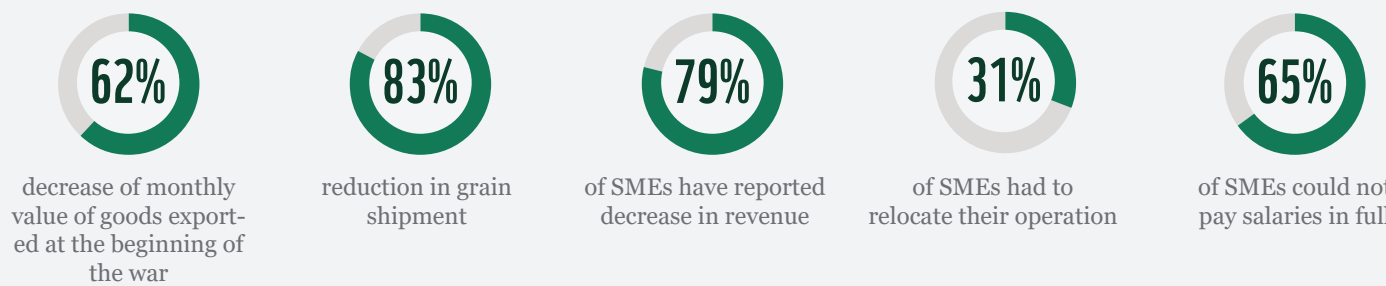
The plan has been designed under the coordination of the National Recovery Council, set up by the President of Ukraine, with 24 working groups mobilizing more than 2,500 experts, business and civil society representatives. The plan is a first version of a strategy that will be developed over the coming years, with a new version expected before the end of 2022. The document published for Lugano³³ is the main reference for this report when we refer to current plans for Ukraine.

THE IMPACT OF THE CONFLICT

The war has tremendously increased the economic and environmental challenges facing Ukraine. The country’s GDP is expected to fall by 35%³⁵ over the course of 2022; around 75% of companies have limited or suspended their operations since the

start of the war³⁶. The impact could bring the economy back to 2016 levels. Years of progress have been lost, and the Recovery Plan will have to adapt to the new reality of the country.

Years of economic progress have been lost due to war



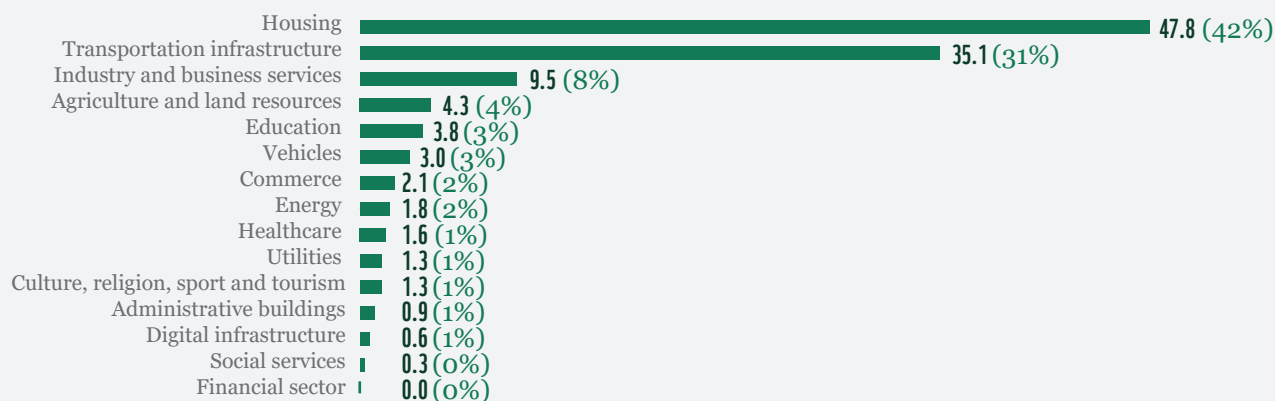
Sources: Velkovna Rada on GDP; State Statistics Service of Ukraine for Employment data (% employed aged 15 or more); International Labour Organization, Gradus Research Company & Kyiv School of economics SME report; Ukrainian State Road Agency; World-grain.com; Centre of Eastern Studies Warsaw; European Business Association, Unlimit Ukraine March 2022 survey on small businesses

The economic shock is not simply a “suspension” of economic activity from people fleeing the war and businesses suspending operations. The shock is expected to be durable, due to the extent of destruction of physical capital. As of August 22,

damages were already estimated to be more than \$110bn³⁷ (see chart below), largely in housing and transportation. At the current rate of destruction, damages could reach the equivalent of one full year of pre-war GDP by the end of 2022.

+\$110bn. of war damages, ~75% on housing and transportation

Losses of Ukraine's economy from damage of physical infrastructure since the beginning of hostilities – as of August 22, 2022 (\$bn)



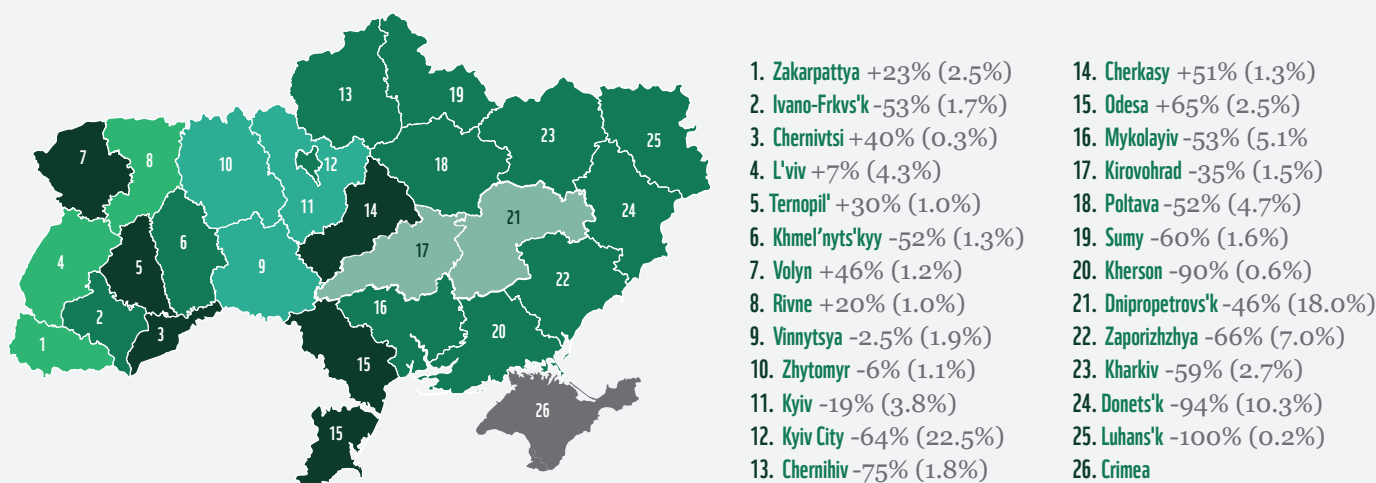
Source: Kyiv School of Economics

Reconstruction needs to take into account the territorial impact of the war. The eastern and southern parts of Ukraine that are currently occupied are the most industrialized. The fragmentation and loss of integrity of Ukrainian territory creates specific challenges. Until a long-term peace agreement is in place, there will be massive challenges for interoperability and continuity of Ukrainian infrastructure.

Another important element is the shift of the Ukrainian economy toward the west. Using exports as a proxy, the map below shows the disproportionate impact of the war on eastern parts of the country. A significant part of the Ukrainian workforce in these eastern regions may also be displaced to the west for the short- and medium-term at least. The Recovery Plan needs to take these challenges and imbalances into account.

With trade routes shifting westward, Ukraine needs to adapt

Year-on-year change in export flows of production by oblast for May 2022 (incl. % of 2021 total)



Source: Ukrainian National Service of Statistics, National Institute of Strategic Studies of Ukraine, BCG analysis

Different sectors have been hit at different levels. Construction froze and only started to resume during the summer. Many companies are at risk of bankruptcy due to limited demand and low selling prices, high costs and limited availability of materials, as well as staff shortages. Trade routes suffer from blockades, tariff increases and traffic reduction: 70% of maritime exports are blocked, rail cargo tariffs have increased by 70% as of 1 July 2022, freight tonnage has decreased by 61% year-on-year in July 2022, and road transit across the Polish border takes up to 4 days compared to ~4 hours before the war. All domestic oil refining capacity has been destroyed, renewable electricity production has decreased by 50% and nuclear capacity has decreased by 50%. 30% of agricultural land has been affected by war and grain exports decreased by 90% due to blockades. Metallurgy and mining production decreased by 75-85% due to destruction, maritime blockade and limited re-routing³⁸. Other sectors such as retail and services have been hit, but to a lesser extent.

MANAGING MULTIPLE TIME HORIZONS

A balance between the immediate needs of the Ukrainian people and building the future economy needs to be found. For that purpose, the Recovery Plan presented by the Ukrainian government is structured along three time horizons:

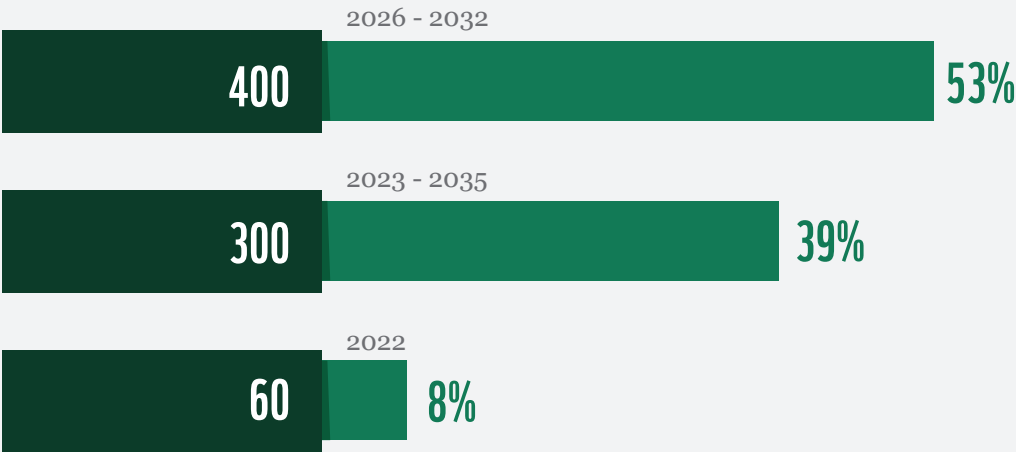
- “War time economy” (2022)
- “Post-war recovery” (2023-2025)
- “New economy” (2026-2032)

Practically, the sequencing of the recovery will obviously depend on military developments. In terms of sustainability, each time horizon has specific constraints. In the short term, the principle should be to serve the immediate humanitarian needs of Ukrainians with housing, food, health infrastructure, schools, transportation, access to water and electricity, etc. However, these short-term solutions should avoid locking in unsustainable solutions that may become stranded assets and ultimately prevent the greening of the economy. Where relevant, temporary solutions should be adopted, for instance if time does not permit quality reconstruction. Finally, short-term solutions should not cause significant harm to climate and biodiversity. For instance, fast-tracking procedures for infrastructure development should aim at cutting red tape and accelerating processes, but not skip environmental impact assessments (EIA).

In the medium- and long-term, an integrated approach needs to be adopted across industries, so that all efforts participate in the decarbonization of the economy. The 15 “National Programs” laid out in the Recovery Plan will need to be closely coordinated. For instance, the renewable energy development agenda should be consistent with the plans for green hydrogen production. Green hydrogen has the potential to decrease global GHG emissions by 5 to 6 gigatons annually, more than 10% of current emissions, through applications in various sectors such as transport, industry and chemistry³⁹. The hydrogen production agenda should thus meet the needs of domestic heavy industry, fertilizer production, transportation or exports, and take into consideration efficiency loss at conversion, storage and distribution facilities. An approach that simply sets targets and thresholds for each sector within each National Program may not be sufficient.

The recovery plan will require sustained efforts and support from the international community: >50% of funds needed after 2026

Funding needs estimate by time horizon (\$bn)



Source: Ukraine’s National Recovery Plan, National Council for the Recovery of Ukraine from the Consequences of the War

“

IN THE CONDITIONS OF POST-WAR RECOVERY, AND WITH THE RISK OF ABSENCE OF QUALITY CONTROL, THERE WILL BE A HIGH PROBABILITY OF COMPROMISING ENVIRONMENTAL STANDARDS WITH “TEMPORARY” DEVIATIONS FROM THE NORMS. AT THE MOMENT, ENVIRONMENTAL AND SOCIAL CONDITIONS ARE MINIMALLY INCLUDED IN THE CRITERIA FOR EVALUATING AND SELECTING INVESTMENT PROJECTS. WE BELIEVE THAT SUSTAINABLE DEVELOPMENT APPROACHES NEED TO BE MANDATORY FOR ALL STATE AND INTERNATIONAL INVESTMENT AND GRANT RECOVERY PROGRAMS, ESPECIALLY IN THE CONSTRUCTION, TRANSPORT AND ENERGY SECTORS.”

Oleg Zubchenko, Sustainability Expert, Graduate Business School of the Kyiv School of Economics (KSE)⁴⁰

A ROLE TO PLAY FOR ALL STAKEHOLDERS

All stakeholders need to be mobilized to achieve the sustainability ambition of the Recovery Plan. The international community rightly emphasizes that the recovery must be led by Ukrainians. The Ukrainian government will be responsible for setting priorities and delivering the plan, and should involve its population and local communities with tools such as participatory budgeting and planning. Primary donors will be public institutions: the European Commission, EU Member States, the United States, international bodies such as the World Bank and IMF, sometimes directly and sometimes through agencies and development banks, in particular the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD).

Private sector actors also have an important role to play. In the Recovery Plan, they are expected to contribute a third of the investments, i.e. \$250bn by 2032, especially after 2026 as Ukraine comes out of post-war recovery and focuses on sustainable economic development. Beyond financing, companies and entrepreneurs will have to ensure that they propose the right technologies and solutions, support implementation and monitor governance. The sustainability objectives cannot be achieved without these.

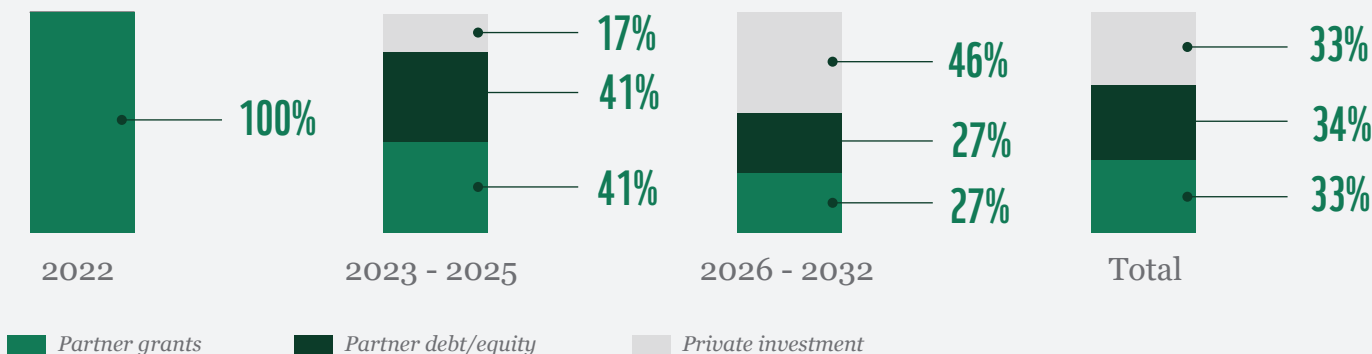
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CUSTOMER AWARENESS, CULTURE AND EDUCATION ARE CRITICAL FOR A GREENER UKRAINE. A LOT OF PEOPLE ARE FACING ECONOMIC DIFFICULTIES; SUSTAINABILITY HAS NOT ALWAYS BEEN A CORE CONCERN. BUSINESSES HAVE A ROLE TO PLAY BY INFORMING CUSTOMERS AND EDUCATING EMPLOYEES. THE RETURN OF DISPLACED PEOPLE, WITH THEIR SKILLS AND RECENT EXPOSURE TO INTERNATIONAL STANDARDS, WILL BE IMPORTANT TO REBUILD THE WORKFORCE.”

Denys Khrenov, Chamber Sustainability Committee Co-Chair, American Chamber of Commerce in Ukraine⁴¹

Private investors expected to take a leading role (46% of funding) after 2026, once short-term urgency needs are met

Potential structure of funds (%) (numbers excl. Security and Defense)



Source: Ukraine's National Recovery Plan, National Council for the Recovery of Ukraine from the Consequences of the War

Finally, civil society has an essential role to play and must get more consistent access to decision making, in line with Principle 4 “Democratic Participation” of the Lugano Principles guiding the recovery process in Ukraine. The creation of the National Council for the Reconstruction of the Country from the Consequences of War on April 21 is a first step. Ukrainian civil society is willing to participate more actively in the process. As 25 organizations including WWF wrote: “the development of documents, such as post-war recovery strategies or programs, should involve all stakeholders, including local governments and civil society organizations”⁴².

The RISE coalition gathering 20 civil society organizations is a positive initiative. It aims at “making the reconstruction a model of integrity, sustainability and efficiency, through inclusive dialogue, open data and the latest digital technology to put information about project status and the use of funds at the fingertips of anyone, anywhere”⁴³. Finally, sustainability must be science based: an independent scientific and research community is essential both to participate in decision making and review the process.

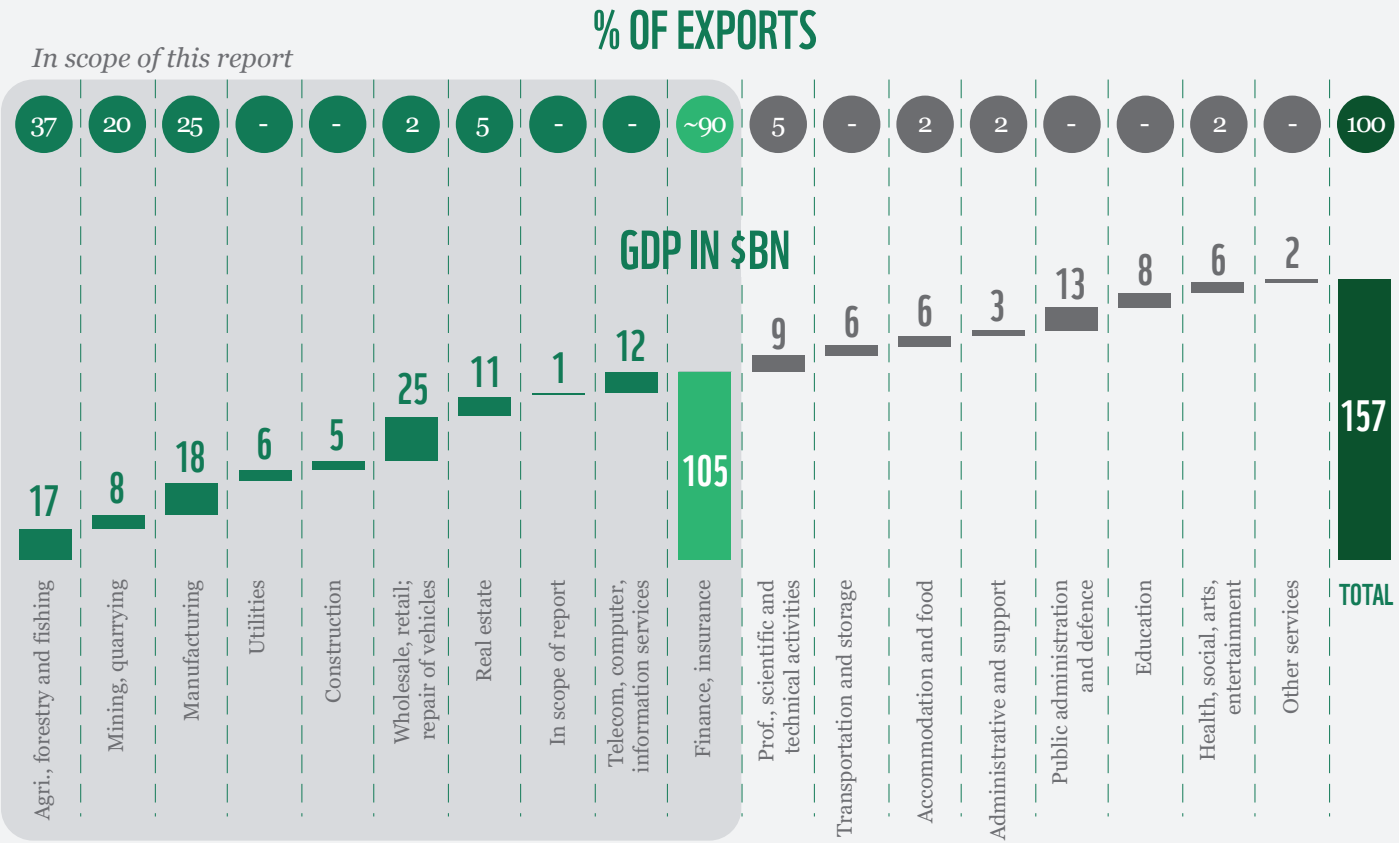
A SECTORAL APPROACH BUILDING ON JOINT BCG-WWF EXPERTISE

This report will first lay out the Principles that we think should underpin the Building Back Better program. The state of the environment in Ukraine and key challenges are then assessed to anchor recommendations in reality on the ground. The report then focuses on the industries with greatest environmental relevance. We have also included the tech & digital sector as an essential enabler for sustainable development and a differentiating asset of Ukraine. These sectors represent 67% of pre-war GDP.

The report draws from on-the-ground experience and knowledge of the WWF network and partner organizations as well as business expertise from BCG’s Climate & Sustainability team. The report also leverages extensive research and public data (see bibliography), as well as emerging literature in disaster recovery and green recovery⁴⁴.

Sectors with high environmental impact in scope of this report represent 67% of Ukrainian GDP and ~90% of exports

GDP in 2020 per sector (\$bn), Share of exports in 2021 (%)



Source: State Statistics Service of Ukraine, BCG analysis

PRINCIPLES

FOR FAIR, INCLUSIVE AND TRANSPARENT IMPLEMENTATION OF THE RECOVERY PLAN

Building off the statement of leading Ukrainian civil society organizations⁴⁵, WWF and BCG call on all those involved in the recovery and reconstruction to make green recovery the basis of the future strategy for the post-war reconstruction and economic development of Ukraine.

To achieve this, the following principles are essential to safeguard. They are based on a comprehensive review of the global and Ukraine-specific literature⁴⁶ on Build Back Better, and tailored to the current context:



1. Prioritizing green recovery for the health, safety and well-being of Ukrainians

The Recovery Plan should be designed to promote the role of nature in the social, emotional and physical recovery of affected and displaced people, building on the right to a “clean, healthy and sustainable environment” recently adopted by the United Nations General Assembly⁴⁷.



3. Mainstreaming environmental and climate policy into all decisions

Embedding sustainability in the recovery plan, underpinned by the establishment of environmental standards and regulations, marks an opportunity to uphold Article 50 of Ukraine’s Constitution⁴⁸, which states “*Everyone has the right to an environment that is safe for life and health*”



2. Enhancing the strategic autonomy and resilience of Ukraine through the energy transition

Transition to a sustainable, resilient and low-carbon economy can lead Ukraine to greater strategic autonomy. A greener Ukrainian economy can reduce its external dependencies, including on imports of fossil fuel, and therefore make the country strategically stronger.



4. Investing in sustainable infrastructure and best available technologies, including nature-based solutions, with a long-term view

The rehabilitation of infrastructure and business for a sustainable recovery of Ukraine can be supported by developing the most advanced tech and data capabilities available, by investing in the green growth of industry and by prioritizing environmental recovery and nature conservation in partnership with the right business partners.



5. Ensuring transparency, inclusion, participatory decision-making and accountability principles are applied in post war reconstruction efforts

The reconstruction process is an opportunity for public and business reform⁴⁹. Setting up clear public disclosure, accountability and monitoring mechanisms with uniform reporting standards for efficient aid utilization can further strengthen the rule of law. It is also an opportunity for decentralization and enhanced geographic and social equity, preferencing decision-making and implementation closest to affected populations (including those displaced or returning from abroad), and prioritizing vulnerable groups, women and youth in programming and consultation.



6. Promoting effective coordination of local and international stakeholders, with local governments and communities at the heart of decision-making

The reconstruction process should be led and driven by Ukraine in collaboration with its international partners. Donor funds and aid programs will be most effective when

aligned and consistent with Ukraine's long term objectives. Promoting close coordination of stakeholders at all levels and empowering local governments and communities to take a lead is essential to achieve a green recovery as they have the closest knowledge of their local environment.



7. Cultivating sustainability values, skills and practices in the Ukrainian population to deliver on the country's long-term sustainability ambition

The Recovery Plan should make young people's education and the Right to Higher Education (RTHE)⁵⁰ - with sustainability-linked skills development at its core - a key priority. Expanding training and education on sustainability skills to entrepreneurs and society more broadly will strengthen the country's human capital and support entrepreneurship to flourish from the start of the recovery efforts. It will also drive progress toward the United Nations Sustainable Development Goal 4 on the right to inclusive and equitable quality education, which calls for "*all learners [to] acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality [...]*"⁵¹.



Rye for silage in the Volyn region, North West of Ukraine. June 2022.

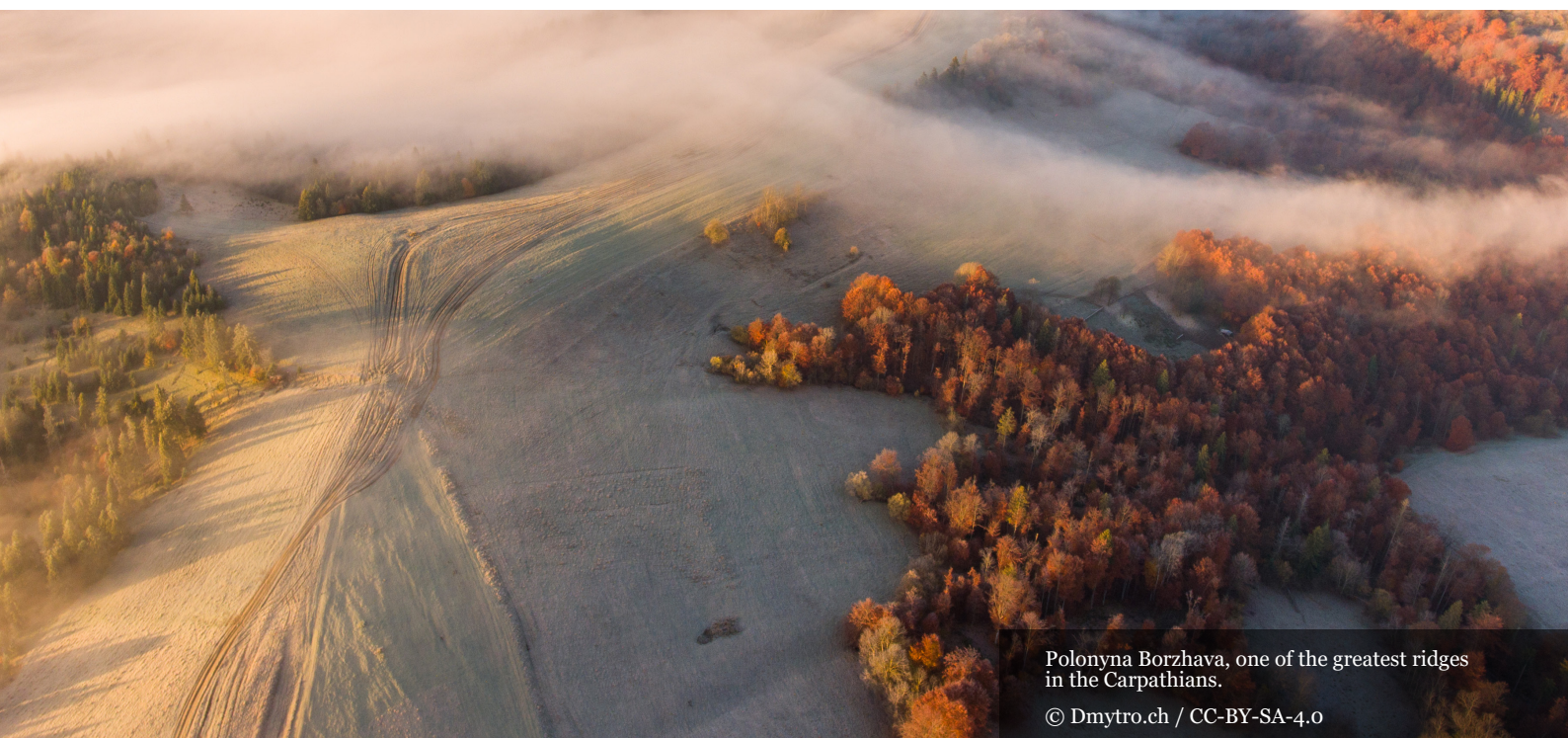
© Nikita Gubar

STATE OF THE ENVIRONMENT AND CHALLENGES

To make the post-war Ukrainian economy sustainable, the recovery must be based on a balanced understanding of the current state of the environment and the challenges to address. There are structural aspects to be considered, such as a heavy industry infrastructure, a low energy efficiency, a high share of arable land (57% of the total land area⁵²) and the commercialization of forestry for timber production. A relatively weak system of environmental policy and law enforcement aggravates these issues, resulting in poor control and management of domestic and industrial waste as well as “paper parks” in which declared nature conservation areas are not properly managed.

Nature is not only important in itself, but also as the foundation of the economy. Ecosystem services, i.e. “the benefits people

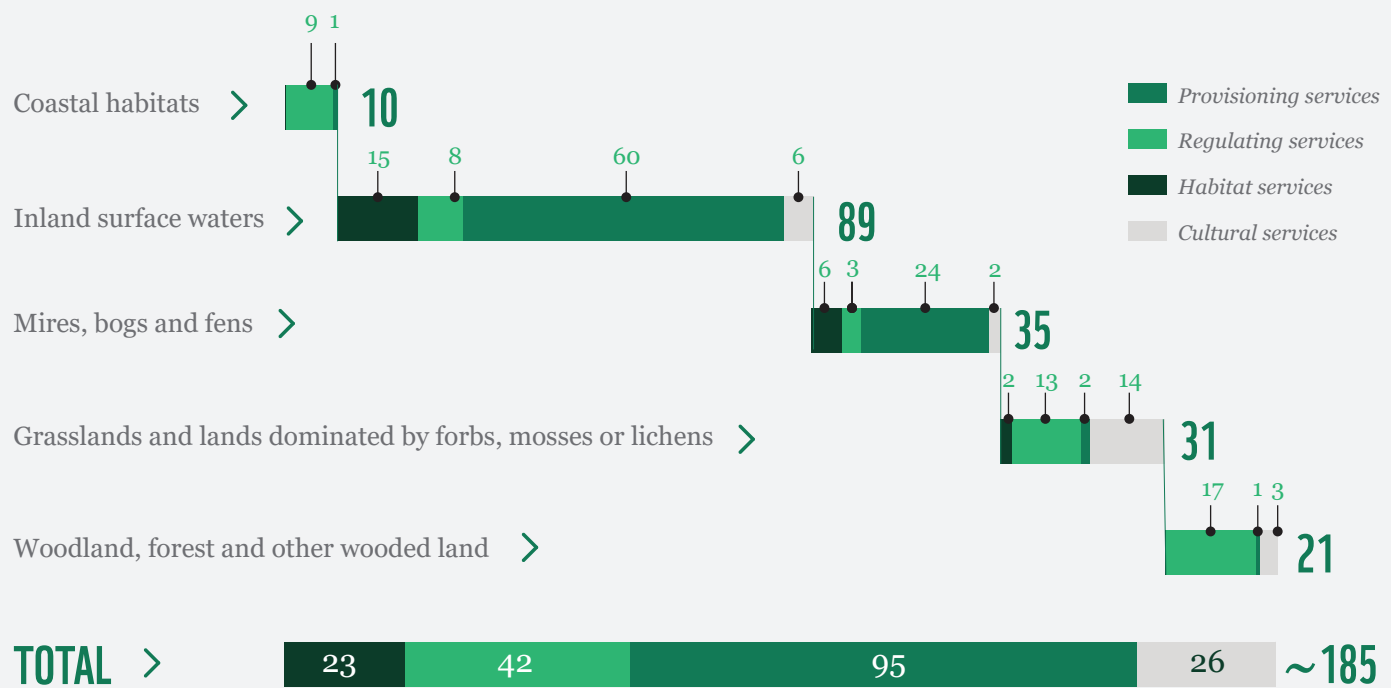
*obtain from ecosystems*⁵³, include pollinators for agriculture, carbon sequestration, provision of clean water, or prevention of floods or storms. Valuation of ecosystem services “helps to raise awareness of the importance of ecosystem services to society and serve as a powerful and essential communication tool to inform better, more balanced decisions regarding trade-offs with policies that enhance GDP but damage ecosystem services”⁵⁴. Generally, these services are estimated at the global level to be “much larger in relative magnitude right now than GDP”⁵⁵. For Ukraine, we estimate that the services provided by natural ecosystems represent as much as ~\$185 billion per year⁵⁶, which is slightly more than Ukraine’s GDP. So maintaining these ecosystems is a matter of economic resilience as much as nature preservation.



Polonyna Borzhava, one of the greatest ridges in the Carpathians.

© Dmytro.ch / CC-BY-SA-4.0

Ecosystem services valued at ~\$185bn per year, roughly equivalent to Ukraine’s GDP



Sources: “Concept of ecosystem services and its implementation in Ukraine”, Prykhodko M., Arkhypova L., Horal L., Kozhushko S., 2020; “Global estimates of the value of ecosystems and their services in monetary units”, de Groot R. et al., 2012

A 2021-2022 OECD survey in 40 countries shows that the Ukrainian population is aware of environmental issues: 87%⁵⁷ recognize that climate change is an important problem, and knowledge of the issue is above average. There is a strong level of support to climate and environmental policies, especially related to transport, energy and infrastructure. However, when it comes to changing behaviors, Ukrainians show more reluctance: only 35% are prepared to limit meat consumption, 25% to limit driving and 9% to limit heating or cooling (vs.

middle income countries average ~45%). Similarly, policies that directly impact daily life are perceived more negatively, such as food policies or taxes on carbon, gas or flying. While the aspiration to higher standards of living still drives most consumer decisions, new patterns of consumption show the increasing appetite for green products among younger generations in particular⁵⁸. It is unclear to what extent the war has impacted this trend.



CLIMATE MITIGATION: A PAST DECARBONIZATION PRIMARILY DRIVEN BY UKRAINE'S DEINDUSTRIALIZATION

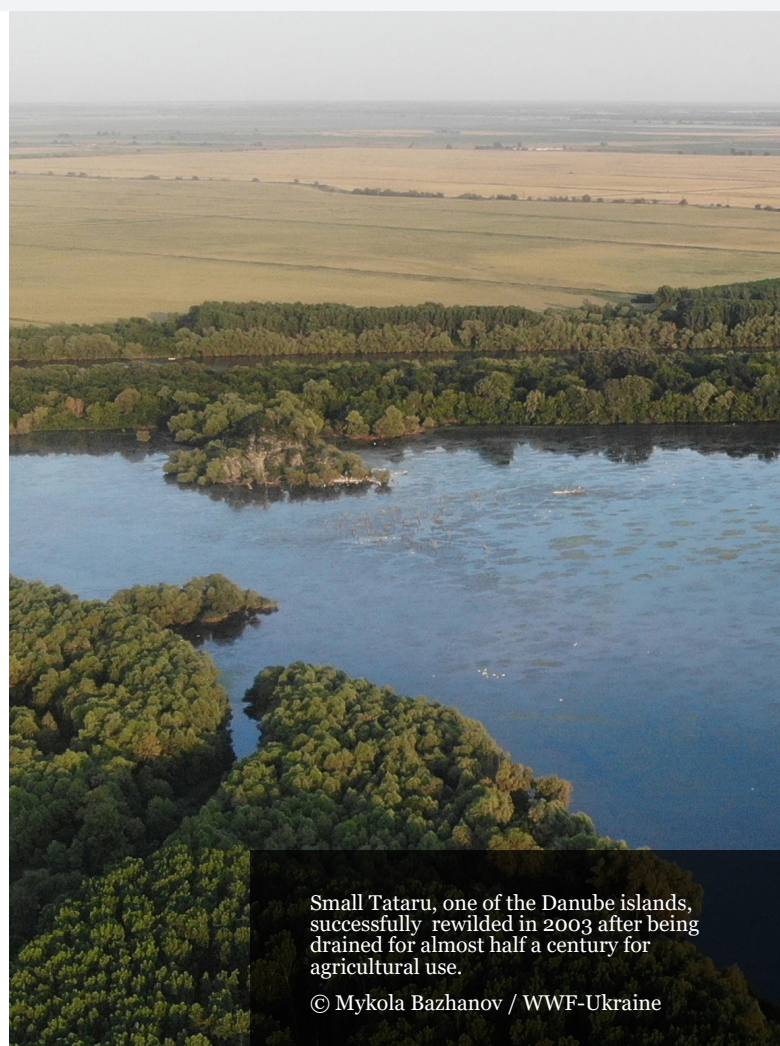
KEY MESSAGES



- GHG emissions have declined in parallel with the country's GDP until 2000, and kept going down from 2000 to 2019 despite the strong rebound of the economy in this period.
- Ukraine's NDC translates into a stagnation of emissions until 2030, given the strong emissions reductions in the last three decades.

GHG emissions in Ukraine dropped by 61% from 1990 to 2019 to reach 359MtCO₂e, with a 56% decline between 1990 and 2000 in line with a strong GDP decline (-57%) over these first 10 years. It is worthwhile underlining that, while emissions were slowly going down over 2000-2019, this same period saw a strong rebound of the economy (+46% GDP in constant US\$), reflecting a substantial improvement of carbon productivity, the economic value produced per unit of carbon emission. This is the result particularly from a fundamental evolution since 2014, with an improvement in energy efficiency and a transition to lower carbon energies in all sectors. In addition, while this is difficult to isolate and quantify, the military conflict in Donbas since 2014 has caused a drop in production and a loss of control of territories for Ukraine, including regions with coal facilities. In 2019, 36% of emissions stemmed from energy production, followed by mining industries and construction (21%), and agriculture, forestry and fishing (13%)⁵⁹.

The Nationally Determined Contribution (NDC) submitted by Ukraine to the United Nations Framework Convention on Climate Change (UNFCCC) in 2021 holds the ambition to reach a -65% carbon emissions target in 2030 compared to 1990. Given the strong decline of emissions between 1990 and the current period, this translates into a leveling of the country's emissions until 2030⁶¹.



Small Tataru, one of the Danube islands, successfully rewilded in 2003 after being drained for almost half a century for agricultural use.

© Mykola Bazhanov / WWF-Ukraine

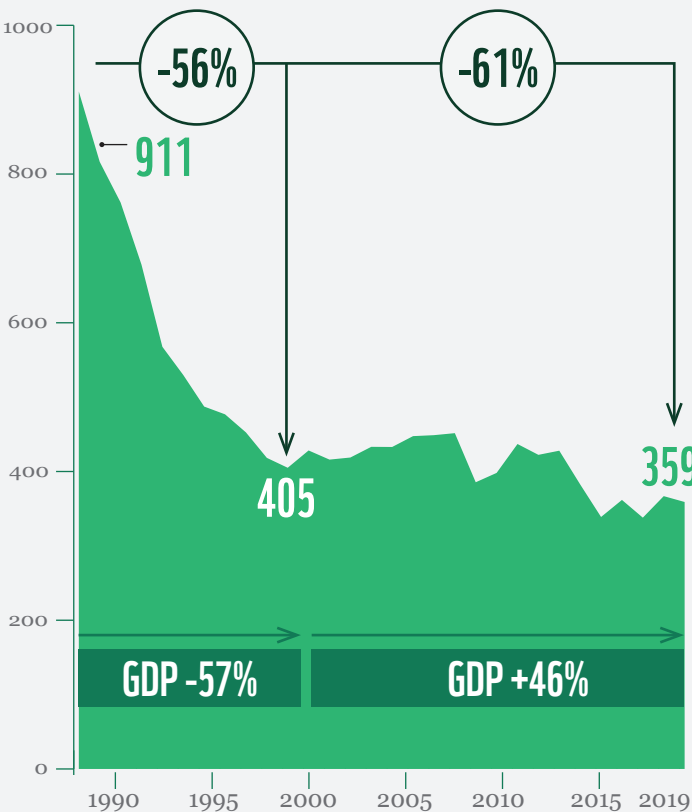
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AS INTERNATIONAL COMPANIES, WE AIM TO ACHIEVE OUR SUSTAINABILITY GOALS, IN PARTICULAR NET ZERO GHG EMISSIONS AND CIRCULARITY, IN ALL GEOGRAPHIES INCLUDING UKRAINE. HOWEVER, TO DO THIS, WE NEED ACCESS TO THE RIGHT INFRASTRUCTURE SUCH AS WATER TREATMENT FACILITIES OR RENEWABLE ENERGY, WHICH IS CHALLENGING FOR MANY BUSINESSES IN UKRAINE. WE HOPE THE RECOVERY PLAN WILL SUPPORT THE DEVELOPMENT OF THIS GREEN INFRASTRUCTURE WITH THE BEST TECHNOLOGIES.”

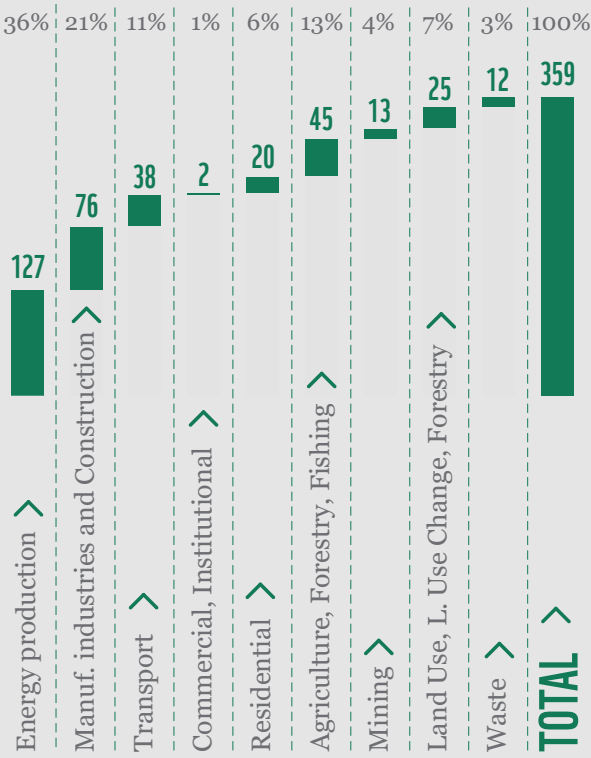
Andriy Bublyk, Chamber Sustainability Committee Co-Chair, American Chamber of Commerce in Ukraine⁶⁰

GHG emissions dropped by 61% in the last 30 years, and 36% of current emissions stem from energy production

GHG emissions evolution incl. LULUCF from 1990 to 2019, MtCO₂e/year



GHG emissions per sector in 2019, MtCO₂e/year



Source: United Nations Framework Convention on Climate Change, The World Bank, BCG analysis

FORESTS: AN ICONIC UKRAINIAN ECOSYSTEM ESSENTIAL FOR THE ECONOMY AND THE CLIMATE

KEY MESSAGES



- 15.9% of Ukraine's total land area is composed of forest areas⁶², compared to 43.5% for the EU⁶³. Half of these forests can be categorized as (semi-)natural, while the other half is mostly monoculture forest plantations with a low adaptability to climate change.
- Critical to mitigating climate change through carbon sequestration, these forests are affected by well-recognized issues such as intensive commercial exploitation in a context of weak regulation enforcement, which generates pressure on local biodiversity and ecosystems.
- These issues are likely to grow during and after the war, due to damages and fires caused by the fighting as well as risks of increased illegal logging and more permissive legal logging.

RECOMMENDATIONS

- In the short-term, establish a strategy for managing forest areas damaged by the war to facilitate rapid demining and decontamination (to ensure the safety of people and forest workers), as well as an ambitious target for forest restoration that would prioritize landscapes, inclusive approaches, native species and connectivity.
- Conduct a forest inventory and create a digital data system for monitoring and reporting, enabling a transparent digital logging and transport system accountability.
- Ensure that Ukraine's forests of high conservation value are well governed and protected, with national policies to successfully combat illegal logging and degradation, and with improved management of forest concessions and plantations to improve forest integrity, resilience (including fire-related) and biodiversity conditions.
- Develop an afforestation and restoration strategy to increase forest coverage, selecting areas based on their potential for generating societal and economic benefits, improving climate change resilience, biodiversity protection, ecological connectivity and carbon sequestration.
- Develop a forest economy strategy for the wood industry to increase the value of standing forests (including tourism), in particular by working towards 100% certified timber and by relying on best practices such as the "cascading use" of wood products⁶⁴.



Ukrainian spruce old growth forest.

© Bogomaz Conservation Photography / WWF-Ukraine

UKRAINE'S FORESTS BEFORE THE WAR

Ukraine is covered by 9.6 million hectares of forested areas⁶⁵ representing 15.9% of the country's total land area⁶⁶; 38% of this is production forests⁶⁷. These forested areas have been stable over the years, covering an area similar to that of 1990 (then 9.3 million hectares). Ukraine's forests are predominantly publicly-owned (87% through the state, and 13% through local communes⁶⁸), while private ownership is extremely low, at less than 1%.

The forest sector contributes directly to around 1% of Ukraine's GDP⁶⁹ and employs around 68,000 Ukrainians for forestry and logging activities. Its overall contribution to the economy is wider though, as 131,200 additional jobs are dependent on forests - namely in the wood processing and the furniture industries⁷⁰. The sector is heavily export-oriented, with around 50% of the timber production (mostly log wood and sawn wood) exported annually⁷¹. Half of national production is used as fuel⁷², for both domestic and industrial uses.

Maintaining healthy forest landscapes is also essential for climate change mitigation, as forest ecosystems contribute to carbon sequestration through both trees and soils. In 2020, Ukrainian forests captured 30MtCO₂e, just below 10% of the country's gross GHG emissions⁷³.

Environmental law enforcement is limited, causing illegal logging and widespread corruption. Numbers are uncertain, but illegal logging could represent a volume of up to 1.25 million m³ annually⁷⁴, meaning that illegal harvesting could represent as much as 8% of the country's official annual production (14.9 million m³ in 2021⁷⁵). This issue is a threat to Ukraine's forests, and in particular to the Carpathian Mountains' primary forests that are a hotspot for biodiversity⁷⁶.

DANGERS FOR UKRAINE'S FORESTS LYING IN BOTH THE WAR AND THE POST-WAR PERIODS

Forests have been directly impacted by the war, with around 280,000⁷⁷ hectares subject to war-caused deforestation or mass felling. It is also estimated that 600,000 hectares of forest are currently located in conflict areas⁷⁸, putting them at a high risk of destruction. In total, according to the Ministry of Environmental Protection and Natural Resources of Ukraine, close to 3 million hectares of forests are or have been affected by the conflict⁷⁹, representing around 30% of the country's total forests. Last, forestry assets have also been damaged, with an estimated \$440m of destructions inflicted on the State's forestry enterprises⁸⁰.



Demining in the Donetsk region.
© The State Emergency Service of Ukraine



CASE STUDY:

The burning of Ukraine's forests

The scale of fires affecting Ukraine's forests is hugely increasing due to the war: the number of forest fires in Ukraine has almost tripled compared to 2021, while reports are that the scale of fires has increased by 90 times. This is particularly driven by shelling but also the war's impact on wildfire suppression services (decreases in resources, difficulties to intervene in conflict areas). In total, between February and June 2022, 176 213 hectares of fires have been identified on territories affected by military actions⁸¹. These fires have notably affected high-risk areas and protected areas, such as the Chernobyl exclusion zone⁸² or the Kinburn Sit reserve, where according to reports 4,000 hectares of forest were affected by fires.

The restoration of forests in the war-affected southern and eastern regions of Ukraine must be approached carefully though: these regions were originally steppes, and therefore the (re-)creation of forests brings drawbacks, including increased fire risks. An alternative solution would be instead to restore the natural vegetation cover of steppe ecosystems, which would contribute to both nature conservation purposes (especially as less than 2% of the preexisting steppe ecosystems remain in Ukraine⁸³), carbon sequestration and fire protection purposes (through increased spacing between the remaining forests).

Beyond direct damages, war also complexifies the management of Ukraine's forests. Risks of unexploded explosive ordinances (UXO) are high in large areas, making exploitation and conservation dangerous. Accessibility to the forest for required treatment such as fire or pest management will not be possible in parts of the country until full demining efforts have been undertaken, and they are very difficult with vegetation.

Even in areas not directly affected by military operations, key environmental policies have become harder to implement. For instance, following the start of hostilities, the Ukrainian government lifted a regulation prohibiting logging in protected forests during spring and early summer, as part of a bill to increase the country's export earnings during wartime⁸⁴. Similarly, occupied territories have lost their eligibility for forest certification schemes, with the Forest Stewardship Council (FSC) suspending certification in these areas⁸⁵, despite FSC being the most important forest certification body active in Ukraine (60% of the wood harvested in Ukraine in 2021 was FSC-certified⁸⁶). The highest risks may lie in the post-war and reconstruction periods, though: there are risks of higher levels of deforestation and logging after the war, especially when economic conditions are dire.

NEXT STEPS FOR PROTECTING UKRAINE'S FORESTS

For environmental, social and economic reasons, the recovery needs to protect and enhance Ukraine's forests. Lugano's July 2022 Recovery Plan only mentions the "increase of forest cover" in its environmental goals; this is consistent with the 2021 extension plan of forested areas by 1 million hectares⁸⁷. However, outside of this environmental action, the plan

heavily focuses on the development of the wood processing and furniture industries, for \$1bn identified investments; it does not specify how to preserve the underlying resource in the long term.

For long-term forest protection, an array of new initiatives needs to be implemented. In particular, the management and governance of Ukraine's forests should be greatly improved, through digitalized monitoring and reporting systems as well as through the deployment of national policies focused on tackling key identified issues (lack of separation between the control and management bodies of forests, illegal logging, forest degradation, forest integrity risks and biodiversity issues). Additionally, Ukraine can better value its forests and its timber by increasing the value people place in forests (e.g. development of eco-tourism) or increasing the value Ukraine extracts from its wood (e.g. through the "cascading use" of the wood, meaning that wood is put to good use - construction, furniture, etc. - before it is reused, recycled and only finally burnt for energy or its nutrients returned to the land as compost⁸⁸).

The enhancement of Ukraine's forests, both in terms of coverage as well as quality, is needed in order to use the potential of safeguarding ecosystem services they provide and adapt to climate change - especially considering that there is public support for such action, with 83% of Ukrainians considering it urgent to take into account the ecological role of forests⁸⁹. Forest recovery shall aim at balancing benefits for biodiversity, carbon storage and ecological connectivity while taking into consideration the urgent need to adapt forests to a changing climate. Work on forests shall be closely integrated with commitments on protected areas, while forests managed for timber shall aim at long-term sustainability through close-to-nature forestry and adherence to highest certification standards.

TESTIMONY

Environmental conservation under war conditions

Mykhailo Bogomaz, Senior Forest Officer, WWF-Ukraine⁹⁰

“

OVER THE LAST FIVE YEARS, WWF HAS IDENTIFIED AROUND 100,000 HECTARES OF OLD-GROWTH FORESTS IN UKRAINE AND MANAGED TO PUSH FOR THE PROPER PROTECTION STATUS FOR OVER A QUARTER OF THEM. DESPITE THE WAR, WE HAVE CONTINUED WITH OUR PLAN TO ADD 10,000 HECTARES OF PROTECTED OLD-GROWTH FORESTS IN 2022, AND THE OFFICIAL APPROVAL PROCESS FOR SUCH CONSERVATION WORK HAS NOT BEEN TERMINATED BY THE AUTHORITIES. HALF OF THESE ARE AREAS WITH 150-200 YEAR-OLD RELIC EUROPEAN CEDAR PINES.

FORESTS ARE OF HIGH VALUE AT ANY TIME, ESPECIALLY IN A COUNTRY LIKE UKRAINE, WHERE THERE IS LIMITED FOREST COVER AND ONE OF THE LOWEST RATES OF NATURE PROTECTED AREAS IN EUROPE. UKRAINE'S POST-WAR RESTORATION DEPENDS NOT JUST ON WOOD AVAILABILITY BUT ON THE ABILITY OF FOREST ECOSYSTEMS TO PROVIDE US WITH CLEAN AIR AND WATER, AND HELP ADAPT TO CLIMATE CHANGE. THIS IS A BASIC SAFETY APPROACH TO SUSTAIN THE HEALTH AND WELLBEING OF UKRAINIANS FOR YEARS, AND WE CANNOT JEOPARDIZE THIS EVEN IN TIMES OF WAR.”



Mire in the alder forest near Chernihiv city in the Northern Ukraine.

© Bogomaz Conservation Photography/ WWF-Ukraine

WILDLIFE BIODIVERSITY: PROTECTING HABITATS FOR THE BENEFIT OF UKRAINIANS

KEY MESSAGES



- Protected areas cover 13% of Ukraine's territory; this is half of the average terrestrial protected areas coverage of the EU's 27 member states. They provide critical habitats for 367 endangered species in Ukraine and a broad range of ecosystem services people depend on.
- Habitat loss in Ukraine through landscape fragmentation has been a main threat to endangered species and biodiversity as a whole, while wildlife crime has also exerted pressure.
- 44% of Ukraine's protected areas, which constitute a haven for rare plants and animals, either were or remain temporarily occupied by military troops, often causing severe damage.
- Protected areas governance and management has been ineffective and further weakened since the war broke out.

RECOMMENDATIONS

- Develop a national biodiversity strategy in line with the EU Biodiversity Strategy for 2030 and Post-2020 Global Biodiversity Framework, based on a national assessment of biodiversity and nature's contributions to people's well being.
- Develop a strategy to protect 30% of Ukrainian territory and establish effective governance mechanisms and management with sustainable funding, transparent monitoring including a digital habitat mapping system, appropriate changes in land legislation and a governmental agency in charge of protected areas and biodiversity conservation.
- Develop a Nature Restoration Policy and actively support the restoration of protected areas impacted by the war. Rewild other heavily affected sites where possible, aligned with the Nature Restoration Law proposed by the European Commission, which aims at restoring ecosystems on at least 20% of the EU's land and sea areas by 2030, and ultimately all ecosystems in need of restoration by 2050.
- Establish financial instruments such as payments for ecosystem services and compensatory legislation for the damage caused by wild animals to reduce Human–wildlife conflict (HWC).



The brown bear is one of the iconic animals of Ukraine, populating the Carpathians and Polissya forested areas in the North, is highly endangered and included in the Red Book of Ukraine, protected by the Bern Convention on the Conservation of European Wildlife and Natural Habitats. Photo made in the Synevyr National Park.

© Moahim_CC BY-SA 4.0

~10% OF UKRAINE'S TERRITORY PROTECTED, WITH ~1,500 PROTECTED SPECIES

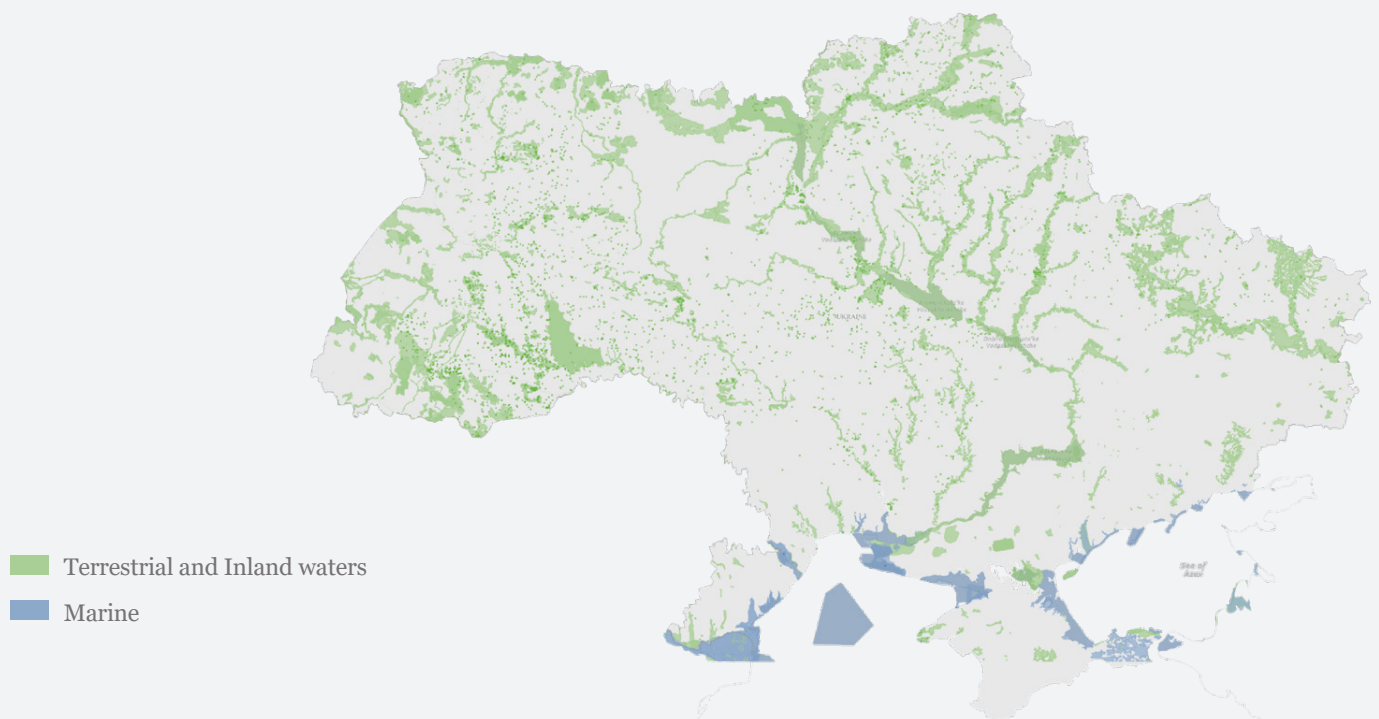
Ukraine's protected areas, which either have a nationally protected area designation or are integrated into the Emerald Network, cover 77.6 thousand km² of terrestrial areas representing 13%⁹¹ of the country's territory as well as 12.5 thousand km² of marine areas representing 9% of Ukrainian marine waters. In the European Union, the average share of land protected areas is 26.4%, double that of Ukraine's⁹².

The National Recovery Plan aims to reach 30% of protected areas, which equals the target of EU ambitions by 2030, but with an undefined date.

Ukraine legally protects 1,545 species, of which 205 plant and 162 animal species are endangered, and of which 313 plant and 277 animal species are vulnerable. Habitat loss is a main threat for these species. WWF has also documented wildlife trafficking of critically endangered species like sturgeon in the Danube region^{94,95}. Ukraine is an important area for European biodiversity, with free-flowing rivers⁹⁶ and natural areas that are generally less fragmented than in western European countries.

Protected areas exist all over Ukraine with significant concentration in coastal and river areas

Type of protected areas in Ukraine



Source: UNEP-WCMC and IUCN (2022), Protected Planet: The World Database on Protected Areas (WDPA)



© Fritz Pölking / WWF

THE EURASIAN LYNX, AN ICONIC ANIMAL

The Eurasian lynx (*Lynx lynx*) is the biggest cat in Europe and Ukraine. The species is widespread on the territory of Polissia and can be found in all Carpathian regions from Poland and Slovakia to the state borders of Romania. The dynamics of the species in recent years are considered stable. There are two populations of lynx in Ukraine — Carpathian (from 400 to 430 individuals) and Baltic in Polissia (up to 100 individuals), but there is no reliable data on their direct connection.

The lynx is sensitive to changes in the environment; its range and number are negatively affected by disturbance, habitat loss and food base. Conflicts with hunters are possible due to competition for prey (ungulates) and conflicts with farmers in the Carpathians due to lynx attacks on domestic animals - sheep or goats.

Since 1994, the lynx has been listed in Ukraine's Red Book with the status of "rare species". As of 2021, this species shifted to "vulnerable" status in the Red Book. It is listed by the IUCN Red List, CITES and the Berne Convention. In September 2021, the Ministry of Environmental Protection and Natural Resources of Ukraine approved the Action Plan for the Conservation of the Eurasian Lynx, developed jointly with WWF-Ukraine.

WAR, A THREAT TO WILDLIFE AND ENDANGERED SPECIES

According to the Ukrainian Nature Conservation Group (UNCG)⁹⁷, as of August, *"a third of the protected territories of Ukraine are in the zones of active hostilities, occupation and humanitarian crisis"*, without any guarantee of preservation. These areas include unique forests, steppes, wetlands and coastal ecosystems.

The military operations and the damages caused constitute a direct and high-level threat to the survival of natural species in Ukraine. As highlighted by the Ukraine Minister of Foreign Affairs on 29 June 2022 during the United Nations Ocean Conference plenary⁹⁸, half of Ukraine's wetlands of international importance (as designed by the Ramsar Convention) have been affected by military activities. Sea mines carried by currents to shores threaten marine life. Shelling of ports and the consequent chemical leaks could cause ecological disaster in the Sea of Azov.



CASE STUDY:

The war is disrupting bird migration routes

According to the Ministry of Environmental Protection and Natural Resources of Ukraine, the war is perturbing the migration routes of numerous bird species⁹⁹. Active combat is not the only direct cause: the presence of active armed forces in occupied territories and coastlines is an important disruption as well. In particular, the three large bird migration routes passing through Ukraine have been directly affected by the war: the southern pathway (Azov-Black Sea corridor, on the coastline),

the northern pathway (along the forests of Polissia), and the Dnipro pathway (along the stream bed of the Dnipro River and its tributary Desna). This situation forces birds to adjust or prolong their migrations despite the need to conform to narrow timeframes for migration; it also causes damage to habitats or direct hits to birds. It therefore results in the loss of species and in a decrease of biodiversity. Some unique centers of endemic species may disappear as well due to hostilities.

A BIODIVERSITY STRATEGY FOR UKRAINE

To protect biodiversity, a national strategy needs to be defined in line with EU and international frameworks that articulates the restoration needs raised by the war and the protection ambitions of Ukraine. Specifically:

- to achieve the protection of 30% of Ukrainian territory with sustainable funding and a digital habitat mapping system
- to restore protected areas impacted by the war and rewild other heavily affected sites where this is possible
- to establish payments for ecosystem services and a compensation system for the damage caused by wild animals to reduce Human–wildlife conflict (HWC)
- in line with the EU Biodiversity Strategy’s nature protection and restoration objectives for 2030, and with the UN Post-2020 Global Biodiversity Framework



Sheep farm in the Carpathians.
© Suzanna Tymochko / WWF-Ukraine

FRESHWATER ECOSYSTEMS: A FOUNDATION FOR CLIMATE ADAPTATION AND RESILIENCE

KEY MESSAGES



- Ukraine's water resources are relatively abundant, but unevenly distributed and highly exploited for agriculture, hydropower, navigation and other uses¹⁰⁰; freshwater ecosystems and water resources are mainly threatened by excess use, inefficient distribution and irrigation, wastewater discharges as well as regulation of rivers and drainage of wetlands, creating shortages and conflicts between users that will only worsen with climate change.
- The war has worsened the environmental situation with direct impacts on more than 6 million people who have no or limited access to safe water.
- Emerging water regulation is ineffective due to relatively poor law enforcement and lack of efficient infrastructure; the development of nature-friendly, sustainable water management solutions will require significant investments to meet EU standards by 2030.

RECOMMENDATIONS

- In the short-term, repair the environmental damages caused by the war on terrestrial and aquatic ecosystems to ensure safe drinking water and sanitary conditions for local communities.
- Develop and approve river basin management plans for the 9 river basin districts in Ukraine in line with the EU Water Framework Directive (WFD) and finance them to implement both basic and supplementary measures; apply payments for ecosystem services where possible.
- Ensure the effective protection of valuable rivers and wetlands (peatlands, bogs, mires, floodplains, etc.) to prevent their further destruction – strengthen enforcement of legislation related to their protection and designate “no-go” areas to protect high value river sections and wetlands.
- Develop and ensure financing for integrated, climate-proof river and wetland restoration projects with high potential for multiple benefits like nature-based solutions and natural water retention, to reduce drought or flood risks, increase carbon sequestration, biodiversity and other benefits.
- Prioritize water efficient projects with potential impacts on the availability of water; incentivize responsible consumption through water pricing and raise awareness of good water stewardship.
- Develop a more sustainable irrigation and drainage strategy for Ukraine, shifting to climate-smart water management, irrigation and drainage in the agriculture sector. Set a legal framework to support implementation in line with the EU Water Framework Directive.



Mires play a key role in climate change adaptation and clean water access. 6,000-year-old Hlukhanya mire in the Synevyr National Natural Park of Ukraine needs restoration to provide those ecosystem services for many years to come.

© WWF-Ukraine

A PRECIOUS RESOURCE AT RISK

Freshwater ecosystems provide a wide range of goods and benefits, including the provision of drinking water, essential inputs for agriculture and industry, water purification, mitigation of droughts and flooding, fish and other biodiversity, and much more. In Ukraine, freshwater resources are, overall, relatively abundant, but unevenly distributed and highly exploited for agriculture, hydropower, navigation and other uses. The management of these water resources is relatively poor, compounding problems with availability and quality.

The water needs of economic sectors, including the utility sector, are met to more than 90% by surface water. About 38% of Ukraine's overall renewable freshwater resources are generated within the territory of the country, with the remainder coming from transboundary rivers, particularly the Dnieper. Hydromorphological modifications, including drainage and the construction of dikes and dams, have had a significant impact on rivers and wetlands and the multitude of ecosystem goods and services they provide, from fish to flood management. A large part of Ukraine used to be covered with wetlands, mires and bogs, most of which have been lost. Today, such valuable wetlands cover only 2% of the country's total territory, with the remainder under significant threat¹⁰¹.


Ukraine faces significant challenges with water quality due to the discharge of untreated and insufficiently treated wastewater into water bodies. Rural areas have low access to sewage

treatment, and urban treatment plants, which lack tertiary treatment, have inadequate capacity¹⁰². Untreated run-off from agriculture is also a major problem. The lack of access to efficient water treatment, together with relatively poor law enforcement, has led to “*systematic violations and failures in complying with legislation*”¹⁰³. Irrigation and water distribution suffer from inefficiencies, with losses in water pipes reaching as much as 30-50%¹⁰⁴.

Existing problems with water quantity and quality are and will be aggravated by the consequences of climate change, which significantly affects the seasonal distribution of water resources and leads to prolonged dry periods - with consequences in key sectors such as agriculture, energy and industry. Changing weather patterns and intensive agricultural activity have led to the run-off of small rivers in the forest-steppe zone and in Polissya decreasing by 5% and in the steppe by 10%¹⁰⁵.

As in other parts of the world, access to freshwater has also been a growing source of geopolitical tensions, resulting in severe water conflicts between Russia and Ukraine¹⁰⁶ since 2014 in Donbas and around the North Crimean Canal¹⁰⁷.

The war has worsened an already poor situation. Military operations have disrupted water management and polluted water and soil. According to UNICEF, by April 2022, the war had left “*1.4 million people without access to safe water in the east of the country and a further 4.6 million people with only limited access*”¹⁰⁸. In the short-term, the priority must be to restore access to safe water for all Ukrainians.



Small Tataru, one of the Danube islands, successfully rewilded in 2003 after being drained for almost half a century for agricultural use.

© Mykola Bazhanov / WWF-Ukraine

A NEED TO ACCELERATE RIVER BASIN MANAGEMENT AND ENFORCE GOOD PRACTICES

Ukraine has committed itself to the challenging task of aligning with the EU Water Framework Directive (WFD)¹⁰⁹. The development, public consultation and approval of river basin management plans for the country's nine basin districts must be accelerated by 2025.

All forms of peatland should be included in the list of inland surface water resources to prevent peat extraction and drainage, and all pristine wetlands should be brought under protection to prevent their degradation or conversion to other uses. Restoration measures should also be outlined where needed.

Goals for ecological restoration of freshwater ecosystems and rewetting of drained wetlands need to be set, in line with the UN Decade on Ecosystem Restoration as well as the proposed EU law on nature restoration¹¹⁰. Technical qualification on freshwater ecosystems and their restoration should be established to ensure proper freshwater policy design and management at all levels, drawing on the expertise of European countries. Environment and agriculture policy-making need to be linked in an integrated approach.

In the agriculture sector, a shift is needed to climate-smart irrigation and drainage with more sustainable water management including natural water retention. The Irrigation and Drainage Strategy of Ukraine should be amended and implemented in a way that stops degradation of drained land, prevents drainage of natural wetlands, ensures efficient irrigation systems, crop choice and tillage techniques, applying natural water retention where possible. Farmers and local communities should be supported in applying nature-based solutions to water challenges.

To effectively enforce protection of water resources, environmental inspections need to be resumed and strengthened, with sufficient capacity for investigation and prosecution of violations as well as an adequate level of fines. Moreover, a legal basis for “no-go areas” could be put in place to guarantee protection from significant human influence for areas of high conservation value, especially valuable sections of rivers. WWF-Ukraine has already demonstrated that restoring free-flowing rivers is possible – in the last years, the organization has removed seven dams, freeing 531 km of the White and Black Cheremosh rivers and their tributaries in the Carpathian Mountains.

Preserving water resources is a prerequisite for safeguarding the right to clean water and sanitation for all. It is also a foundation for economic development and stability in key sectors such as industry and agriculture. It is profitable in the long-term, but does require significant investment. An OECD study found that reaching full compliance with the EU Water Framework Directive, efficient water resources and environmental management nationally by 2030 would require annual investments of €23 billion from public and private actors, versus €4 billion in the business-as-usual scenario.

Funding the journey concretely translates to the economy and users. This means assessing all projects with potential impacts on the water balance to prioritize those that are the most water efficient, incentivizing responsible consumption through water pricing and promoting water-saving technology. Private actors also have a role to play here. BCG analysis shows a correlation between strong water management practices and higher EBITDA margins; in the consumer packaged goods sector, for example, companies with strong practices posted EBITDA margins that averaged 3.1 percentage points higher than those of their less sustainability-minded peers¹¹¹.



Dnister river

© Mykola Bazhanov / WWF-Ukraine

THE CHALLENGE OF ASSESSING ENVIRONMENTAL DAMAGES

KEY MESSAGES



- While the environmental damages of the 2014 conflict in Donbas are now documented, it is too soon to fully assess the additional toll of damage caused by the current war.
- These damages are monitored using satellite technology and through citizen participation with the Ecozagroza platform where ~\$10.7bn of damages have already been reported as of August 2022¹¹². This work provides data and evidence for a robust scientific assessment that will have to take place after the war, when conditions are safer.

Numerous damages to the environment have been caused by the war launched in February 2022 in Ukraine. These damages are under assessment and still growing as the conflict goes on. However, a retrospective look can already be taken on the conflict in the Eastern Donbas region, ongoing since 2014. The learnings are already clear, showing that the war had already triggered severe environmental damages¹¹³, including:

- Direct pollution provoked by the release of toxic materials from ammunition
- Industrial pollution
- Operation disruptions and the flooding of more than 35 coal mines, releasing pollution into freshwater
- Water supply, water disposal, and waste removal challenges
- Impact on land resources, ecosystems, flora and fauna
- Decrease in environmental activities within the conflict area



Fields peppered with hundreds of artillery craters near Izyum town, Kharkiv region.

© Maxar

The 2022 war in Ukraine is a full-scale conflict that will certainly provoke massive environmental damages, an order of magnitude larger than the Donbas conflict. It is still too early for a full assessment of the environmental toll, and many areas are not safe enough for scientists to operate. When the war is over, a robust scientific damage assessment will have to be realized throughout the territory to guide the restoration process, building on the set of evidence collected by volunteers, environmental organizations, as well as digital technology.

Ukraine benefits from the support of several partners to monitor environmental impacts. The United Nations Environment Program (UNEP), the environment authority within the UN system, is supporting the Government of Ukraine on “*remote environmental impact monitoring*” using satellite technology¹¹⁴. Efforts to document damages made to the environment are more broadly made by networks of experts and volunteers¹¹⁵.

In addition, Ukraine has launched the Ecozagroza (“Eco Threat”) platform, a standardized application for the collection and recording of information on environmental threats in real time: as of August 2022¹¹⁷, nearly 1,900 contributions were submitted through the application, for total damages estimated at ~\$10.7bn. This includes more than 280,000 hectares of

felled or destroyed forests, spillage of poisonous substances into water and soils, emissions of poisonous substances into the air, waste from military equipment, etc. For the health and safety of Ukrainians as well as nature protection, the recovery needs to take direct environmental damages into consideration.

“

THE MAPPING AND INITIAL SCREENING OF ENVIRONMENTAL HAZARDS ONLY SERVES TO CONFIRM THAT WAR IS QUITE LITERALLY TOXIC. THE ENVIRONMENT IS ABOUT PEOPLE: IT’S ABOUT LIVELIHOODS, PUBLIC HEALTH, CLEAN AIR AND WATER, AND BASIC FOOD SYSTEMS. IT’S ABOUT A SAFE FUTURE FOR UKRAINIANS AND THEIR NEIGHBORS.”

Inger Andersen, Executive Director, United Nations Environment Programme (UNEP)¹¹⁶



Forests polluted with burnt military hardware near Demydiv village of Kyiv region.

© Serhii Korovainyi

HOUSING AND CONSTRUCTION

KEY MESSAGES



- Ukraine's housing is composed primarily of buildings with poor insulation and low energy efficiency: buildings in Ukraine are responsible for 40% of final energy consumption¹¹⁸, and 54% of residential energy consumption is for heating purposes¹¹⁹.
- Housing is the sector with the most direct economic damages from the war (\$40bn) due to intense shelling of Ukrainian cities; the need to relocate 6.3 million internally displaced Ukrainians also creates an urgency to rebuild rapidly and in the right areas; damage to critical infrastructure, including district heating and water supply, is also massive.
- The National Recovery Plan estimates that \$40bn is required to provide temporary housing and rebuild damaged housing, and an additional ~\$90bn for modernization and energy efficiency; it also mentions recycling of construction waste.

RECOMMENDATIONS

- In the short-term, focus immediate response on refurbishment and rebuilding of district heating and on providing efficient stoves for winter.
- Apply a zero-emission buildings (ZEB) performance standard for new buildings by 2025 and for renovated existing buildings by 2032, in line with the draft revised EU directive on the energy performance of buildings in 2021.
- Set public procurement rules that support low carbon construction solutions and enable the development of the low carbon cement sector.
- Organize circularity of materials, water and energy upstream and downstream of the construction process, prioritizing reuse of materials such as cement, aluminum or plastic from damaged infrastructure and the improvement of waste management.
- Integrate housing reconstruction into a more comprehensive approach to city planning that considers affordability and inclusion, mobility, energy generation (rooftops), reconstruction/ repositioning or industrial sites from cities, etc.



Residential building in Kyiv after being hit by a missile on February 26, 2022.

© Olena Viediarnikova

AN ENERGY-INEFFICIENT AND ILL-ADAPTED HOUSING PARK

Ukraine's population of 41 million is predominantly urban, with 70% of its population living in urban settings¹²⁰. Despite a steady decline in Ukraine's urban and rural population since 1990¹²¹, the housing stock has grown rapidly. As a consequence, before the war in 2022, there was technically a surplus of housing units for the existing number of households (more than 17 million housing units in 2018, for about 15 million households)¹²².

However, this massive construction policy did not accurately consider demand-side dynamics to deliver housing that meets the needs of the most vulnerable populations. In addition, housing stock has been massively privatized (with private ownership exceeding 90% before the war), making it more difficult to ensure access to housing for all¹²³.

Houses are often poorly insulated and energy inefficient, leading to high energy consumption. Buildings in Ukraine cause 40% of final energy consumption. In the residential sector, 54% of final energy consumption is devoted to space heating or cooling. Utility bills represent 20-40% of total household expenses for nearly one in every two Ukrainian families¹²⁴. The situation is aggravated by the share of natural gas in residential energy supply (48.8% versus 32.1% for the EU), making Ukraine dependent on imported fossil fuels¹²⁵.

A HOUSING SECTOR AT THE CORE OF WAR DESTRUCTION

The housing infrastructure has been heavily impacted by the war: 15,000 apartment buildings and 116,000 private houses have been damaged, as well as 2,290 educational institutions and kindergartens and more than 930 health facilities have been damaged or destroyed. Together, they account for approximately half of the total destruction in value (\$51.6bn)¹²⁶.

In cities like Kharkiv where 40% of buildings have sustained damage¹²⁷, the entire functioning of living areas needs to be rebuilt from scratch – from housing and other urban amenities to infrastructure, water and energy supplies.

The destruction of buildings, including houses and public services, is a humanitarian, social and economic disaster. Providing temporary living infrastructure to meet the needs of displaced populations must be the priority. This should leverage existing frameworks for humanitarian aid and disaster recovery, to manage environmental risks associated with rapid rebuilding. *“The massive rebuilding effort that occurs after a disaster requires an enormous amount of building materials. What may have been sustainable rates of extraction for minerals, sand, or clay before the disaster are likely to become unsustainable in the years immediately following a disaster”*¹²⁸. The principle to “do no significant harm to the environment” should be applied to short-term recovery solutions.

EMBEDDING ENERGY AND WATER EFFICIENCY IN NEW BUILDING STANDARDS

In the medium- and long-term, the reconstruction plan must enable housing quality, wellbeing and energy and water savings to the best level possible, together with public services and infrastructure that meet the needs of the population. An efficient planning approach will create long-term positive impacts for household purchasing power, economic and environmental resilience and the relaunch of economic activity.

For this, the 2021 revised EU Energy Performance of Buildings Directive¹²⁹ provides a reference framework. In the EU, all new buildings are required to be nearly zero-emission buildings (NZEB) from 2021. To meet the climate goals, the requirement will be enhanced. By 2027 for public buildings and 2030 for private ones, all new buildings will have to be Zero-Emission Building (ZEB). The Directive also provides strict requirements for renovation. To deliver on these standards, energy efficient heating and cooling technologies need to be implemented, requiring the right infrastructure such as district heating.

While NZEB tends to pay back over time through energy savings, the upfront costs are considerable and will require dedicated financing. Based on data from adjacent countries, one study found that the costs of building NZEBs in Ukraine can amount to a 10% to 40% increase in construction costs that translates to billions of euros if deployed on the full housing park destroyed by the war¹³⁰.

PROMOTING CIRCULARITY TO OPTIMIZE RESOURCE USE

Circularity must be another key element in Ukraine's reconstruction. It will not only optimize resource use, but also help develop the local economy and promote local job creation. Planning ahead to proactively manage raw material, water and energy will generate positive economic and environmental spinoffs by reducing resource use and valuing waste.

Technical solutions that minimize construction costs while improving housing quality are available; they include circularity in cement, aluminum or plastics from demolition waste. The majority of emissions can be tackled through material and process efficiency levers such as cement clinker substitution, more efficient transport vehicles, and renewable power and heat use for aluminum production or at the construction site. According to BCG and WEF research, Net Zero construction only leads to a <3% average cost increase on a €150k home¹³¹.

Digitalization in construction, such as smart buildings, Building Information Modeling (BIM) or unmanned construction operations, can lead to significant cost savings. In the non-residential sector, BCG experience shows that savings can reach up to 21% in the construction phase and 17% in the operations phase¹³².

Reconstruction policies should support these cost and energy saving technologies. This support can come in several ways, for instance by setting public procurement rules that evaluate bidders on their qualification and design, or by creating incentives to promote energy and water efficient technologies. Public support that sets new rules of the game for the construction sector is essential to challenge the status quo and drive the availability and attractiveness of low-carbon solutions.

Energy, water and waste management infrastructure that supports the building sector must also be prioritized. District heating from renewable energies should be chosen over existing natural gas systems to lower the carbon footprint of building consumption. Waste recycling, which only covers 8% of household waste today, should be strongly developed. Wastewater treatment plants should be designed with the most advanced technologies to ensure the reduction of water pollution.

“**THE BUILT ENVIRONMENT [...] REQUIRES VAST AMOUNTS OF RESOURCES AND ACCOUNTS FOR ABOUT 50% OF ALL EXTRACTED MATERIAL. THE CONSTRUCTION SECTOR IS RESPONSIBLE FOR OVER 35% OF THE EU’S TOTAL WASTE GENERATION. GREENHOUSE GAS EMISSIONS FROM MATERIAL EXTRACTION, MANUFACTURING OF CONSTRUCTION PRODUCTS, CONSTRUCTION AND RENOVATION OF BUILDINGS ARE ESTIMATED AT 5-12% OF TOTAL NATIONAL GHG EMISSIONS. GREATER MATERIAL EFFICIENCY COULD SAVE 80% OF THOSE EMISSIONS.”**

European Commission¹³³

THE NEED FOR AN INTEGRATED SUSTAINABLE RECONSTRUCTION FRAMEWORK

The reconstruction first concerns local populations, and they must be consulted to ensure their needs are understood and taken into account. Connections between family units, schools, living areas and green spaces are vital references for displaced populations, and rebuilding this social fabric is of utmost importance. Rethinking the urban natural environment should include ecological restoration of urban rivers and wetlands, as well as new green zones with ecosystems that resemble nature provide people with green shelters during heat waves, decrease the temperature in cities and positively impact mental health and emotional well-being¹³⁴.

The sustainable reconstruction and recovery framework developed by the World Green Building Council (WorldGBC), European Bank for Reconstruction and Development (EBRD) and United Nations Human Settlements Programme (UN-Habitat) provides one approach to ensure all dimensions are taken into consideration. As shown in the figure below, it evidences the need for planning. Simply rebuilding the same buildings but with higher environmental standards for individual buildings will fail to deliver.

Expertise and technical assistance from peer European cities could be leveraged within the European Alliance of Cities and Regions for the Reconstruction of Ukraine launched at the end of June 2022¹³⁵.

NATURE-BASED SOLUTIONS FOR RESILIENT CITIES WITH MANY ADDITIONAL BENEFITS¹³⁶

Nature-based infrastructure solutions in cities, such as trees, wetlands, parks, open spaces and green roofs address a number of urban development challenges while providing significant co-benefits. For example, research shows that covering 40% of urban areas with tree canopy reduces day-time air temperature by 3°C¹³⁷, building resilience to climate change and reducing air conditioning needs. Tree coverage in cities also helps capture carbon, reduces air pollution, and contributes to the wellbeing of inhabitants and the attractiveness of the city.

Framework for a holistic reconstruction

EFFICIENT RESOURCE UTILISATION

- Materials
- Energy
- Water

HERITAGE

- Archeology
- Heritage

HEALTH & WELLBEING

- Pollution
- Comfort
- Safety
- Social & mental wellbeing

ENVIRONMENTAL & CLIMATE RESILIENCE

- Land
- Ecology
- Climate change mitigation
- Climate change Adaptation

SUSTAINABLE MOBILITY

- Mobility
- Pedestrian infrastructure

INTEGRATIVE SOCIAL & ECONOMIC RESILIENCE

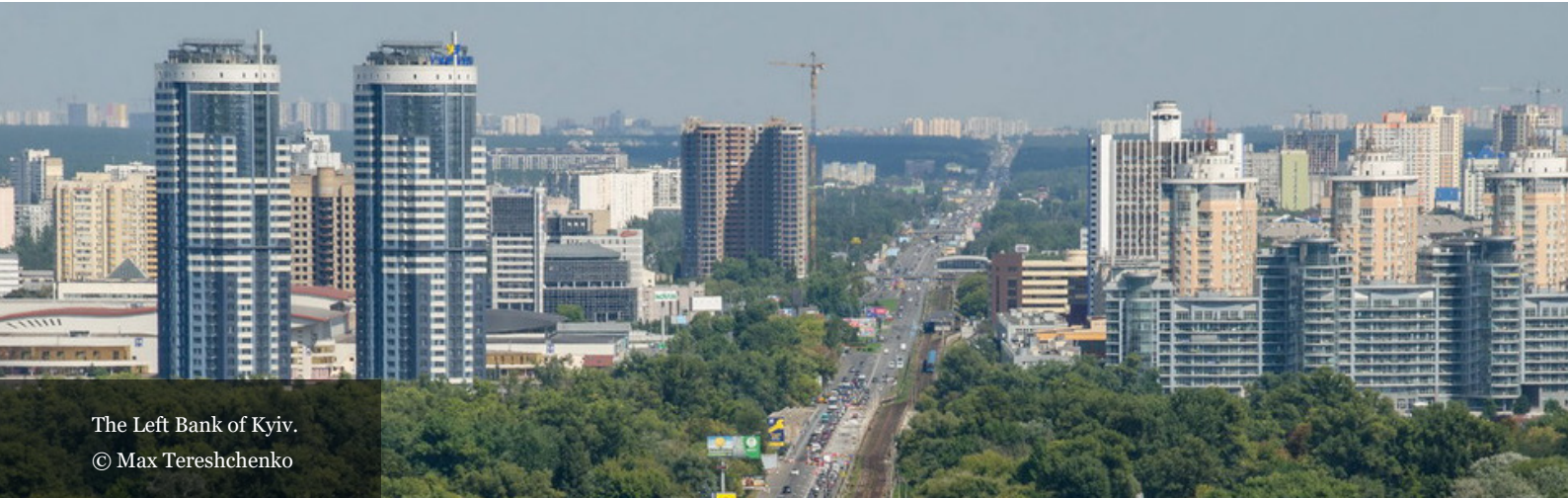
- Social resilience
- Economic resilience
- Education

SUSTAINABLE RECONSTRUCTION FRAMEWORK

Sources: Sustainable Reconstruction & Recovery Framework For The Southern & Eastern Mediterranean, UN-Habitat, EBD; WorldGBC

Local governments should take ownership to design and lead territorial development projects in their area, integrating their population’s needs and the unique characteristics of each

area. Public services need the capacities and competencies to adequately lead local territorial development.



The Left Bank of Kyiv.
© Max Tereshchenko

TRANSPORT

KEY MESSAGES



- Ukraine transportation relies mainly on roads, with 170,000 km of roads, 22,000 km of railway, and high levels of traffic congestion.
- Transport infrastructure is in high need of modernization, with 85% of roads requiring heavy renovation, 50% of railways obsolete and 53% not electrified.
- The National Recovery Plan dedicates \$110bn to the reconstruction and modernization of highways and bridges, and \$3bn to railways.

RECOMMENDATIONS

- Significantly develop the share of zero and low carbon mobility offerings for passengers and freight, with adequate levels of investments reflecting this priority, including electric rail and smart mobility solutions.
- Promote circularity in infrastructure construction, and choose materials and technologies with low environmental footprints and that improve urban resilience.
- Ensure enough space is allocated for low carbon mobility infrastructure, and assess and mitigate urban sprawl effects from infrastructure projects, as part of an overall land use strategy
- Leverage environmental impact assessment of terrestrial and inland navigation transportation infrastructure as a tool to preserve terrestrial ecological connectivity and marine ecosystems, including the avoid-mitigate-compensate hierarchy¹³⁸.



Ecological corridor under the overpass.

© Peter Drengubiak / CHKO Kysuce, SR

AN AGING TRANSPORT INFRASTRUCTURE WITH UNDERDEVELOPED PUBLIC TRANSPORT AND SOFT MOBILITY

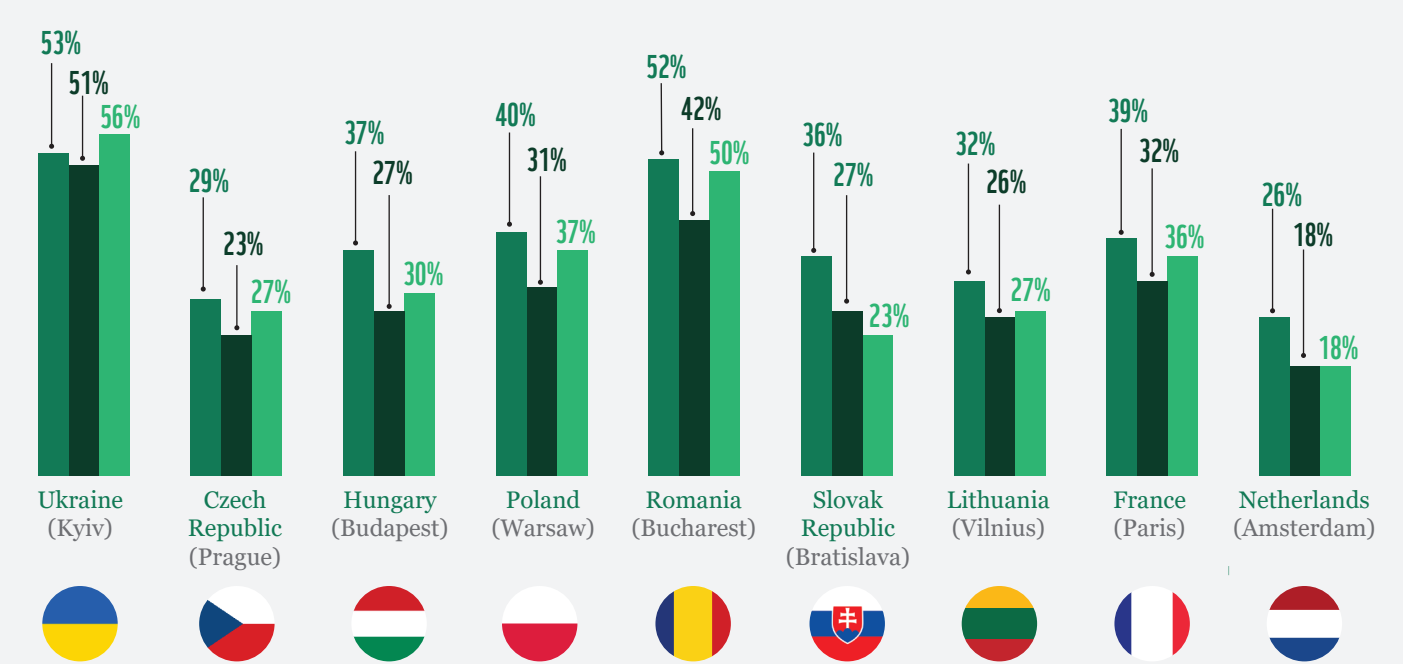
The transport sector significantly contributes to the Ukrainian economy – it accounts for 6.4% of the country’s GDP and 7% of total employment. With 170 thousand kilometers of public roads and 22 thousand kilometers of railway, the Ukrainian transportation infrastructure is heavily concentrated on roads. 85% of the road infrastructure is in need of heavy renovation. The nation’s car fleet is relatively old with an average age for

light duty vehicles of 19 years in 2015¹³⁹, translating into a high level of energy consumption. Half of railroads are obsolete, and 53% are not electrified.

Kyiv has one of the highest levels of traffic congestion among European cities. This pressure on road infrastructure demonstrates insufficient mobility offerings and, in particular, rail and public transportation. With three metro lines and one electric train line to cover its 839 km², Kyiv is underserved in fast public transportation systems. Soft mobilities are on the rise thanks to the 2018 plan for bicycle infrastructure development that includes 240 km of cycling lanes.

Higher traffic congestion in Kyiv than in other EU capital cities

Congestion levels in countries capitals, %



Congestion level is the additional time measured by an average travel compared to the baseline non-congested conditions. Source: TomTom traffic index

War damages to transport infrastructure are estimated at \$35bn¹⁴⁰, of which \$26bn to road infrastructure with 24,000 km of roads (that is, 14% of the network), 18 civilian airports, at least 6,300 km of railways (30%) and 4 ports damaged. In addition to material damages, the economy has suffered losses

due to the disruption of trading and travel routes. The blockade of Ukrainian ports restricts over 70% of the country’s exports¹⁴¹, resulting in additional transportation delays, costs and a decrease in activity.

ZERO AND LOW CARBON MOBILITY SOLUTIONS TO BE DEVELOPED

When reconstructing the transport infrastructure, short and long-term needs should be simultaneously taken into account: answering the urgent need to address vital transport damaged by the war should not lock the country into the same transport mix that prevailed before 2022. Investments to rebuild or rehabilitate carbon intensive mobility solutions (e.g. a road network mainly used by individual vehicles) should be limited to urgent situations for which they provide the quickest answer to their needs. And whenever possible, infrastructure planning should ensure that each phase depicts an overall progression towards lower carbon mobility offering; in other words, short-term plans should be compatible with the development of longer-term low-carbon solutions.

As for passenger mobility, the road infrastructure needs to be restored and modernized. However, plans should prioritize significantly improving zero and low carbon mobility offerings. This means significant investments in railways and trains and their electrification, and, more generally, ensuring that every strategic plan includes not only car infrastructure development, but a comprehensive mix of mobility solutions where the demand for mobility is met and the carbon footprint minimized. The share of investments to develop each type of mobility solution should reflect these priorities.

Investing in smart mobility solutions is also a key factor to optimize the use of transport infrastructure and reduce the carbon intensity of trips. Smart mobility solutions are a way to offer a higher level of service without expanding transport infrastructure or increasing the vehicle fleet. Smart traffic control, car sharing, cars on demand, self-driving cars and micro-mobility solutions all contribute to rethinking and improving the way mobility solutions are provided with the same dimensioning of physical infrastructure.

For freight, the increase of multimodality relies on improving two types of connections. Intermodal connections (nodes between road infrastructure and other transport modes) need to be optimized through technology investments to improve the physical and digital quality of these connections. Connections with the infrastructure of neighboring countries need to be optimized by using compatible technical standards that enable containers to seamlessly pass across borders.

ENVIRONMENTAL IMPACT ASSESSMENT AND A LAND USE STRATEGY TO BE USED FOR PLANNING

The environmental impact assessment of infrastructure projects as promoted by the National Transport Strategy of Ukraine 2030 is a valuable tool to avoid, mitigate or compensate for negative environmental impacts. Inland navigation development

should avoid harming the functioning of water ecosystems and their services to people, and road and rail infrastructure projects should avoid fragmentation of natural habitats. Carefully designed wildlife bridges or underpasses should prevent or minimize remaining harmful impacts.

Transport infrastructure planning is part of land use strategy. Land dedicated to terrestrial infrastructure is a resource that needs to be adequately allocated among different modes, by ensuring that enough of this resource is dedicated to the development of soft and low carbon mobilities such as providing space for bus and bicycle lanes alongside car infrastructure. Impacts on land use, with urban sprawl generated by transport infrastructure projects, should also be assessed and mitigated.

All phases of infrastructure planning from preliminary assessments to project development and monitoring should strongly involve local governments, local populations and businesses, to ensure territorial needs are met while respecting principles of inclusiveness and participation.

LOW ENVIRONMENTAL IMPACTS AND RESOURCE USE TO GUIDE RECONSTRUCTION CHOICES

In infrastructure projects, the construction process, materials used and overall practices have a range of environmental dimensions: carbon emissions and energy consumption, water resource use, materials and waste, land rehabilitation and air quality. Support for solutions with low environmental impacts should be provided in the design phase of projects and through public bidding rules that take into account these dimensions in the selection of contractors.

Circular use of materials and water in the transport infrastructure construction process reduces their consumption. Upstream of the project, this means using industrial waste and materials from old or damaged infrastructure as inputs. Downstream, this involves identifying and connecting to other activities in which unused or degraded resources stemming from transport infrastructure construction can be reintroduced.

The choice of construction materials has an impact on the resource intensity of construction and on climate resilience. In the production of concrete, for example, cement counts for 58% of carbon emissions¹⁴². Solutions for lower carbon intensive cement production exist, such as the use of green energy in the production process, which can reduce its carbon footprint by 25%¹⁴³. Besides low carbon concrete, the choice of materials used in road pavements is an important factor of cities resilience, with the ability to increase soil permeability to mitigate floods and the potential to decrease ambient temperature, thus contributing to climate change adaptation and reducing air conditioning consumption. Experiments launched in several cities across the world show that innovative materials could reduce ambient temperatures up to a dozen degrees¹⁴⁴.

ENERGY AND POWER

KEY MESSAGES



- 55% of gross energy production comes from fossil sources and 34% of energy supply comes from fossil imports; the share of renewable energies is small (9% of production in 2019) but growing rapidly.
- The war has damaged or halted power plants at various levels (including up to 90% of wind power generation); it also put the renewables segment in a vulnerable situation and highlights the dangers of nuclear energy in conflict zones and where water and electricity infrastructure is damaged.
- The National Recovery Plan halts coal production by 2035 and nuclear by 2050; it provides \$57.2bn to develop renewable energies, including 30+ GW of hydrogen (with a share to be exported to Europe) and biofuels from agricultural outputs.

RECOMMENDATIONS

- Design an ambitious energy transition plan, based on scientific modeling of sectoral pathways, that values Ukraine's potential in renewables and leverages green hydrogen, minimizes investments in fossil fuels and other transitional energy sources.
- Create long-term incentives to decarbonize the economy, including mechanisms such as carbon pricing at a level compatible with the achievement of the climate strategy, with targeted support where necessary for vulnerable groups, and progressively remove fossil fuels subsidies to reorient them towards low carbon energies and solutions.
- Ensure consistency between spatial plans for the energy sector and for reconstruction of cities, industry and transport, by identifying “go to” areas for renewable energy development where conflict with environmental conservation and other land use is lowest.
- Develop a robust institutional framework to create renewable energy cooperatives and encourage decentralized energy production.



Freedom square in Kharkiv city, Eastern part of Ukraine.

© iStock-1269157423

AN ENERGY-INTENSIVE ECONOMY RELYING ON FOSSIL FUELS, NUCLEAR AND ENERGY IMPORTS

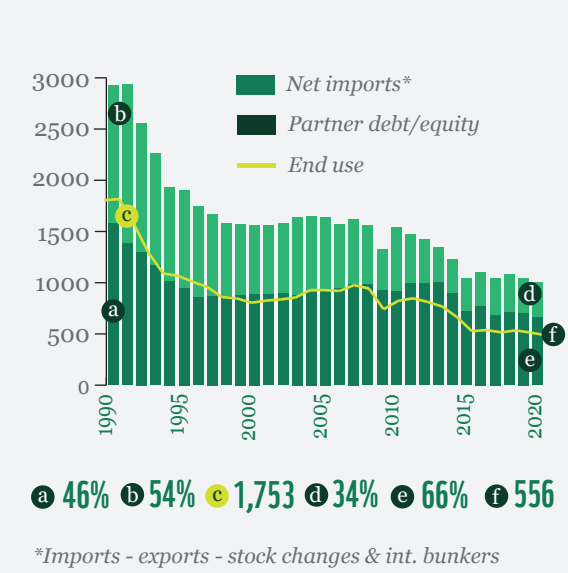
Primary energy supply is defined by the OECD as “energy production plus energy imports, minus energy exports, minus international bunkers, then plus or minus stock changes”¹⁴⁵. Ukraine produced 663 TWh of energy in 2020¹⁴⁶, imported 357 TWh — of which 99% is fossil energy — and exported 14 TWh. International bunkers and stock changes represent a

small amount (1 TWh). Thus 34% of primary energy supply in Ukraine depends on net imports, representing a cost to the Ukrainian economy.

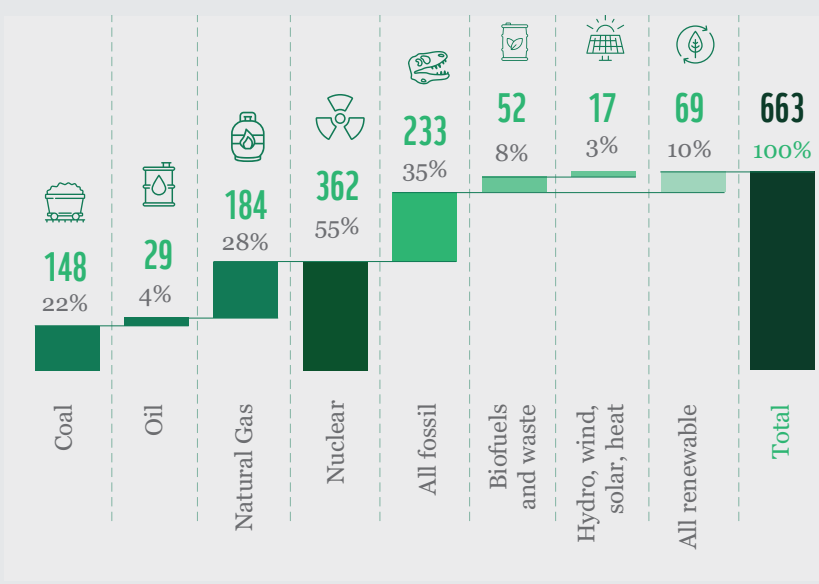
Energy consumption has been divided by a factor 3 between 1990 and 2021¹⁴⁷. But Ukraine’s economy remains highly energy intensive with a high level of fossil fuel subsidies. Paired with the absence of energy performance norms (in the construction sector for example), the current situation offers a large potential for regulatory reforms to tackle energy efficiency issues.

Imports weight 34% of primary energy supply and production is >50% fossil

Evolution of primary energy supply and of final energy end use, TWh/year



Energy production mix in 2020, TWh/year



Source: State Statistics Service of Ukraine

Gross energy production in Ukraine is based on 55% fossil sources, 35% nuclear and 10% renewable energy: this is a more carbon-intensive mix than the EU average (26% of fossil fuels¹⁴⁸), but a comparable nuclear share (31%). 36 years after the Chernobyl disaster, nuclear has a central role in electricity production: in 2020, gross electricity production reached 148 TWh, with 54% nuclear¹⁴⁹, 38% fossil fuels, and 8% renewables. This profile has an equivalent fossil fuel share to the European Union average (36%¹⁵⁰), and a significantly higher share of nuclear power than in the European Union (25%). Ukraine’s nuclear infrastructure is composed of 15 running nuclear reactors¹⁵¹ located in 4 different power plants. They have been

connected to the grid between 1980 and 2004 with an average age of 34 years.

Ukraine is on a path to decarbonize its energy production mix, but there is still considerable potential for improvement. Renewable energy production was multiplied by 2.4 between 2012 and 2020 to reach 69TWh.

The sectors consuming most energy are buildings (39%), manufacturing (33%) and transport (17%). Dedicated sections of the report detail options to improve energy efficiency in these sectors.

AN ENERGY SYSTEM DEEPLY DESTABILIZED BY THE WAR

The Ukrainian government estimates the damages to energy infrastructure to be \$1.8bn as of June 13, 2022. As a consequence of the war, 30% of solar generation, 90% of wind generation, 30% of cogeneration heat and thermal power plants have been either destroyed or occupied¹⁵². The largest

nuclear power plant in Europe, located in Zaporizhzhia, is still under risk of shelling at time of writing this report¹⁵³. The displacement of people and interruption of business activities have also caused a sudden drop of 30 to 35% in electricity consumption¹⁵⁴, resulting in losses of \$9.2bn for the electricity sector¹⁵⁵. This drop has enabled the electricity system to relatively keep meeting the demand despite the significant disruptions to infrastructure.



CASE STUDY: a high risk of bankruptcy for the renewable energy sector

Ukraine's fast growing renewable energy production sector was at an early stage of development before the war. It has faced major losses in the conflict: production assets have been damaged, halted, or are located in the southern and eastern areas with high risk of further damages. Two-thirds of all renewable energy generation is located in southern Ukraine. Concretely, 100% of solar firms have been destroyed in the

Kharkiv region. Two-thirds of wind turbines have been halted. Moreover, nearly half of the electricity market's expected deficit of \$1.2bn by the end of year could be covered by a non-payment of green electricity deliveries according to the National RES industry associations¹⁵⁶, which puts additional financial pressure on the renewables sector and endangers its survival.

THE POTENTIAL FOR AN AMBITIOUS CARBON TRAJECTORY

Ukraine's GHG emission trajectory reflected in its current Nationally Determined Contribution (NDC) translates into a leveling of emissions between the current period and 2030. The NDC was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2021. Ukraine has not yet had the opportunity to review that trajectory in light of the war and the expected impacts of the National Recovery Plan.

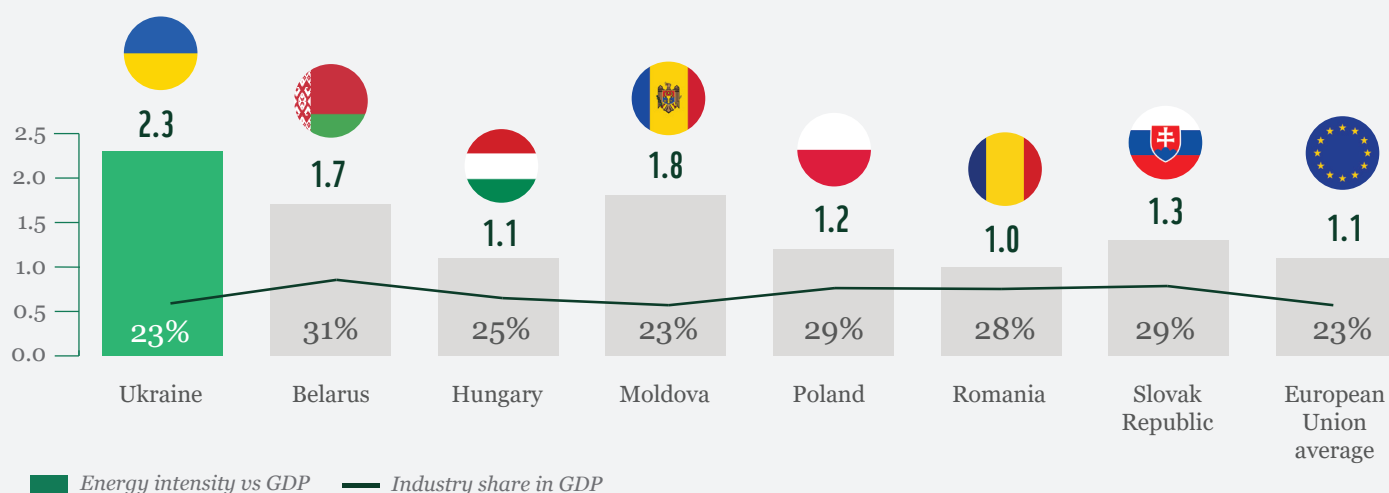
A new emissions reduction trajectory for Ukraine needs to be modeled, building on pillars in the Recovery Plan and driving it further. Ukraine can dramatically improve its emissions

trajectory with two key levers: energy efficiency improvements to reduce energy demand, and growth in low carbon energy production to improve the supply mix.

The energy intensity of Ukraine's economy is up to twice that of its neighbors despite having a comparable or lower share of industry activities. There is indeed significant opportunity to increase energy efficiency and reduce energy demand in every sector. The post-war expected economic rebound can be decoupled in the long run from the level of energy consumption.

Ukraine economy has an energy intensity ~2x its neighbors despite a comparable share of industry production

Energy intensity vs GDP in 2018, kWh/int.\$ and industry incl. construction value added vs GDP in 2018, %



Source: State Statistics Service of Ukraine

Renewable energy has a high development potential in Ukraine, estimated before the war at 1,047 TWh by 2030, of which up to 968 TWh could be cost-competitive (mostly wind and solar)¹⁵⁷. This pre-war estimate is not fully realistic, though, as it would cause massive impact on land use and local environmental pressures; but a share of this potential could be effectively mobilized while respecting the imperative of biodiversity preservation.

In the long run, developing renewable energy should be part of a global strategy to switch all electricity production to low-carbon sources, together with a plan for the electrification of

industry, heating and transportation. This pathway should lead to a decline in fossil fuel consumption and ultimately to a phase out, after a transitory period during which fossil fuels remain necessary to balance energy supply and demand, and fulfill the needs of the economy.

As part of the recovery, investments in fossil fuels should be minimized to avoid the creation of stranded assets that will lock the Ukrainian economy into unsustainable production models. As stated by the International Energy Agency, “there is no need for investment in new fossil fuel supply” if we are to achieve a Net Zero scenario by 2050¹⁵⁸.

“**THE ERA OF COAL AND OIL HAS CAUSED HUGE DAMAGE TO THE ENVIRONMENT, TO OUR PLANET AS A WHOLE. GREEN TECHNOLOGIES AND GREEN ENERGY HAVE BECOME A LOGICAL AND JUST ANSWER TO THIS CHALLENGE.**”

Speech by President of Ukraine Volodymyr Zelenskyy in Folketing, 29 March 2022¹⁵⁹

THE IMPERATIVE OF AN INTEGRATED STRATEGY TO REDUCE RELIANCE ON FOSSIL FUELS

Designing the energy transition of Ukraine into a more efficient and decarbonized model requires the technical exercise of scenario planning and setting a comprehensive strategy across all sectors. The energy mix trajectory should consider the potential from renewable energy, its evolution under appropriate supporting policies, as well as how energy demand will evolve.

Planning for the energy sector needs to be done in tandem with plans to reconstruct cities, industry and transport. Specifically, it requires a careful mapping of “go to” areas with full involvement of local stakeholders, where harmful impacts of renewable energy projects on biodiversity are minimal, and where authorization of renewable energy installations should be prioritized (e.g. degraded land, contaminated soil and distance from settlements) and “no go” areas where conflicts with nature conservation or water quality objectives are high.

It also needs to account for the intermittency of solar and wind electricity production and how to balance it. Measures acting on the energy demand profile, such as Demand Side Response, allow to shift 15% of electricity consumption and up to ~25% under favorable policies¹⁶⁰. Additionally, highly flexible power supplies should be built, prioritizing renewable fuels development.

The National Recovery Plan projects to develop a capacity of more than 30 GW of hydrogen. The underlying development and use strategy should be clarified, to define the potential for green hydrogen and extent to which it could be mobilized as a resource to balance the electricity supply. Green hydrogen is a mature technology, even if industrial scale up remains to be proven, that stores energy out of renewable electricity. It has a significant potential to replace classic fuels for energy intensive activities such as steel production and to contribute to the electricity system balance. It thus plays an important role as part of the energy strategy where it needs to first fulfill national needs for industry (including fertilizers, steel, shipping) and electricity generation and where the surplus could be exported to supply European countries. The export ambition needs to be carefully assessed as hydrogen production requires high amounts of green electricity, and long-distance transportation is not easy. Feasibility will depend on investments and

technology bets, such as repurposing gas pipelines, which comes at approximately one-third the cost of a new pipeline for investments in compressors¹⁶¹, or blending a share of hydrogen with natural gas in gas pipelines¹⁶².

Measures also need to be crafted to stimulate renewable energy consumption in every sector. For instance, in heat production for buildings, this means increasing the share of biofuels and waste (6% in Ukraine, two times less than the OECD average¹⁶³); in transport, incentivizing the incorporation in gasoline and diesel of biofuels that have no food or carbon storage application; or in agriculture, supporting local energy generation and consumption from agricultural waste.

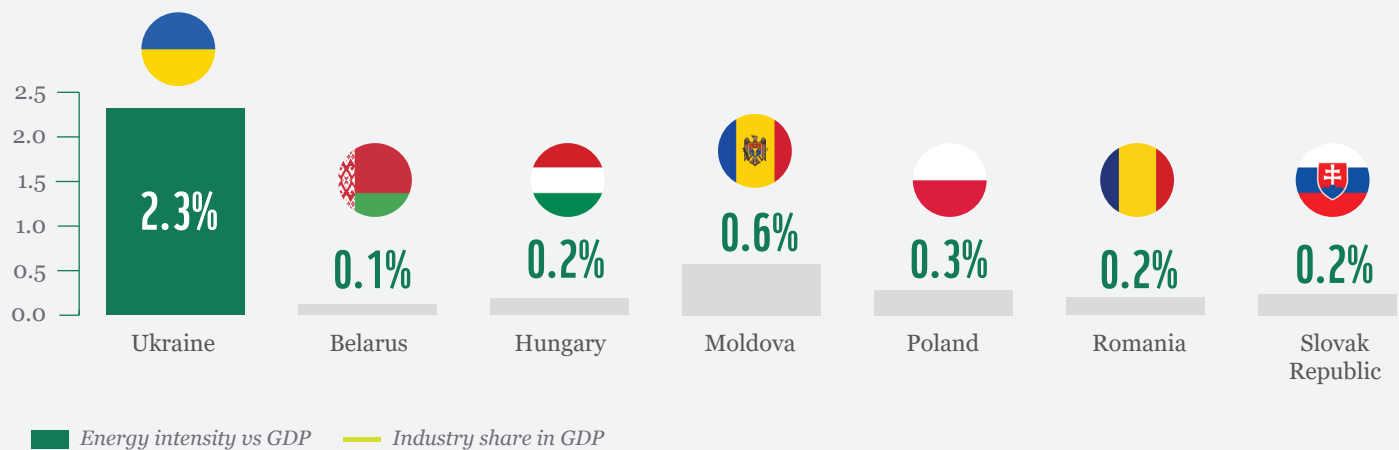
In the strategy for green and low-energy transition, providing the right financial incentives is a key success factor. This should be done by setting an efficient price on carbon, reducing subsidies to fossil sources, and financially supporting businesses and employment in low carbon and energy efficiency sectors - with part of the revenues from the first two levers granting funds for the last one.

For carbon pricing, Ukraine has a carbon tax with one of the lowest rates in the world - despite a rate that increased from UAH 10 to UAH 30/tCO₂e (approximately \$1/tCO₂e) in January 2022¹⁶⁴. This equals to a \$0.10 tax on a 40-liter car petrol fill-up¹⁶⁵. A progression of the carbon tax rate to an adequate level could have decisive effects to orient economic behaviors towards higher energy efficiency and lower carbon solutions by supporting their economic attractiveness. Carbon pricing is a strong financial instrument. To be effective, it should be predictable - with a stable enough trajectory and enough visibility several years ahead for all economic stakeholders. It should also not burden economic activity, employment nor the situation of the Ukrainian people. It should follow the principles of Just Transition, such as the EU Just Transition Mechanism (JTM)¹⁶⁶ and provide targeted support to vulnerable groups to help them adjust.

Parallel to carbon pricing, fossil fuels subsidies should be reduced. In Ukraine, the share of these subsidies to GDP is 4 to 19 times greater than in neighboring countries. These subsidies support a high carbon and an energy intensive model, canceling part of the effects of measures that favor the energy and carbon transition. Public financial support for fossil fuels should be progressively removed and reoriented toward climate-friendly solutions.

Fossil fuel subsidies vs GDP in Ukraine are higher than its neighbors by an order of magnitude

Fossil fuel subsidies incl. electricity of ossil origin as part of the country’s GDP in 2020



Source: Fossil Fuel Subsidy Tracker

Among solutions to support the production of renewable energy, local energy communities like those cited in the EU Clean Energy Package framework help citizens take ownership in the transition to climate neutrality. Social engagement is critical to building a stronger and future-proof post-war Ukraine, generating

income for households, fighting energy poverty and promoting innovation. Decentralized energy production structures can also be built by companies provided they are given the right incentives and ability to connect to the grid.



AGRICULTURE

KEY MESSAGES



- Agriculture is important for Ukraine's economy (40% of export revenues) but also for global food systems, as Ukraine is a top 5 global exporter of wheat, sunflower oil and other crops.¹⁶⁷
- High production and above-average yields¹⁶⁸ have been realized at the expense of Ukraine's nature: soil erosion (40% of Ukraine's agricultural land) and illegal pesticides (25% of the pesticide market) are common issues, while fertilizer use by hectare has been multiplied by 5 in 20 years¹⁶⁹.
- The war has heavily disrupted Ukraine's agricultural supply chains and production, and there is now a global imperative to preserve levels of production and secure the supply chain.
- While transforming the agricultural sector is critical for securing ecosystem services, the Recovery Plan does not really tackle these issues, with only 4% of the investment package for agriculture directed to the green transition of the sector (\$1.1bn for precision farming, out of \$28.5bn).

RECOMMENDATIONS

- Develop a holistic transition plan for agriculture that considers citizens' food and water security, farmers' livelihoods, global transition of food and diet systems, climate change adaptation and development of local value chains.
- Give a new direction to Ukraine's export-focused agriculture by implementing wider systemic changes in practices, in line with nature-based solutions and the EU's list of eco-schemes, such as organic agriculture (EU target of 25%), agroforestry and conservation agriculture.
- Deploy adequate technological solutions to accompany these agricultural and ecological transitions, such as precision farming tools that would help decrease water and pesticide use, in line with the EU's Farm to Fork Strategy targeting a 50% reduction in pesticide use.
- Develop an agricultural land use strategy that ensures a diverse and resilient landscape by reaching a balance in the repartition of cultivated land, pastures, hayfields, forests and shelterbelts.



Natural islands are an example of a nature-based solution (NBS) supporting sustainable agriculture.

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WORLD-LEADING AGRICULTURAL EXPORTS, BUT AT THE EXPENSE OF UKRAINE'S SOILS

Agriculture is one of the most important sectors for Ukraine's economy, and for food stability globally. It represents a 12.2% direct contribution to Ukraine's GDP¹⁷⁰, and up to 20-22% when including upstream and downstream sectors¹⁷¹. 13.8% of Ukraine's population worked in agriculture as of 2019¹⁷², with the average farm worker earning \$220/month¹⁷³.

Ukraine's agricultural system is heavily geared towards exports: 40% of export revenues are generated from agriculture, and Ukraine represents 9% of global wheat exports, 12% of corn, and even 46% of sunflower oil. This makes Ukraine one of the world's major food exporters, with leading positions in key crops (1st globally for sunflower oil, and top 5 for wheat, corn and barley). Most major productions are exported without processing (55-60% of maize, wheat and barley¹⁷⁴), resulting in part of the value being captured by importing countries. This point is tentatively addressed by the Recovery Plan, with large investment packages aimed at building the country's agro-processing industry (e.g. \$10.2bn destined to the crops processing industry alone).

Ukraine's agricultural model has been ramping up from its previous extensive model, to a new *large-scale intensive* model. This has been realized in part through the increased share of

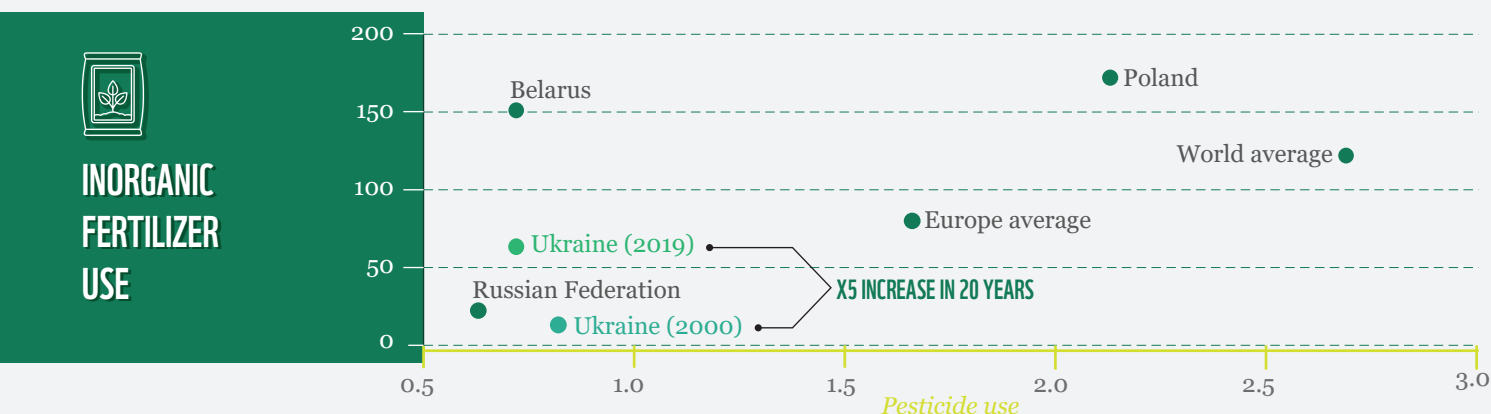
large agricultural enterprises ("*agroholdings*") controlling land through long-term leases: the share of land leased by *agroholdings* grew from 8% in 2007 to 29% in 2017¹⁷⁵. Ukrainian agricultural SMEs still carry a significant weight in this expansion too, with around 50,000 legally registered entities currently active in the agricultural sector¹⁷⁶; though many SMEs struggle to expand because they lack access to finance, talent, markets, knowledge and support¹⁷⁷.

This transition to an intensive model has driven up the use of agricultural inputs, in particular fertilizer use, with levels converging toward the European Union average over the last 20 years:

This has negatively impacted soil and plant management: most farm operators have abandoned traditional crop-rotation practices, such as the 1-in-7 principle that ensures that sunflowers are not planted more than once every 7 years in the same field¹⁷⁸. Around 1 million hectares of agricultural land are monocultures today¹⁷⁹, and the share of sunflower cultivation jumped from 5% to 15% of sown area compared to 1990 levels¹⁸⁰. This goes hand-in-hand with excessive tillage, with more than half of Ukraine's land being plowed¹⁸¹, as well as mismanagement of the water regime of soils through inefficient irrigation. Less than 0.5 million hectares of land is properly irrigated today¹⁸², despite infrastructure that used to cover up to 2.2 million hectares during the USSR period¹⁸³.

Ukraine's use of fertilizer jumped by 5x over the last two decades

Use of agricultural inputs in Ukraine (in kg per ha, for cropland area only, 2019)



Source: Food and Agriculture Organization (FAO), BCG analysis

A DIFFICULT HERITAGE FOR UKRAINE'S GHG EMISSIONS: UKRAINE'S DRAINED PEATLANDS

Between 1965 and 1990, to pave the way for Ukraine's agricultural development and expansion, a significant number of peatlands (around 1 million hectares) were drained for agricultural purposes. These lands now suffer from intense mineralization. More importantly, instead of being carbon absorbers, they now generate massive levels of greenhouse gas emissions through microbial peat oxidation and peat fires. As a reference point, drained peatlands play a disproportionate role in worldwide GHG emissions: they generate 5% of the world's GHGs while only representing 0.3% of the global land surface¹⁸⁵. Solutions to this issue lie in restoring these wetlands (as well as the freshwater buffer zones), while continuing agricultural exploitation where possible through paludiculture.

Those practices tend to accelerate erosion, pollute soils, and reduce soil fertility. 40% of Ukraine's agricultural land is currently subject to erosion¹⁸⁶, including 5 million hectares of land affected by moderate to high erosion levels, and 1.2 million hectares considered "significantly eroded." Soil fertility is also impacted, with soil humus content decreasing at ~3% over 10 years (from 3.24% to 3.14%). Last, soil pollution is happening at scale, through the excessive use of legal substances as well as illegal pesticides (25% of the Ukrainian's pesticide market¹⁸⁷) growing from a lack of implementation of international regulations, according to the UN.

LIMITED DAMAGES TO THE LAND, BUT HEAVY DISRUPTIONS TO THE SECTOR

To date, around 5% of Ukraine's agricultural land has been damaged by the war¹⁸⁸, through shelling, direct combat or large-scale fires caused by either of the two previous confrontation types. The FAO estimates total damages on the agricultural supply chain to be \$6.3bn¹⁸⁹; this includes destroyed irrigation, infrastructure, storage facilities, machinery and other agricultural equipment, port

infrastructure, greenhouses, field crops, livestock and processing plants. Over 10,500 agricultural enterprises are located in the regions immediately affected by fighting in Ukraine.

Another impact of the war is the loss of access to arable land due to unexploded ammunition, mining and explosives. Pre-war Ukraine was already one of the most mine-contaminated countries in the world¹⁹⁰, and the current war has greatly increased the problem: 83,000 km² of land is estimated to be affected by mines¹⁹¹, representing around 15% of the country. According to UNICEF¹⁹², "10 to 30% of the explosive weapons used, dropped, fired or launched do not explode as intended and many other explosive ordnance are abandoned in various locations". Decontamination will take time. Only around 150,000 explosive items have been cleared by the State of Ukraine since the beginning of the war - and there have been more than 150 mining casualties¹⁹³.

The impacts of the war on global food security have also been widely described¹⁹⁴, and long term solutions laid out: "Avoiding more such crises in the future will require diversifying food production across diets, supply chains, and markets and addressing issues of indebtedness, economic inequities, and market distortions that have contributed to the current crisis"¹⁹⁵.



CASE STUDY: Ensuring Ukraine's food security through "Victory Gardens"

Food security is at risk in Ukraine, due to farms being directly affected by war and due to ruptures in supply caused by the occupation of southern territories, which are one of the main suppliers of fresh food. One of the solutions against this problem lies in the "Victory Gardens" initiative launched by the SURGE Project in cooperation with the Ukrainian Ministry of Agrarian

Policy and Food, which encourages the growth of vegetable, fruit and herb gardens in private homes and public parks. This campaign is modeled after a similar "Victory Gardens" campaign organized in the United States during World War II. At the time, it resulted in more than 20 million household-managed gardens producing around 10 millions of tons of fruits and vegetables per year.

The long-term impact of the war on Ukrainian agriculture is yet to be determined. A first order of disruptions affecting Ukraine's agriculture lies in lost outputs and revenues due to the war. The FAO estimates that 20% of Ukraine's total agricultural output has been foregone (equivalent to \$6.5bn losses), with an overall impact on the agribusiness sector of \$16.7bn¹⁹⁶. Concretely, this involves disruptions to sowing and harvesting of crops, due to planting that didn't happen (with a ~20% decrease in spring crops planted), but also due to difficulties in being able to harvest crops because of missing manpower or fuel for mechanical equipment. (*"The availability of fuel will determine how much of the areas can be harvested and the crop yields stored"*, according to the FAO.) Overall, damages to the land and unharvested crops constitute 50% of the damages to Ukraine's agricultural sector in value¹⁹⁷.

The second order of disruptions involves destroyed or overcrowded agricultural supply chains. Part of the agricultural infrastructure has been destroyed, from storage to roads, and this causes numerous issues for Ukrainian farmers who are not able to distribute their production at all, or at prohibitive costs. This results in much lower revenues for farmers as exporters need to face these higher costs. For instance, in some cases the market price of corn at farm gate more than halved¹⁹⁸. With the military blockade of sea ports, exports have decreased from 6-7 million tons per month pre-war to 1.5 millions tons per month¹⁹⁹.

The last order of disruptions involves the loss of agricultural land and territories in southern and eastern areas of Ukraine now under occupation – preliminary calculations²⁰⁰ show that around 20% of the country's production of wheat, sunflower and barley could be affected.

TECHNOLOGY AND SYSTEMIC CHANGES IN PRACTICES TO SOLVE UKRAINE'S AGRICULTURAL ISSUES

A first array of solutions lies in the development and deployment of precision agriculture technology solutions. It is notable that the current draft National Recovery Plan for Ukraine (July 2022) mentions that \$1.1bn of investments should be devoted to "promoting the transition of the agri food sector to green growth by enabling precision farming"; the amount is relatively low compared to the full agricultural investment package target (\$28.5bn in total for agriculture).

The most promising precision agriculture technologies are variable-rate nutrient application (VRNT), machine guidance (MG), variable-rate irrigation (VRI) and controlled traffic farming (CTF). They rely on GPS (radars, radio navigation and receivers),

sensors for monitoring liquids (fuel, water, etc.), meteorological stations, as well as sprayer and sprinkler nozzles, among other tools. These technologies have a demonstrated positive impact on GHG emissions reduction for agriculture (1.5% for VRNT technologies, for instance²⁰¹), but also have positive environmental co-benefits on air and water quality by reducing ammonia volatilization and nitrogen leaching and runoff.

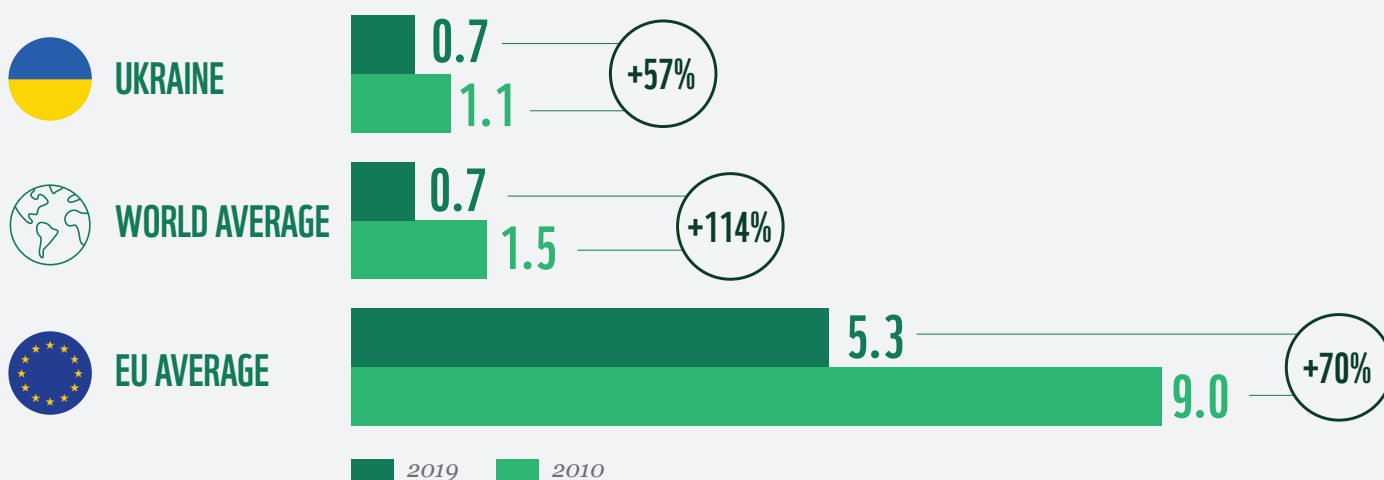
In the context of the war and the global food crisis, maintaining production is essential. Deploying a full array of ICT solutions and tools in Ukraine's agriculture could restore yields and save resources. According to the UNEP²⁰², the application of modern ICT over 10 million hectares of agricultural land in Ukraine could result in 20% savings in the use of fertilizers (through variable rate application technologies, without productivity losses), increased fuel efficiency of 10-15% per hectare of land cultivated (through GPS trackers), and the control of land use practices - including land use changes that increase GHGs emissions (through satellite and aerial images analysis). Implementing ICT technologies could decrease emissions by up to 2 Mt of CO₂-eq. per year.

“THE COVID-19 PANDEMIC, INTERRUPTION IN INTERNATIONAL SUPPLY CHAINS, AND THE WAR IN UKRAINE HAVE SEVERELY DISRUPTED FOOD, FUEL, AND FERTILIZER MARKETS, WHICH ARE INTERLINKED. SUPPORTING RESILIENT INVESTMENTS IN AGRICULTURAL CAPACITY AND PROVIDING SUPPORT TO ADAPTATION, SMALLHOLDER FARMS, FOOD SYSTEMS AND CLIMATE-SMART TECHNOLOGIES ARE ESSENTIAL TO DEVELOP A RESILIENT CLIMATE-SMART AGRICULTURE”

Joint Statement by the Heads of the Food and Agriculture Organization, International Monetary Fund, World Bank Group, World Food Programme, and World Trade Organization on the global food security crisis, July 15, 2022²⁰³

Organic agriculture is still marginal in Ukraine

Share of agricultural areas under organic agriculture (in %, evolution from 2010 to 2019)



Source: Food and Agriculture Organization (FAO), BCG analysis

Ukraine's agricultural sector needs a more profound systemic change than a step up in technology. Sustainable consumption and reduction of food loss are necessary. Agriculture needs to move away from the short term focus on output and yields, and transition to a paradigm of "healthy and nutritious food with preservation of nature for future food security". A first change could be the development of organic agriculture. While local demand is still low, this could be suitable for exports to the EU where there is significant consumer demand. This trend should be reinforced in the coming years through the EU Green Deal target aiming for at least 25% of EU agricultural land under organic farming²⁰⁴. UNEP recommends a mid-term target of up to 10% organic farming in Ukraine, much higher than the initially planned 3% target set in the 2021 National Economic Strategy for 2030²⁰⁵.

Other nature-positive systems of production could be developed in Ukraine, such as the scaling up of agroecological approaches (e.g. agroforestry and conservation agriculture). For agroforestry, notably, UNEP estimates that shelterbelts (tree shelters) could cover up to 440,000 hectares of Ukrainian arable land in the long term²⁰⁶, and that optimally selected shelterbelts might increase crop efficiency by up to 33 %, while generating additional non-timber green goods revenues of about \$60,000 per hectare. Agroforestry comes with co-benefits, such as higher adaptability to climate change. Agricultural conservation is a method best used jointly with drip irrigation technologies, which together could be applied on up to 700,000 hectares of land across Ukraine by 2030²⁰⁷, resulting in 1.5-2.0x cost reduction ratios for labor, fuel and equipment maintenance.

“INTRODUCING NATURE BASED SOLUTIONS IS A VERY IMPORTANT STEP FOR THE DEVELOPMENT OF UKRAINE’S AGRICULTURAL SECTOR. CLIMATE CHANGE AND THE IMPACT OF THE WAR ARE REDUCING PRODUCTIVITY AND THE AVAILABILITY OF CULTIVATED AREAS. NATURE BASED SOLUTIONS WILL ALLOW US TO USE RESOURCES SPARINGLY AND PRESERVE UKRAINE’S POTENTIAL AS ONE OF THE WORLD’S LEADING AGRICULTURAL PRODUCERS FOR MANY YEARS TO COME.”

Maryna Kaliuzhna, Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Agro-industrial group “Arnika”²⁰⁸

Transforming agriculture toward nature-positive food systems cannot happen without a switch to healthy and sustainable diets²⁰⁹, in particular through a decrease in animal protein consumption. Such a switch would generate large and profitable economic opportunities for companies developing alternatives to animal proteins, while achieving a strong positive impact on climate: as per BCG's research, *"investing in plant-based proteins has the highest emission savings per invested capital"*²¹⁰. And with trade increasingly shifting towards the European Union, Ukraine could consider prioritizing such productions. A robust strategy for agriculture should consider evolutions in diet together with sustainable production. The initial Recovery Plan includes large investments in meat and milk production (target of \$5.5bn investments²¹¹) - though the plan

also aims to develop the cultivation and processing of vegetables, fruits, berries, and seeds products in Ukraine (\$7.7bn).

Smart policies can guide private actor actions toward nature-positive agriculture. Ukraine could benefit from adopting new laws in line with the European Union's goals and directives. For instance, adopting the EU goal of 10% of agricultural areas under natural landscape elements would increase biodiversity and preserve productivity over the long-term; and harmonizing the Ukrainian pesticides legislation with the EU pesticides directive (Directive 2009/128/EC) would solve the previously-mentioned pesticide use issue. The challenge will be in implementation and enforcement, e.g. through more frequent controls of crop rotations or of crop residue uses, to ensure the prevention of soil degradation and thereby ensure food security for future generations.

COMPANIES LEADING THE WAY: FOCUS ON ASTARTA-KYIV

Astarta-Kyiv is a Ukrainian agricultural and industrial listed company²¹² with leading positions in sugar, milk and cattle production²¹³ as well as soybean processing, among other products. In 2022, its CEO Viktor Ivanchyk was named an "SDG Pioneer for Sustainable Business Strategy" by UN Global Compact, in recognition for his achievements in leading Ukraine's agricultural sector towards sustainability. In particular, Astarta-Kyiv implemented energy efficiency programs that achieved a 14% reduction in diesel fuel consumption, as well as gas, electricity and water savings in several sugar plants.



THE PRESERVATION OF UKRAINE'S NATURAL ECOSYSTEMS DEPENDS DIRECTLY ON A SUSTAINABLE APPROACH BY BUSINESSES. TO PRESERVE NATURE'S INTEGRITY, IT IS VITAL TO IMPLEMENT CARBON FARMING AND FOCUS ON ENERGY AND RESOURCE EFFICIENCY. UKRAINE IS IN HIGH NEED TO WIDEN REGENERATIVE AGRICULTURE PRACTICES -SUCH AS NO-TILL FARMING, PLANTING OF COVER CROPS, USING NITROGEN INHIBITORS, REDUCING APPLICATION OF SYNTHETIC FERTILIZERS, AMONG OTHERS, TO BUILD UP ORGANIC MATTER IN SOIL. THE SUSTAINABILITY APPROACH SHOULD ESPECIALLY BE SCALED UP IN TIMES OF WAR, ALONG WITH SUPPORTING THE ENVIRONMENT AND PEOPLE'S STANDARDS OF LIVING."

Viktor Ivanchyk, CEO and Founder of "Astarta-Kyiv"²¹⁴

STABILIZATION & CLEAN-UP AS PREREQUISITES

Peace, the prospect of stabilization, or at least some return to normalcy with relative security on flows of agricultural products, are essential conditions for the implementation of the solutions. To quote the FAO²¹⁵, *"it is clear that investment will not flow under uncertainties on the control of sovereign territory, access to ports and markets, market infrastructure, domestic consumption based on the return of refugees and internally displaced people, the resumption of usual business activities and many other conditions."*

Also, the actual clean-up, demining and reconstruction of the agricultural sector will have to be done in an integrated manner with the other sectoral reconstruction strategies. Notably, infrastructure (especially roads and trains) are key for ensuring that Ukraine's agricultural output circulates internally and internationally, especially with the uncertain blockades on ports. For low-value goods such as cereals, there is no real economically viable alternative to deep sea shipping, otherwise transport costs will reach unsustainable levels and create pressure on farmers' livelihoods. Housing will need to be reconstructed in rural areas damaged by the war, so that displaced agricultural workers can once again live and work in the same place.

INDUSTRY

KEY MESSAGES



- Due to history, inefficiencies and the presence of heavy industry, Ukraine's industry is one of the most energy intensive in Europe and Central Asia. Energy intensity of GDP is more than twice Europe's average. Industry causes at least 25% of Ukraine's CO₂ emissions²¹⁶, as well as waste and pollution issues.
- The impact of the war has been tremendous, with \$9.5bn²¹⁷ of destruction so far, and notably with the destruction or military occupation of key industrial sites.
- This situation can be viewed as the right window for a green rebuilding from the ground up, following decades of under-investment. With average labor costs well below the EU average and a global trend to regionalize supply chains, Ukraine has the potential to become an industrial cradle turned toward the EU if investments are well directed and targeted.

RECOMMENDATIONS

- Achieve Net Zero objectives in line with EU targets through the reconstruction, thereby enabling EU integration as well as environmental competitiveness.
- Lay out a clear green industrial policy focused on key technological bets, with a concentration of resources on eco-industrial parks that could achieve a green-based competitive advantage.
- Transform the wider industrial model on the principles of efficient use of natural resources and circularity (use of co-products, emissions of pollutants, energy efficiency, waste management, etc.) - in particular through Industry 4.0 models.



Azovstal, a metallurgical plant in Mariupol, before its destruction.

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A CAPABLE BUT DATED, ENERGY-INTENSIVE AND POLLUTING INDUSTRIAL SECTOR

Ukraine has a large industrial and manufacturing base, with historical concentrations in heavy industry, including mining, railway rolling stock, machine tools, aircraft engines, as well as light manufacturing and the food industry²¹⁸. The manufacturing sector represents around 10% of the GDP, while industry as a whole (including the construction sector) generates around 24% of the GDP²¹⁹; this is in stark contrast to the post-USSR Ukraine in which more than 30% of GDP was generated exclusively by the manufacturing sector. Existing industrial assets are evenly distributed among four subsectors²²⁰, namely light industry, coke/chemical/minerals manufacturing, machinery and equipment manufacturing, and metallurgy. On the employment side, Ukraine's industrial sector employs around 25% of the working population²²¹.

Similar to the agricultural sector, the industrial and manufacturing sector is disproportionately important for exports, with 42.5% of the country goods exports generated by manufacturing²²², while the remainder is composed of agricultural, fuel and mining exports. In particular, the role of the metallurgy subsector is critical, accounting for 23% of Ukraine's total exports in 2018, with around 90% of steel production being exported²²³ - notably to Italy and Turkey²²⁴. These capabilities are actually inherited from the USSR period, as Ukraine was then designed as a metallurgy center in the USSR thanks to its rich iron ore resources.

Ukraine is one of the most energy intensive countries in the world according to the World Bank, with an energy intensity in 2018 of 2.3 kWh per \$ of GDP (more than twice Europe's average²²⁵). The industry sector plays a key role in this issue, as it accounts for 35% of the final energy consumption in the country²²⁶. This situation was enabled over the years by cheap energy prices (50% lower gas prices than Germany over the 2000s decade²²⁷), but it was also driven by the focus on exporting energy-intensive products. It is in particular the case for steel, which is still produced through legacy technologies, due to chronic under-investment since the USSR period, resulting in 90% of Ukraine's steel mills and furnaces being fully depreciated²²⁸. Another example of this issue can be found in Ukraine's glass-making industry, which requires roughly twice as much energy input per unit of final product compared to the EU average²²⁹.

In terms of direct GHG generation, Ukraine's industrial sector only contributes to around 25% of the country's GHG emissions²³⁰, but this figure needs to be re-assessed by taking into account the weight of industry in total energy consumption: the industrial sector consumes 35% of the country's energy²³¹. Ukraine's industry's CO₂

impact is therefore multiplied by its reliance on a heavily carbonated energy sector. Again, metallurgy is a core factor, with 24% of steel being produced using inefficient open-hearth furnace (OHF) technology, which have already been phased out in many countries due to its level of pollution and energy consumption²³². As a result, around 55% of Ukraine's industrial emissions are generated by iron and steel production only²³³.

Last, in terms of waste production and management, the imperfection of Ukrainian industry's outdated technologies does not allow a comprehensive processing and use of resources, in particular for mineral resources. Much of it is returned to nature in the form of waste. And waste itself is poorly utilized. For instance, almost none of the waste generated by ore enrichment processes is re-used (e.g. in construction materials), while theoretically 70% of such waste could be re-deployed²³⁴. Overall, in 2019, only 0.14% of the waste (among all sectors) was recycled and 1.7% was burned for energy, while the rest was disposed of in landfills and dumps²³⁵. There was some progress before the start of the war, though, and signs of increasing awareness of the issue, with for instance in 2021 a coalition of companies, united by the American Chamber of Commerce in Ukraine and the Ukrainian Packaging and Ecological Coalition, that started launching a Producer Responsibility Organization (PRO) in the field of packaging²³⁶.

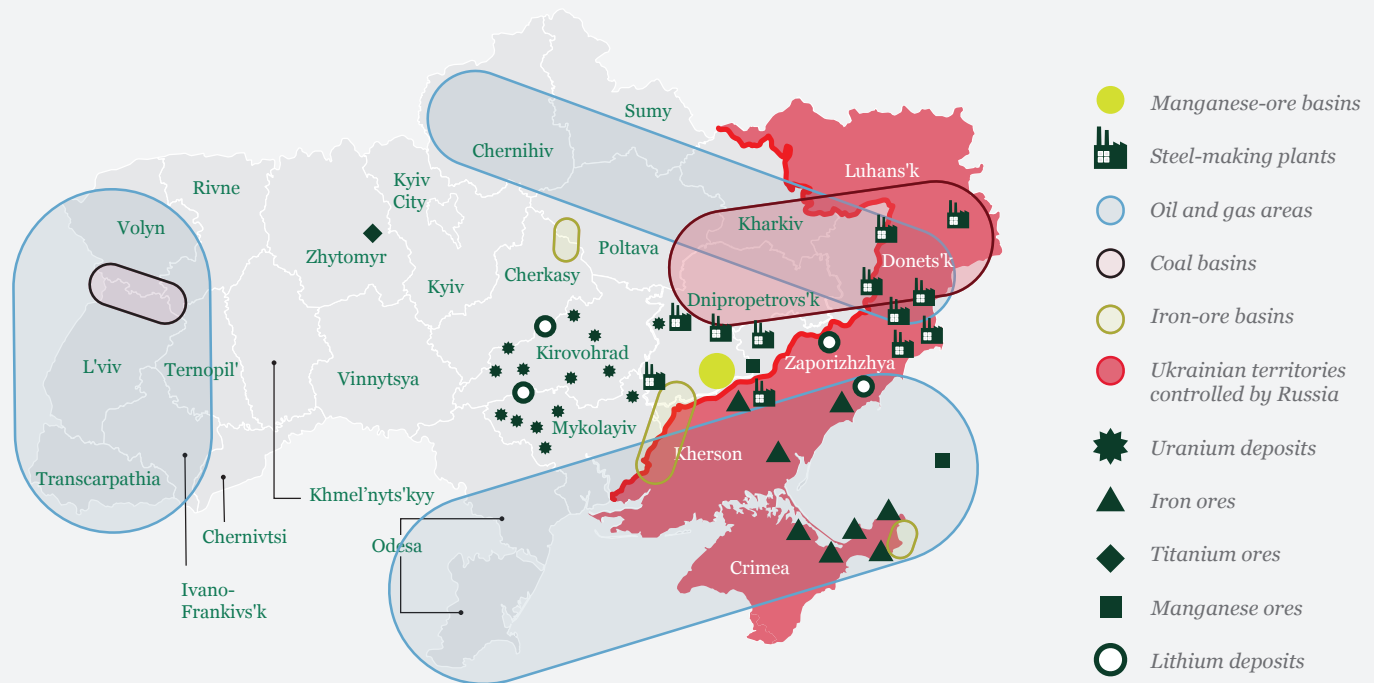
A WAR-DEVASTATED INDUSTRIAL CAPITAL

The war has been very destructive to Ukraine's industrial sites. The sector has suffered at least \$9.5bn in destruction²³⁷ since the beginning of the conflict. Major Ukrainian production sites such as Mariupol's Azovstal iron and steel works²³⁸ or Severodonetsk's Azot chemical plant²³⁹ have been destroyed; while many others of all types have been damaged due to their locations in or near big strategic cities. Production has dropped fast. For instance, estimates are that steel production has been cut in half during the first semester of 2022 compared to the previous year²⁴⁰.

This destruction also causes air pollution incidents and potentially serious contamination of ground and surface waters, according to UNEP²⁴¹. Numerous industrial facilities, warehouses and factories have been damaged while they were storing a range of hazardous substances ranging from solvents to ammonia and plastics.

Beyond the destruction, what is most affecting Ukraine's industry is the loss of control of industrial areas in the eastern and south-eastern parts of the country. These areas were built in proximity to both heavy industry sites (in particular steel production) and natural resources extraction basins (iron ore, coal, etc.). Lost areas are mapped below. A status quo in the conflict would require entire industries to be rebuilt from the ground up.

Ukraine's major industrial sites and resources basins in the East & South-East are now controlled by Russia



Source: Berlin Economics, 2021; Center for Economic Recovery, 2022; Wikipedia, retrieved on 23 Aug. 2022 (for areas controlled by Russia)

ECONOMIC SAVINGS IN THE LONG TERM THROUGH GREEN MODERNIZATION

Decarbonization of industry is not easy. A 2020 BCG global survey²⁴² found that worldwide only 13% of industrial companies had fully delivered on their decarbonization ambition in their production and logistics. The main obstacle is costs: nearly two-thirds of companies believe that decarbonization will increase their conversion costs. However, *“as pressure intensifies to pursue decarbonization throughout the industrial supply chain, environmental and economic sustainability will become increasingly difficult to separate”*.

Energy efficiency is typically a good place to start, as it combines decarbonization and cost savings. According to the International Energy Agency, replacing system components with more efficient alternatives can provide 2% to 5% savings, and improving production systems can generate savings exceeding 30%. If Ukraine were to rise to the EU's energy efficiency levels, it would bring savings valued at around €7bn annually for Ukraine's economy²⁴³.

Technology solutions are available. A first step is process optimization and automation, as well as improved energy management systems and procedures, which could be realized either voluntarily or through enforcement by Ukraine's government, in line with EU best practices. A second step would be at-scale deployment of sub-metering systems in Ukraine's industrial companies, since only a limited number of companies currently use sub-meters²⁴⁴. A final and costlier step would be equipment technology upgrades such as heat recovery and cogeneration technologies.

Ukraine could start to enforce efficiency standards in line with the European Union. It could also require minimum energy performance standards (MEPS) for industrial equipment, since industrial equipment standards have hardly been adopted in Ukraine so far and there is still potential for improvement. Targeted public policies and incentives, such as promoting energy efficiency for SMEs, could also encourage industrial energy efficiency programs.

REBUILDING AN INDUSTRY FOR THE FUTURE: THE CASE OF STEEL PRODUCTION

Ukraine's steel sector is a remarkable example of an industrial sub-sector that has not been modernized in decades, despite large recurring export volumes and a trained workforce. The decarbonization potential is therefore large.

Steel production in Ukraine has a double problem: high energy consumption that relies on a carbon-heavy energy sector, and manufacturing processes that emit GHGs at unnecessarily high levels. These two issues could be reduced by a factor of 4 with the best available technologies. Ramping up the use of electric-arc furnace (EAF) technology could reduce energy consumption per unit of output by more than four-fold²⁴⁵, according to the International Energy Agency. This would be a welcomed change from existing blast furnace (BOF) or open-hearth furnace (OHF) steel production technologies still in use. CO₂-efficiency gains are also estimated to be of at least a factor of 4 in the case of Ukraine: for instance, emissions during production for EAF steel technology in Ukraine is estimated to be of 0.6 tCO₂/t, compared to around 2.5 tCO₂/T for older technologies (OHF and BOF)²⁴⁶.

Such rebuilding or modernization projects are doable and possible, as demonstrated earlier this year in Europe with ArcelorMittal (a company also present in Ukraine) committing to replace its technologically-dated blast furnaces in France²⁴⁷. But such changes are also necessary in the long term, as Ukraine's competitive advantage may be at threat once the EU implements the carbon border adjustment mechanism (CBAM)²⁴⁸ which will tax imported materials based on the embedded emissions of products of specific sectors (iron and steel, as well as cement, aluminum, fertilizers, and electric production).

A more ambitious solution is to attract and deploy large investments to rebuild or retrofit Ukraine's industrial sector with Industry 4.0 technologies and processes. Such a project would turn Ukraine into a low-cost decarbonized industrial cradle turned toward the EU. Industry 4.0 refers to the intelligent networking of machines and processes for industry, with the help of information and communication technologies: *"Sensors, machines, workpieces, and IT systems will be connected along the value chain beyond a single enterprise. These connected systems can interact with one another using standard Internet-based protocols and analyze data to predict failure, configure themselves, and adapt to changes"*²⁴⁹.

With digital, environmental impact reduction can be included by design. For instance, manufacturing-related emissions can be measured and tracked directly, and the lifetime of production equipment can be extended thanks to sensors and data analysis models that can measure carbon emissions or predict machine part failures. Another use case is on the energy generation side: Industry 4.0 takes into account the potential on-site production of energy either through available renewable energy or through the use of by-products for energy generation (e.g. heat generated in the pulp and paper sectors). According to the UN, it is estimated that in key energy-intensive sectors, energy use could be decreased by up to 29 % through the implementation of such technologies²⁵⁰.

A GREEN INDUSTRIAL POLICY

The Recovery Plan currently includes a \$10bn package for eco-modernizing Ukraine's industry, with the planned importation of innovative technologies that would result in an estimated

tenfold reduction of the GHG emissions of eco-modernized installations. This positive initiative demonstrates an awareness of the industrial sector's issues, but only limited details are present regarding how the results would be effectively achieved, and whether the right policy incentives are in place. The creation of a modern, low carbon, industrial infrastructure should be a key focus of the support delivered by both the Ukrainian government and the international donors and investors.

To make Ukraine's green reconstruction a success, it will be essential for Ukraine to lay out a clear industrial policy. It will mean making limited technology bets and concentrating investments where there is proven potential for competitive advantage, as well as promoting the creation of hubs that can maximize resource use - for example with local use of coproducts, reuse of energy and heating, and circularity of materials. Such hubs could specifically take the form of eco-industrial parks that would achieve *"industrial symbiosis, which is a means by which companies can gain a competitive advantage through the physical exchange of materials, energy, water and by-products, thereby fostering inclusive and sustainable development"*²⁵¹, as currently developed and implemented by UNIDO, notably in Asia.

Reconstruction investments should be compatible with incoming EU carbon border adjustment mechanisms (CBAM) and focused not merely on heavy industries, but should also be encompassing lighter manufacturing and finished goods production to better meet both local and EU demand. The scale of needed capital investments and technology transfers will require a broad alignment between national governments, international institutions, private companies and donors.

TECH & DIGITAL

KEY MESSAGES



- The Ukrainian workforce's capabilities in tech & digital have been and remain a key potential for Ukraine's development, with a significant digitally-trained workforce (~250,000 Ukrainians²⁵²), a remarkably digitized public sector, and key global positions in IT sourcing and start-up creation.
- The conflict has put these advantages at risk, through the displacement of Ukraine's IT workforce and the drying up of digital opportunities; a strategy to re-attract this workforce and to develop this sector further is critical to Ukraine's future.
- The Tech & Digital sector is a proven key enabler of economic opportunity creation, sustainability (energy efficiency and low-emission technologies, or creation of new solutions) and better governance (through public administration digitalization).

RECOMMENDATIONS

- Leverage tech & data capabilities of Ukraine to attract investors, promote the deployment of best available technologies within the country and support the decarbonization of other industries with digital solutions.



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A KEY ENABLER FOR ECONOMIC GROWTH

The IT sector, while only representing 4% of Ukraine's GDP²⁵³, has a disproportionate weight in Ukraine's trade, with 10% of the country's total exports for this sector alone in 2021²⁵⁴, totaling \$6.8bn. The sector's growth is also unparalleled: digital exports grew by 36% between 2020 and 2021, making Ukraine's IT sector currently one of Europe's largest software development industry²⁵⁵.

The tech & digital sector has a lot more potential for Ukraine's economy. According to the UN, an increase of 10% in Ukraine's digitization would result in a 2.1% growth in the GDP per capita; this is a much higher growth figure than other European countries (where estimates range from 0.5% to 1.4%)²⁵⁶. Moreover, developing the digital economy presents greater opportunities compared to other sectors: the global digital economy has been growing more than 2 times faster than global GDP over the past 20 years, and represents more than 15% of global GDP²⁵⁷.

Ukraine is also notable for its advanced digitization relative to its peers and other Central & Eastern Europe countries, especially in its public sector. This is shown through leading positions in multiple international rankings: for instance, Ukraine ranked 39th in The Economist's 2018-2022 Technological Readiness Ranking²⁵⁸, and 6th in Europe in the 2021 European Open Data Maturity Ranking²⁵⁹. Ukraine's pre-war ambitions were to continue building on these early successes: the government was planning to bring high-speed internet to 95% of the citizens²⁶⁰ and deploy novel projects such as an e-residency project enabling foreign citizens to run businesses in Ukraine without being residents of Ukraine²⁶¹.

Ukraine boasts a cost-competitive workforce of 250,000 working across start-ups, SMEs and large firms²⁶². Notably, this workforce is highly trained: for instance there are over 100,000 Microsoft certified software professionals in Ukraine²⁶³. Ukraine's IT workforce ranked first in 2020 in terms of price/quality ratio across Eastern Europe²⁶⁴. This local talent can be employed by large international companies. It also enables the growth of successful local start-ups, some of which have been acquired by tech giants - for instance Viewdle (facial recognition company) was purchased by Google, and Lookserly (real-time facial modification app) acquired by Snapchat²⁶⁵.

In the public sector sphere, digitization led to the creation of an online portal ("Diia") offering 70 online government services, including the fastest business registration in the world - with an estimated duration of 10-15 minutes to become an entrepreneur, and 30 minutes to found an LLC. This portal hosts 3.6m users, including 370,000 entrepreneurs and

4,500 companies. The government also launched a mobile application, Diia 2.0, downloaded by more than 17 million Ukrainians²⁶⁶, which grants access to 9 digital documents (ID card, passport, driver's license, etc.) - making Ukraine the first country in the world to provide a digital ID.

MAINTAINING AND REBUILDING THE DIGITAL WORKFORCE, AN ESSENTIAL (POST-)WAR CHALLENGE

The war has brought moderate pressures on digital infrastructure. On the physical side, 22% of optical networks and 11% of mobile towers have been destroyed since the start of the war²⁶⁷, with up to 100% destruction of the internet infrastructure in war zones. Data transmission quality has dropped (13% decrease over fixed Internet networks, 26% decrease over mobile networks) and mobile communications in 12.2% of Ukraine's settlements have been fully lost²⁶⁸. On the virtual side, cyberwar has sometimes blocked access to important online services and websites (such as public radio websites and banks²⁶⁹), and there have been extensive attempts to destroy administrative data through hacking²⁷⁰.

The war has not stopped digitization of the country. On the contrary, government had doubled down on efforts to integrate and align further with European regulations: since the beginning of 2022, Ukraine has adopted multiple laws on electronic communications and telecommunications regulations ("*in-depth sectoral reform and approximation to EU DSM acquis*"²⁷¹). The government also actively continued the development of its mobile application Diia 2.0, by integrating new services, therefore demonstrating the importance given to digitalization and transparency in its strategy.

A more profound impact of the war on the digital sector, though, could be through population displacement: as of August 2022, close to 7 million Ukrainians had moved to neighboring countries and Europe²⁷², including more than 50,000²⁷³ IT professionals (around 20% of the country's IT workforce). The digital human capital available for work at home also thinned with the war, with up to 7% of the tech sector employees who have been enlisted in the military or in the government cyber forces²⁷⁴. This is especially concerning for Ukraine's digital future, with a remaining digital workforce that could easily relocate or work remotely, and that would like to do so if possible: at least 27,000 additional IT professionals intend to leave even in case of a Ukrainian military victory²⁷⁵. Reversely, employment opportunities for Ukraine's digital workforce have been drying up: the number of vacancies on the IT market has been halving since the beginning of the war²⁷⁶.



CASE STUDY: AI for rebuilding cities and protecting forests

High-resolution satellite imagery, when processed through adequate Machine Learning technologies, could become a useful tool for Ukraine's sustainable recovery. AI is especially valuable in two key applications: priority area selection for conservation or sustainable growth, and damage assessment. In Ukraine, AI algorithms help map deforestation as well as

destruction of buildings and urban areas. This complements time-consuming field work, freeing up local resources for reconstruction efforts instead. It could also help provide fact-based information for hard-to-measure issues. The illustration on the right shows how these technologies can be used to map war damages, here in the city of Mariupol²⁷⁷.

DIGITAL, AN ACCELERATOR FOR THE SUSTAINABLE ECONOMY

Repairing and developing Ukraine's tech capability is not just about economic growth: tech & digital sectors can enable the country's sustainable recovery and support the green growth in the other industries. According to IPCC, digital technologies can contribute to the mitigation of climate change²⁷⁸: *"Sensors, internet of things, robotics, and artificial intelligence can improve energy management in all sectors, increase energy efficiency, and promote the adoption of many low-emission technologies, including decentralized renewable energy, while creating economic opportunities"*. In Ukraine, technology has the potential to drive sustainability across sectors and

industries, from resource-savvy precision agriculture to a circular economy achieved through Industry 4.0 technologies.

Investments in digital solutions are recognized as key for the sustainable development of the economy and society, as, to quote the Council of the European Union²⁷⁹: *"The effective deployment of digital technologies can help decouple growth from resource use and its negative environmental impacts"*. There are ample opportunities to develop new digital solutions dedicated to environmental recovery or to the integration of environmental aspects into design choices. Development of this could happen through the funding of green and environment-focused start-ups, which would then enable an integration of data and digital solutions for environmental recovery and nature conservation into the wider digital strategy.

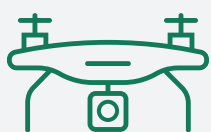
“
TODAY, TECHNOLOGIES ALLOW NOT ONLY TO ACCOUNT FOR OR REDUCE ENERGY CONSUMPTION, EMISSIONS, AND WASTE PRODUCTION, BUT ALSO TO CREATE NEW PRODUCTS OR PROCESSES THAT ARE MUCH MORE ENVIRONMENTALLY FRIENDLY. THE MAIN INCENTIVE FOR THE DEVELOPMENT OF “GREEN” PROJECTS IS THE DEMAND FOR THEM. WE ARE SEEING THIS IN THE GLOBAL MARKET RIGHT NOW. [...] AS SOON AS UKRAINIAN COMPANIES OR FOREIGN COMPANIES OPERATING IN UKRAINE ARE READY TO INVEST IN DIGITAL SOLUTIONS FOR THEIR BUSINESS, THEY WILL BE ABLE TO FIND ENOUGH EXPERTISE IN THE UKRAINIAN MARKET TO IMPLEMENT THESE SOLUTIONS.”

Taras Kytsmey, Co-Founder and Member of the Board of Directors, SoftServe²⁸⁰

Digital can and should be integrated from the ground-up in reconstruction choices throughout all sectors of the economy. For instance, in the infrastructure sector, the OECD recommends laying fiber cables throughout Ukraine - including in rural areas - during the reconstruction of the roads, even if operators may not be able to provide services yet for several years²⁸¹. Or, similarly, in the industrial sector, Industry 4.0²⁸² should be a recurring design principle so that Ukraine's products acquire long-term competitiveness in European and worldwide markets, in terms of both energy efficiency and GHG

emission levels. This would also contribute to better quality of environmental data, in particular on GHG emissions.

Last, when the war is over, Ukraine may have to proactively reach out to digital talent to re-attract workers to the country. There are examples, such as the former ReturntoPoland.pl online platform aimed at Polish nationals working abroad²⁸³, or the Spanish Guide for Coming Back ("*Guía del retorno a España*")²⁸⁴.



CASE STUDY:

Locating and clearing Ukraine's minefields through drones & AI technologies

Minefields are cheap and easy to lay: it is a matter of minutes to scatter antipersonnel mines over a large area through aircraft or artillery²⁸⁵, for an average cost per mine between \$3 and \$30²⁸⁶. But once the harm is done, clearing minefields and unexploded ordnance (UXO) is long and expensive, with an average cost to remove a mine being between \$300 and \$1,000. In Ukraine's case, 15% of the country is now estimated to be affected by mines²⁸⁷, making it one of the most mined-affected countries in the world²⁸⁸. Mines indiscriminately hurt humans, nature and wildlife.

A number of new demining technologies are available internationally, building on experience from other war zones, for instance in the form of drones or artificial intelligence. These technologies have already been proven to "*greatly aid [...] the initial technical survey to find the most likely locations of minefields*"²⁸⁹. Using its digitally-trained workforce, Ukraine could scale up the use of these technologies, and develop them further.



Participant to the IT Arena – the biggest IT event of Ukraine and Eastern Europe, held since 2014 in Lviv city.

© IT Arena

PROVISIONS

FOR SOUND GOVERNANCE

OF THE RECOVERY PLAN

Based on reports highlighting the need for reform in Ukraine's public administration system (such as the European Commission's Association Implementation Report on Ukraine²⁹⁰) and using relevant international thematic rankings (such as the Rule of Law Index²⁹¹) as a compass, we see great opportunities for the country to leverage best practices to build a better and stronger Ukraine.

International research and reports show that countries with stringent environmental regulations are those whose economies are the most competitive and efficient. The results of the OECD's work on measuring environmental policy stringency²⁹² are compelling: through this transnational analysis of the economic dimensions of environmental laws and policies, the OECD debunks the popular belief that regulatory arrangements

for the protection of the environment are "costly" for the economy and for productivity. Quite to the contrary: a robust corpus of environmental laws and policies, when firmly implemented and supported by public administration and government, creates a clear enabling environment for green innovation and sustainable investments, while offering legal certainty.

Good governance and the encouragement of public participation in the decision making process (as set-out in the Aarhus Convention²⁹³ "*On Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters*" which Ukraine is party to) are essential for increasing the acceptability and implementation of environmental regulations.

RECOMMENDATIONS FOR KEY REFORMS

- Ensure that the Verkhovna Rada (Parliament of Ukraine), Cabinet of Ministers (executive government) and the Ministry in charge of Environment reports annually on environmental policy and law-making, and presents the results to the plenary. In this manner, Ukraine's legislature will be well informed about the state of implementation of environmental laws and policies and the approximation to EU legislation. It will also be engaged in building solutions through cross-party debate and acceptance. Nature conservation and climate stability affect all dimensions of society.
- Strengthen the implementation of Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA), through:
 - a. Adopting EU law compliant mandatory standards and technical guidance for EIA and SEA consultants;
 - b. Creating a publicly accessible platform hosting public consultations and approval documents for each project undergoing the environmental permitting process;
 - c. Enriching the EIA and the SEA legislative framework with specific rules applying to biodiversity hotspots and protected areas, in compliance with the requirements for "appropriate assessment" under the EU's Habitats Directive 92/43/EEC.
- Reform the State Environmental Inspection of Ukraine with an emphasis on the expansion of objects and subjects of control (extend control to government bodies, as well as individuals, not only to businesses). In addition, increase the transparency of the course and results of inspections by comparing the results of the inspection with data on the state of the environment from monitoring systems, coverage of the dynamics of the state of the environment, and public access to documents (inspection protocols, as well as sanctions). The possibility of corruption could be minimized by introducing a system of fair investigation and basic principles of accountability in daily work and monitoring the dynamics of the state of the environment in the territory under control. The social status of inspectors must be guaranteed by the state by a random selection of inspectors for each case.

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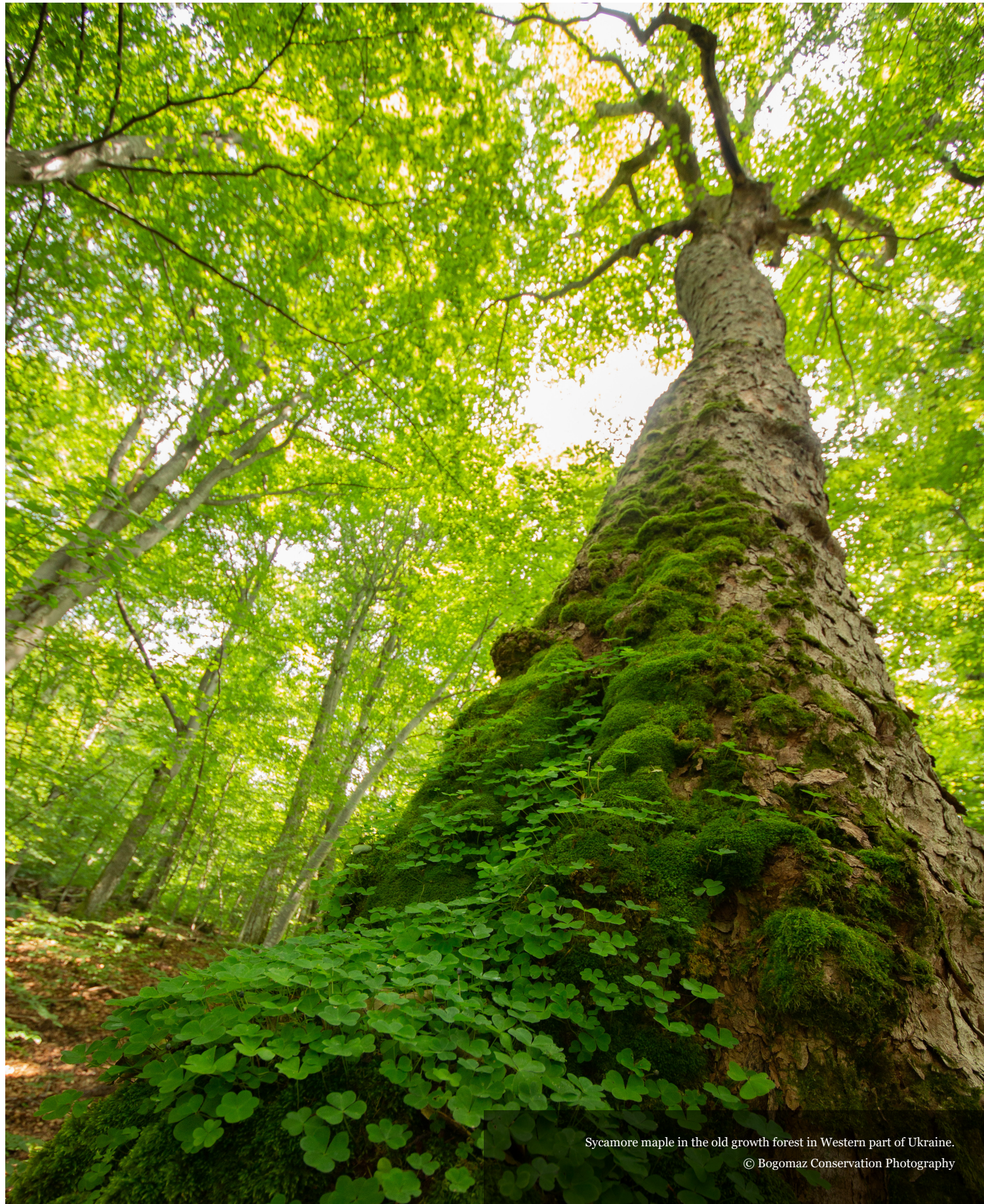
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- ²⁸² See the “Industry” section of this report for more details on the potential impact of Industry 4.0
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Sycamore maple in the old growth forest in Western part of Ukraine.
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