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Ukraine war and sustainability policy

Cornerstones for a sustainable recovery program for Ukraine

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On behalf of the German Environment Agency

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Abstract: Cornerstones for a sustainable recovery program for Ukraine

This discussion paper presents the German Environment Agency's (UBA) initial considerations for a sustainable recovery program for Ukraine.

In UBA's view, the following principles should apply to the design of a recovery program: Integration of environmental, sustainability and economic policies; resilience; sufficiency; socially just design of reconstruction; ownership; learning orientation; solidarity; use of potentials of digitalization.

The following frameworks (policy mix) should apply to the program: Green energy price reform; social-ecological tax reform and dismantling of environmentally harmful subsidies; promote green innovations in economy, society and administration; create green(er) jobs, launch skills offensive; sustainable procurement policy; exploiting potentials of central economic sectors.

Some, essential fields of a recovery program are: Reducing environmental and climate impacts; energy; industry; transportation; infrastructure; cities; construction and housing; agriculture; governance and institutional design.

For the policy design of the recovery program by the Ukrainian government, the EU and the international community, UBA makes the following policy recommendations: comprehensive transformation to a sustainable economy and society; implementation of a post-conflict environmental assessment; comprehensive, sustainable modernization of the industry; transformation of the energy system; development of sustainable agriculture.

Kurzbeschreibung: Eckpunkte für ein nachhaltiges Wiederaufbauprogramm für die Ukraine

In diesem Diskussionspapier legt das Umweltbundesamtes (UBA) erste Überlegungen für ein nachhaltiges Wiederaufbauprogramm für die Ukraine vor.

Für die Gestaltung eines Wiederaufbauprogramms sollten nach Auffassung des UBAs die folgenden Grundsätze gelten: Integration von Umwelt-, Nachhaltigkeits- und Wirtschaftspolitiken; Resilienz; Suffizienz; sozial gerechte Gestaltung des Wiederaufbaus; Ownership; Lernorientierung; Solidarität; Nutzung von Potentialen der Digitalisierung.

Die folgenden Rahmenbedingungen (Policy Mix) sollten für das Programm gelten: Ökologische Energiepreisreform; sozialökologische Steuerreform und Abbau umweltschädlicher Subventionen; grüne Innovationen aus der Wissenschaft und dem Privatsektor für die Wirtschaft, Gesellschaft und Verwaltung fördern; grüne(re) Arbeitsplätze schaffen, Qualifikationsoffensive starten; nachhaltige Beschaffungspolitik; Potentiale der zentralen Wirtschaftssektoren ausschöpfen.

Einige, wesentliche Felder eines Wiederaufbauprogramms umfassen: Reduktion der Umwelt- und Klimabelastungen; Energie; Industrie; Verkehr; Infrastruktur; Städte; Bauen und Wohnen; Landwirtschaft; Governance und institutionelles Design.

Für die politische Gestaltung des Wiederaufbauprogramms durch die ukrainische Regierung, die EU und die internationale Gemeinschaft werden vom UBA die folgenden Politikempfehlungen gegeben: umfassende Transformation zu einer nachhaltigen Wirtschaft und Gesellschaft; Durchführung eines Post-conflict environmental assessment; umfassende, nachhaltige Modernisierung der Industrie; Transformation des Energiesystems; Entwicklung einer nachhaltigen Landwirtschaft.

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List of Abbreviations

CO_2	Carbon dioxide
COP26	26th United Nations Conference of the Parties
e.g.	for example
EU	European Union
f.	following
GDP	Gross domestic product
IT	Information technology
kg	Kilogram
kWh	Kilowatt hour
m^2	Square metre
mm	Millimetre
n.d.	undated
OECD	Organization for Economic Co-operation and Development
%	Per cent
SDG	Sustainable Development Goal
UBA	German Environment Agency
USSR	Union of Soviet Socialist Republics

Summary

The Ukrainian government has already prepared a Ukraine Recovery Plan for the reconstruction and development of Ukraine. The European Commission presented its plans for a long-term framework for reconstruction in a communication on 18 May 2022. The European Council has decided on 23 June 2022 to grant the status of candidate country to Ukraine. Based on this, this discussion paper presents the German Environment Agency's initial considerations for a sustainable recovery program for Ukraine, for which also Ukrainian experts have been consulted.

In the view of the German Environment Agency, the following principles should apply to the design of a recovery program: Integration of environmental, sustainability and economic policies; resilience; sufficiency; socially just design of recovery; ownership; learning orientation; solidarity; use of potentials of digitalization.

The political and economic framework must ensure that recovery simultaneously benefits the fulfilment of the population's basic needs, the recovery of the economy, the strengthening of society and environmentally sound development. Only by exploiting synergies for all goals sufficient capital and resources will be available in the long term. This requires a coherent system of framework conditions (policy mix) with the following fields: Ecological energy price reform; socio-ecological tax reform and dismantling of environmentally harmful subsidies; promote green innovations in business, society and administration; create green(er) jobs, launch skills offensive; sustainable procurement policy; exploiting potentials of central economic sectors.

A recovery program will have to meet many different requirements. Some essential fields of a reconstruction program are: Environmental and climate impact reduction; energy; industry; transportation; infrastructure; cities; construction and housing; agriculture; governance; and institutional design.

For the policy design of the recovery program by the Ukrainian government, the EU and the international community, the German Environmental Agency makes the following policy recommendations:

- Ukraine should use the opportunities of the recovery program to position itself for the 21st century through a comprehensive transformation to a model sustainable economy and society. The country's resilience should be strengthened to withstand future crises (such as the climate crisis). Existing environmental pressures should be reduced, war-related environmental damage should be repaired, and future environmental pressures should be avoided. Recovery measures should be compatible and coherent with long-term environmental policy objectives (such as climate neutrality, climate adaptation, and the Sustainable Development Goals) to avoid false path dependencies and future investment ruins (stranded assets). To achieve this, a comprehensive, societal discussion process on what sustainable reconstruction could look like should as soon as possible start in Ukraine in order to reach a societal consensus on the need for transformation.
- The eventual and still coming environmental damage of the war is currently unpredictable. Immediately after the end of the war, a post-conflict environmental assessment should be conducted by the Ukrainian government - to the extent that this has not already been done through the work of the National Council for Recovery - with the participation of the United Nations Environmental Programme and the Organization for Security and Co-operation in Europe - to determine the environmental damage caused by the war. It can draw on their

decades of experience. Germany should participate in an appropriate manner (including the expertise of the German Environmental Agency).

- Industry in Ukraine is to a considerable extent considered to be resource-intensive and inefficient. Recovery should be combined with comprehensive, sustainable modernization of the industry by increasing resource and energy efficiency (leapfrogging). Procurement of new facilities/equipment and reconstruction of infrastructure should focus on high resource and energy efficiency as well as the use technologies which achieve the goal of greenhouse gas neutrality in the long term. This also applies to the content design of education and training and applied research. Instead of rebuilding resource-intensive facilities, resource-light and climate-friendly alternatives should be promoted.
- Ukraine's energy system is very energy-intensive. Recovery in Ukraine should be carried out in combination with a social-ecological energy price reform including the socially responsible dismantling of environmentally and climate harmful subsidies and the transformation of the energy system towards energy efficiency, prevention of energy poverty, energy sufficiency, use of renewables and climate neutrality by 2050 in line with EU targets. Ukraine should phase-out coal by 2035 as planned by the government.
- Ukrainian agriculture makes an important contribution to feeding the world. The reconstruction program should push the development of sustainable agriculture and make it into a globally recognized model for sustainable agriculture. It should promote the broad implementation of agroecological approaches and the expansion of organic farming. The current minimal use of mineral fertilizers and pesticides offers great potential to achieve these efforts.

Zusammenfassung

Die ukrainische Regierung hat bereits einen Ukraine Recovery Plan für den Wiederaufbau und die weitere Entwicklung der Ukraine vorgelegt. Die Europäische Kommission hat am 18.5.2022 in einer Mitteilung ihre Pläne für einen langfristigen Rahmen für den Wiederaufbau vorgelegt. Der Europäische Rat hat am 23. Juni 2022 beschlossen, der Ukraine den Status eines Kandidatenlandes zu verleihen. Darauf aufbauend werden in diesem Diskussionspapier erste Überlegungen des Umweltbundesamtes für ein nachhaltiges Wiederaufbauprogramm für die Ukraine vorgelegt, für die auch ukrainische Expert*innen einbezogen wurden.

Für die Gestaltung eines Wiederaufbauprogramms sollten nach Auffassung des Umweltbundesamtes die folgenden Grundsätze gelten: Integration von Umwelt-, Nachhaltigkeits- und Wirtschaftspolitiken; Resilienz; Suffizienz; sozial gerechte Gestaltung des Wiederaufbaus; Ownership; Lernorientierung; Solidarität; Nutzung von Potentialen der Digitalisierung.

Die politische und ökonomische Rahmensetzung muss dafür sorgen, dass der Wiederaufbau gleichzeitig der Erfüllung der Grundbedürfnisse der Bevölkerung, der Erholung der Wirtschaft, der Stärkung der Gesellschaft und einer umweltgerechten Entwicklung zu Gute kommt, da nur durch die Nutzung von Synergien für alle Ziele langfristig hinreichend Kapital und Ressourcen zur Verfügung stehen. Dazu bedarf es eines kohärenten Systems von Rahmenbedingungen (Policy Mix) mit folgenden Feldern: Ökologische Energiepreisreform; sozialökologische Steuerreform und Abbau umweltschädlicher Subventionen; grüne Innovationen aus der Wissenschaft und dem Privatsektor für die Wirtschaft, Gesellschaft und Verwaltung fördern; grüne(re) Arbeitsplätze schaffen, Qualifikationsoffensive starten; nachhaltige Beschaffungspolitik; Potentiale der zentralen Wirtschaftssektoren ausschöpfen.

Ein Wiederaufbauprogramm wird viele unterschiedliche Anforderungen erfüllen müssen. Einige wesentliche Felder eines Wiederaufbauprogramms sind: Reduktion der Umwelt- und Klimabelastungen; Energie; Industrie; Verkehr; Infrastruktur; Städte; Bauen und Wohnen; Landwirtschaft; Governance und institutionelles Design.

Für die politische Gestaltung des Wiederaufbauprogramms durch die ukrainische Regierung, die EU und die internationale Gemeinschaft werden vom Umweltbundesamt die folgenden Politikempfehlungen gegeben:

- Die Ukraine sollte die Chancen des Wiederaufbauprogramms dazu nutzen, um sich durch eine umfassende Transformation zu einer nachhaltigen Wirtschaft und Gesellschaft für das 21. Jahrhundert aufzustellen. Die Resilienz des Landes sollte gestärkt werden, um auch künftigen Krisen (wie der Klimakrise) gewachsen zu sein. Bestehende Umweltbelastungen sollten vermindert, kriegsbedingte Umweltschäden beseitigt und künftige Umweltbelastungen vermieden werden. Wiederaufbaumaßnahmen sollten mit langfristigen umweltpolitischen Zielsetzungen (wie z.B. Klimaneutralität, Klimaanpassung und den Sustainable Development Goals) vereinbar und kohärent sein, um falsche Pfadabhängigkeiten und künftige Investitionsruinen (stranded assets) zu vermeiden. Um dies zu erreichen, sollte möglichst frühzeitig ein umfassender, gesellschaftlicher Diskussionsprozess in der Ukraine erfolgen, wie ein nachhaltiger Wiederaufbau aussehen könnte, um zu einem gesellschaftlichen Konsens über die Notwendigkeit der Transformation zu kommen.
- Es ist gegenwärtig unklar, welche Umweltschäden durch den Krieg entstanden sind und entstehen werden. Unmittelbar nach Beendigung des Konflikts sollte ein Post-conflict environmental assessment durch die ukrainische Regierung – soweit dies noch nicht durch

die Arbeit des National Council for Recovery erfolgt ist – unter Beteiligung des United Nations Environmental Programme und der Organisation for Security and Co-operation in Europe - durchgeführt werden, um die Umweltschäden durch den Krieg zu ermitteln. Dabei kann auf deren Jahrzehnte lange Erfahrung zurückgegriffen werden. Deutschland sollte sich (unter Einbeziehung der Expertise des Umweltbundesamtes) in geeigneter Weise daran beteiligen.

- Die Industrie in der Ukraine gilt zu einem erheblichen Teil als ressourcenintensiv und ineffizient. Der Wiederaufbau sollte mit einer umfassenden, nachhaltigen Modernisierung der Industrie durch eine Steigerung der Ressourcen- und Energieeffizienz (leapfrogging) verbunden werden. Bei der Beschaffung von neuen Anlagen/Ausrüstungen und dem Wiederaufbau der Infrastruktur sollte auf hohe Ressourcen- und Energieeffizienz geachtet werden sowie Technologien eingesetzt werden, die langfristig das Ziel der Treibhausgasneutralität erreichen. Dies gilt auch für die inhaltliche Gestaltung der Aus- und Weiterbildung und der anwendungsorientierten Forschung. Statt des Wiederaufbaus ressourcenintensiver Anlagen sollten ressourcenleichte und klimaschonende Alternativen gefördert werden.
- Das Energiesystem der Ukraine ist sehr energieintensiv. Der Wiederaufbau in der Ukraine sollte mit einer sozial-ökologischen Energiepreisreform inklusive des sozialverträglichen Abbaus umwelt- und klimaschädlicher Subventionen und einer Transformation des Energiesystems in Richtung Energieeffizienz, Vermeidung von Energiearmut, Energiesuffizienz, Nutzung von Erneuerbaren Energien und Klimaneutralität bis 2050 im Einklang mit den Zielen der EU erfolgen. Der Kohleausstieg sollte, wie von der Ukraine geplant, weiterhin bis 2035 umgesetzt werden.
- Die ukrainische Landwirtschaft leistet einen wichtigen Beitrag zur Welternährung. Der Wiederaufbau sollte dazu genutzt werden, die Landwirtschaft zu einem weltweit anerkannten Modell für eine nachhaltige Landwirtschaft zu entwickeln – etwa indem agrarökologische Ansätze in der Breite gefördert und der Ökolandbau ausgebaut wird. Der geringe Einsatz von Mineraldünger und Pflanzenschutzmittel bietet dafür erhebliches Potential.

1 Introduction

Despite the fact that it is still unclear when and how the war in Ukraine will end and what damages this will leave the country with, the following question must already be posed today: How can the recovery of Ukraine be organized, to ensure a sustainable development in the country?

The Ukrainian government has already presented a Ukraine Recovery Plan for the reconstruction and development of Ukraine. The European Commission presented its plans for a long-term framework for the reconstruction in a communication on 18 May 2022. The European Council has decided on 23 June 2022 to grant the status of candidate country to Ukraine. At the Ukraine Recovery Conference in Lugano, 4–5 July 2022, participating governments agreed on the Lugano Declaration to guide the future recovery process, emphasizing sustainability as a guiding principle. Based on this, the following presents the German Environment Agency's initial considerations for a sustainable recovery program for Ukraine, for which also Ukrainian experts have been consulted (COM 2022; Recovery of Ukraine n.d.; Ukraine Recovery Conference 2022).

The 2030 Agenda for Sustainable Development with its Sustainable Development Goals (SDG) passed by the United Nations in 2015, the Paris Climate Agreement and the European Green Deal should form the framework for the recovery. The objective should be to achieve a "build back better" for Ukraine (Centre, 2022, 25; COM 2019; COM, 2022, 3; EGDU 2020; National Recovery Council, 2022, 3-6; Ukraine Recovery Conference 2022; Umweltbundesamt, 2020, 6; Umweltbundesamt, 2020a, 11; UN 2015; UNGA 2015; WWF 2022).

2 Fundamental principles of a recovery program

In the opinion of the German Environment Agency, the following principles should apply to the design of a recovery program:

- Integration of environmental, sustainability and economic policies: The program should support the implementation of environmental and sustainability goals and be aimed at policy coherence according to SDG-17.14. The standards agreed on in international and European agreements (e.g. 2030 Agenda for Sustainable Development with its Sustainable Development Goals; Paris Climate Agreement; Association Agreement between the European Union and its Member States, of the one part, and Ukraine, of the other part) should serve as a benchmark. As an EU candidate country, the European Green Deal must be a relevant criterion for the reconstruction; particularly, in the economic sectors that are central for the Ukrainian economy as are industry and agriculture. It would be a mistake, both economically and ecologically, to use the reconstruction program to promote fossil fuel investments and infrastructure or methods of production and consumption harmful to the environment that will become stranded investments in a few years' time. This would be the case due to the increasingly stringent climate protection requirements or endanger the natural foundations of life and economic activities. Therefore, the program should be used as a window of opportunity to forward a social-ecological transformation and in doing so, simultaneously achieve ecological, economic and social goals (COM, 2022, 3; Ecoaction 2022; International Initiative for a Sustainable Built Environment, 2022, 4; Nemitz 2021a; Resource & Analysis Center "Society and Environment", 2022, 4; Ukraine Recovery Conference 2022; Umweltbundesamt, 2020a, 11; United Nations General Assembly 2015).
- Resilience: The resilience of the economy and the society and their relevant subsystems must be ensured, to also be able to react to multiple crises in the future (Financial Crisis 2008, COVID-19 Crisis, Refugee Crisis, Climate Crisis, Biodiversity Crisis, ...). Consequently, the systems must be able to withstand external shocks (ability to absorb and adapt) and if necessary, to evolve (ability to transform). Among other things, this requires an ambitious policy for climate change adaptation. In order to guarantee and maintain resilience, competent state and international institutions that citizens trust need to focus their governance on public welfare (G7 2022; 7; National Recovery Council, 2022, 2; Umweltbundesamt, 2020c, 6; WWF and BCG ,2022, 6).
- Sufficiency: In the long run, sufficiency is aimed at consumption patterns within the framework of the recovery program, which help enable economic development and the well-being of the people and to remain within the limits of the Earth's ecological viability while meeting these needs. Sufficiency measures are activities that lead to a reduction of negative effects on people and the environment. This can be achieved in the short term by changes in behaviour, simple technical measures, regulative, pricing and communicative instruments and measures. In the medium term, they require educational measures, investments in technology and infrastructures that make saving resources and energy easier. Sufficiency lowers costs, reduces the need for acquisitions, makes more politically independent of energy and resources and helps in terms of environmental and climate policy (Autor*innengruppe Energiesuffizienz, 2022, 1; Stukalu, 2021, 181; Zell-Ziegler/Förster, 2018, 12).
- Socially just recovery design: The needs of vulnerable groups should be considered in compliance with the fundamental principle "leave no one behind" as per the 2030 agenda. Basic provisions with food, living arrangements, heat, electricity and mobility services as

well as access to educational and health facilities must once more be immediately ensured for all people. Clear objectives and standards must be set to avoid energy poverty. Disadvantaged persons and vulnerable groups in the population should be supported financially in saving energy and behaving in an eco-friendly manner. Climate-friendly construction and sustainable mobility may not lead to burden for socially deprived tenants. Regional disadvantages (e.g. due to nuclear and coal phase-out) should be compensated for using an active structural policy (Autor*innengruppe Energiesuffizienz; COM, 2022, 5; EGDU, 2020, 28; GIZ 2022; Mapping, 2021, 5; National Recovery Council, 2022, 3; Stukalu, 2021, 181).

- Ownership: The program should be developed by the Ukrainian government in consultation and close collaboration with the EU, among others, and international partners, who can support a needs-oriented and ensured implementation. International donor organizations should not force plans on the Ukraine that could lead to dysfunctional development projects. At the same time, it would make sense for Ukraine to have its own sectoral development plans ready, to coordinate with the donors, in order to avoid extra work and redundancies. Ukraine should be able to maintain projects that were financed by the reconstruction aid, after said aid has ended. Fighting corruption is an essential prerequisite for this because the country's internal and external resilience as well as the donors' willingness to financially support the reconstruction depends on it. According to the Transparency International Corruption Perceptions Index, Ukraine ranked 122nd out of 180 in 2021 and therefore, is one of the most corrupt countries in Europe (Centre, 2022, 8; COM, 2022, 4; Gharios/Farajalla/Hajj 2021, 3683; Dunaj, 2019, 141f; OECD, 2022, 5; Transparency International 2021; Ukraine Recovery Conference 2022; WWF and BCG, 2022, 13).

- Learning orientation: The recovery program for Ukraine should make use of experiences from previous reconstruction programs of other countries (lessons learned), e.g. the reconstruction programs for Azerbaijan, Bosnia and Herzegovina, Federal Republic of Germany, Iraq, Japan, Croatia, Lebanon, Nigeria, Portugal, South Korea, Tajikistan and Timor-Leste (East Timor). In these cases, environmental and sustainability aspects were not always sufficiently included. In part, the economic stimulus packages due to the COVID-19 pandemic already took this into consideration. Recovery should be routinely evaluated by a team of scientists, to enable learning processes and political readjustment towards sustainability (Centre 2022; Economic Commission for Europe 1999/2003/2004/2004a; Gharios/Farajalla/Hajj, 2021; Ikpe, 2021; Rohland/Cliffe 2002; Seth, 2013; Umweltbundesamt, 2020a; Waheeb/Andersen 2022).

- Solidarity: In addition to financial support for Ukraine, professional expertise should also be offered by the EU, to enable a sustainable reconstruction. This transfer of knowledge and exchange could for instance take place in the form of a (European) reconstruction agency, as we have already had in other reconstruction times (EUR-Lex 2000; Centre 2022), or an advisory council for reconstruction, which is made up of Ukrainian and international members.

- Making use of the potentials of digitization: As was the case in handling the COVID-19 crisis for example, digitization also offers great potential in line with reconstruction. Even during times of war, companies, educational institutions, administrations and private households can use digital structures that have already gotten a boost through the pandemic. Furthermore, expanding digitization offers tremendous potential for the implementation of energy transition, sustainable mobility, improved recycling management and transparency for supply chains and financial systems. Negative effects on the environment must be

regarded in this respect. These concern high energy and raw material consumption as well as an increasing amount of old electrical equipment and used batteries (National Recovery Council, 2022, 3; Umweltbundesamt, 2020, 18-19; WWF and BCG, 2022, 57-60).

3 Setting the appropriate framework conditions

Recovery requires significant efforts on the part of Ukraine and the international donors as well as high public expenditures and private investments. A long-term and sustainable development requires a parallel mobilization of all social and scientific strength in Ukraine. The political and economic framework must ensure that reconstruction simultaneously benefits the fulfilment of the population's basic needs, the recovery of the economy, the strengthening of society and environmentally sound development because only by exploiting synergies for all goals will sufficient capital and resources be available in the long term. This requires a coherent system of framework conditions (policy mix) with the following fields:

- Ecological energy price reform: There has been a carbon tax in Ukraine since 2011, which is imposed for CO_2 emissions from stationary sources in the industrial, energy and building sectors. However, even with the increase enacted in 2022, the tax rate still belongs to one of the lowest carbon prices in the world, so that its efficacy is arguable. The CO_2 tax merely plays a fiscal role and does not contribute to achieving environmental or climate goals. The external costs of environmental burdens should generally be internalized to a greater extent. For this purpose, a fundamental energy price reform should take place, which also creates economic incentives for investments in climate protection and the development of green markets for the future. The additional government revenue resulting from such a reform should be used to prevent social hardships (possibly war-related increase in poverty) and to promote investments in an efficient and climate-friendly energy production and utilization ((Burkynskyi, 2021, 59; Climate action tracker n.d.; Dovgal, 2021, 56; EU4Environment, 2021, 65-68; EGDU 2020; Frey, 2017, 378; OECD, 2019, 40; OECD, 2019a, 21; OECD, 2020, 98; Sabishchenko, 2020, 10; Soroka, 2019, 144; Stukalu, 2021, 181; Umweltbundesamt, 2020, 15; WWF and BCG, 2022, 41; Yang/Cela/Yang, 2020, 877).
- Socio-ecological tax reform and dismantling of environmentally harmful subsidies: The revenue from environmental taxes in Ukraine is very low compared to other countries. To date, environmental taxes primarily serves fiscal purposes and less the reduction of ecological damage. Therefore, the reconstruction program should be embedded in a social-ecological tax reform that creates economic incentives for eco-friendly methods of production and consumption. The gradual reduction of environmentally harmful subsidies and a shift in the tax burden from labour to environmental consumption can have an important steering effect towards a sustainable economy with future-oriented work and, once the war is over, can also make a significant contribution to consolidating public budgets. The tax burden on labour, eco- and climate-friendly technologies as well as circular economies should be reduced, in order to preserve jobs and improve the competitiveness of sustainable methods of production and consumption. Conversely, there should be an increase in the share of environmental taxes in total tax revenue, so that the resulting environmental costs are more heavily charged to the polluters and competitive distortions at the expense of eco-friendly production and consumption patterns are reduced. The dismantling of environmentally harmful subsidies (e.g. government support of energy prices) while balancing the effects of poor and vulnerable groups in society can create financial leeway and at the same time, initiate incentives for eco-friendly economic activities (Bobrov, 2021, 13-21; Burkynskyi, 2021, 59; EU4Environment, 2021, 65-68; OECD, 2019, 12; OECD, 2022, 7; Sabishchenko, 2020, 16; Reznik 2020; Savko, 2019, 617; Stukalu, 2021, 180-2; Umweltbundesamt, 2020, 18; Uzha, 2021, 97-98; WWF and BCG, 2022, 41; Yang/Cela/Yang, 2020, 877).

- Promote green scientific and private sector innovations for the economy, society and administration: The promotion of green innovation (e.g. for recycling, resource efficiency or climate protection and adaptation) is paramount for the development of an environmentally sustainable and competitive economy and therefore, also to creating future-oriented jobs. It can significantly contribute to establishing sustainable solutions in administration and society. Patent rights and registrations should be boosted. A focus should be placed on promoting green innovations; from research and development to market entry and distribution in the market. At the same time, if possible this should be based on existing programs and existing funding gaps should be eliminated; green start-ups should be promoted by creating competence centers and improving the provision of capital for example. Furthermore, green criteria should be integrated into all existing environmentally relevant funding programs as a condition for funding. Cross-sectoral innovation platforms and experimental spaces for exchange and communication should be created and there should be increased financing of real-world laboratories for testing eco-friendly concepts and measures in practice. (Bobrov 2021; EU4Environment, 2021, 31; Stukalu, 2021, 182; Umweltbundesamt, 2020, 16)
- Create green(er) jobs, launch skills offensive: Data on the employment in environmental protection in Ukraine is missing to a large extent. After the war has ended, it will be important to integrate combatants and refugees into the labour market as quickly as possible. Environmental and climate protection offer great employment opportunities but also require appropriately qualified workers. Labour market instruments geared to these needs can reduce both unemployment and skills shortages and strengthen the competitive position of the economy. In this case, launching a skills offensive can be useful, to reduce unemployment and to qualify people for future-oriented jobs (new as well as existing ones) (e.g. climate change adaptation, mobility, urban and transport planning, electrical engineering, occupations for sustainable construction and energy-efficient building renovation, skilled workers for digitization, care occupations, scientific occupations with focus on sustainability, e.g. chemists). Extensively constructed novel green training institutions could be created, to effectively accompany the social-ecological change and tailored to the needs for further education and qualification. At the same time, the attractiveness of the professions needed in the future could also be enhanced by better working conditions and higher remuneration for instance. Professions in the sustainable economy could be promoted through an accompanying campaign (EGDU, 2020, 30; EU4Environment, 2021, 61; National Recovery Council, 2022, 6; Resource & Analysis Center "Society and Environment", 2022, 4; Umweltbundesamt, 2020, 17).
- Sustainable procurement policy: A sustainable, state procurement policy is the prerequisite for future-oriented infrastructures and provides the market with the right impulses. Ukrainian procurement laws allow taking environmental, climate and resource efficiency criteria into account. It makes sense to intensively focus the public procurement system on the procurement of eco-friendly products and services (EGDU, 2020, 57; Stukalu, 2021, 181; Ukraine Recovery Conference, 2022b, 80).
- Exploiting potentials of central economic sectors: Investments and modernization allow potentials in the most significant sectors to be tapped into and jobs to be ensured. Agriculture and the food industry are the most important economic sectors in Ukraine. The agricultural sector is responsible for 9.3 % of the GDP and represents the largest portion of workers in the country with 17.1 %. The sector had proven stable during the COVID-19 pandemic because of its predominantly economic independency; there is an urgent need for adaptation to climate change. The metal industry, primarily in the Eastern part of the

country, that is either at battle or occupied by Russia, is severely dependent on the global market prices for steel. Complying with the European Green Deal will lead to challenges for this sector. The light and supplying industries, in particular in the automobile sector and geographically in the Western part of the country, are becoming more and more relevant however, mainly due to low production costs and favorable location factors for the European market and not because of an enhanced creation of value. The IT and start-up sectors are growing and are distinguished by skilled workers; interdisciplinary work offers the potential of creating digitization in a sustainable manner and to use it for sustainability (Umweltbundesamt, 2019a, 46).

4 Fields of a recovery program

A recovery program will have to fulfill many different requirements - these cannot all be fully described here. Some of the essential fields of a recovery program are outlined below:

4.1 Reducing environmental and climate impacts

The anthropogenic environmental impact (e.g. caused by particular matter) in Ukraine is above the average values in the OECD countries. With 72.1 years (2019) life expectancy is (among other things due to air pollution) lower than in the OECD countries. There are greater challenges particularly regarding SDG-14, life below water, and SDG-15, life on land. However, significant disparities are indicated regionally within Ukraine. It seems reasonable to combine measures of the recovery program with the reduction of structural environmental impacts by means of environmentally friendly, resource-saving, energy efficient and sufficient methods and systems (Chugai, 2021; Dovgal, 2021, 53; EU4Environment, 2021, 51-98; National Recovery Council, 2022, 29; NGOs 2022; Our World in Data 2022; Sachs, 2021, 458; Stukalu, 2021, 180; WWF and BCG, 2022, 17).

Additional environmental impacts can result from warfare materials and combat operations in the vicinity of chemical and industrial facilities, biological laboratories and nuclear facilities. Furthermore, there is the redevelopment and if necessary, disposal of the immense building waste caused by the war. Measures must be taken post-war, to prevent danger to the people and environment caused by harmful war damages (Held/Gerschütz 2021; National Recovery Council, 2022, 11; OECD, 2022, 4).

4.2 Energy

Ukraine has drastically reduced its primary energy consumption since 1990 and with 21,248 kWh/person, is significantly below Germany with 40,158 kWh/person. In particular, the energy structure and the energy/CO2 intensity pose a problem. The improvement of energy efficiency, the decarbonization of the energy supply and the conversion of the energy supply towards renewable energies seems to be urgent. Energy efficiency programs are of significant importance, given that the Ukrainian economy is very energy-intensive (e.g. the energy intensity of the Ukrainian GDP exceeds the European average by 2.5 times). Ukraine also has sufficient potential for the development of renewable energies and the replacement of fossil fuels. With the 2050 Green Energy Transition Concept from January 2020, Ukraine sets a goal of 70 % for renewable energies by 2050, while model calculations from 2017 indicate that Ukraine could reach 91 % by that point in time. At the same time, renewable energy communities and energy cooperatives could play a role. At the COP26 in Glasgow, Ukraine announced advancing its coal phase-out from 2050 to 2035, to become a member of the Powering Coal Alliance. A quick transition to renewable energy would also contribute to supply security and reduce the security risks from being dependent on authoritarian supply countries. Connecting Ukraine to the EU's power supply system is process that has not yet been sufficiently defined and requires political decisions (Centre, 2022, 24; Climate Action Tracker 2022; Ecoclub 2019; EU4Environment, 2021, 84; Feldhaus, 2021, 7-8; GIZ n.d.a; Kaletnik/Pryshliak/Tokarchuk, 2021, 60; Kuzior/Lobanova/Kalashnikova, 2021, 1; National Recovery Council, 2022, 10; OECD 2019/2019a; Oleksenko, 2021, 4; Onyshchenko, 2022, 762; Our World in Data 2022;

Sabishchenko, 2020, 15; Saha, 2022, 4; Sikorsky, 2022, 3; Soroka 2019; WWF and BCG, 2022, 15).

4.3 Industry

Ukraine's industry is distinguished by the dominance of outdated, resource- and energy-intensive technologies and systems, the export orientation of raw materials and the excessive concentration of production in several regions of the country (Domestic material consumption/GDP, 2019: 5,581 kg/USD compared to 347 kg/USD for Germany). A significant amount of resources is wasted due to the low technological production standards. However, initial approaches towards a sustainable economy can already be seen in Ukraine. In particular, these can be found in the regions Vinnytsia, Zaporizhzhia, Dnipropetrovsk, Kyiv, Lviv, Odesa, Poltava, and Kharkiv. A link can be established to these in line with the recovery program. Above all, this requires a reform of environmental law, the spreading of information on environmentally responsible practices, the promotion of innovative and sustainable business models, increased investments in the environmental sector and the dismantling of environmentally and climate harmful subsidies. In the process, the production of hydrogen could play a specific role in the medium-term. Due to Ukraine's geographical proximity to the EU, its infrastructural links and existing potentials in expertise and along the economic chain, in addition to Russia, Ukraine played a significant role for the EU up until now for its hydrogen strategy. For example, hydrogen can be used for the production of steel and aluminium and the production of fertilizers, i.e. difficult to decarbonize industries. For a recovery program, prompt decisions must be made regarding productions routes for hydrogen, which should be geared to the category of green hydrogen in view of EU entry and greenhouse gas neutrality. (Burkynskyi, 2021, 59-60; DENA 2021/2021a; EU4Environment, 2021, 84-85; GIZ n.d.d; Grinschgl/Pepe 2022; Grinschgl/ Pepe/Westphal 2021; IRP n.d.; Malyarenko, 2021, 52; National Hydrogen Council, 2022, 7; National Recovery Council, 2022, 33; Stukalu, 2021, 178; WWF and BCG, 2022, 53-54).

4.4 Transportation

A part of Ukraine's infrastructure was already outdated prior to the war, so that it ranked 66th in the Logistics Performance Index of the World Bank in 2018. Freight is primarily transported by railway. There are plans to use electric mobility and to promote the infrastructure required for that purpose. When reconstructing Ukraine's transport system, it seems reasonable to, on the one hand, consider the EU's goals for a sustainable transport system – also in regard to a possible future entry of Ukraine into the EU. In particular, these goals include a stronger shift in passenger and freight transportation from roads to railways, a promotion of alternative drives such as electric mobility as well as a fortification of sustainable urban mobility (expansion of public local/urban transport, pedestrian and bicycle traffic). On the other hand, EU standards relating to transport should be considered for reconstruction, to enable improved interoperability in railway transportation e.g. Specifically, this would be adopting the track gauge of 1,435 mm that is common throughout the EU. Another electrification of the transport network would also be worthwhile as well as the introduction of high-speed transportation between cities. The latter transportation can also serve as a substitute for short-haul flights within Ukraine (Centre, 2022, 26; EGDU, 2020, 36; European Union 2021; Mapping, 2021, 38; National Recovery Council, 2022, 10; World Bank 2018; WWF and BCG, 2022, 38-40).

4.5 Infrastructure

Considerable damages to the infrastructure are expected due to the war. Reports available so far indicate this, even if the precise extent cannot be determined until the war is over. In particular, it will be important to rebuild the central supply/collection infrastructure (among others, food, water/wastewater, waste, energy, IT, transport). Investments, besides others, in environmental protection were already insufficient before the ware, which increased the risk of incidents. When rebuilding, it is important to build on infrastructures that are aimed at sustainability, are climate-resilient and climate-adapted, multifunctional and if applicable, linked and in doing so, include nature-based solutions. Among others, the International Good Practice Principles for Sustainable Infrastructure can serve orientation purposes (Centre, 2022, 2; COM, 2022, 6; Gharios/Farajalla/Hajj 2021; Olfert 2021; Stukalu, 2021, 180; Umweltbundesamt 2020d; United Nations Environment Programme, 2022; WWF and BCG, 2022, 15):

- Water/wastewater: The connection rate to the central water supply and wastewater disposal in Ukraine is low, particularly in rural areas. Most water suppliers are not able to provide properly treated drinking water. The mortality rate due to diarrhea based on shortcomings in the provision of drinking water, wastewater connection, disposal and treatment and hygiene in Ukraine is the highest in Eastern Europe. Defective and inefficient pipelines lead to local water losses of approximately 40 %. According to reports, a significant number of water supply and wastewater treatment plants were damaged or destroyed during the war. Extensive measures for modernization and improvement of the water supply and wastewater disposal network are required as well as measures for the reduction of water consumption for production and the improvement of the quality of drinking water also in regard to the necessity of climate change adaptation. To a great extent, data on the quality of flowing waters is missing. Many rivers will most likely require an examination of their state and measures for their restoration after the war has ended (EU4Environment, 2021, 53-95; GIZ n.d.b; Golovka, 2020, 195; National Recovery Council, 2022, 35; WWF and BCG, 2022, 29-30).
- Waste: The better part of waste materials (54 %) are landfilled in Ukraine. An increase in construction and building waste (e.g. damaged buildings) must be expected due to the war; this waste can be reused instead of being landfilled. It would be appropriate to convert waste management in Ukraine from the prevailing linear model into an eco-friendly and economically efficient recycling management after the war is over. Food and residential waste have the potential to be sorted, utilized, composted and used to produce energy. Above all, there are recycling opportunities in the automobile industry, household appliance sector and the aircraft industry. The framework conditions must be changed for this purpose because landfilling waste is still favored over investments in prevention and recycling. With the development of a recycling management, positive economic effects due to the increase in energy and resource efficiency and a social effect due to the creation of additional jobs can be expected (Bobrov, 2021, 21; Economist, 2022, 15; EGDU, 2020, 31; EU4Environment, 2021, 91; Golovko, 2021, 195-197; Ievdokymov 2018; Oleksenko, 2021, 4; Pokataiev 2021; Stukalu, 2021, 181).
- The IT infrastructure must be designed to cater to a frugal use of data, longevity and repair friendliness.

4.6 Cities

By all accounts, there is significant interest in "green" city development and planning in Ukraine (e.g. Green Deal Declaration & a Roadmap of the City Vinnytsia 2022). The decentralization started in 2014 offers a good basis for the future reconstruction of cities and communities. When rebuilding the destroyed cities, it is particularly important to consider the effects of climate change in terms of sustainable regional and urban planning; among others by providing green spaces and an adapted drainage system. A considerable part of the rainwater in Ukraine is mixed with household and industrial wastewater and directed into central sewage treatment plants. The rest is discharged into small waterways without any kind of treatment or with outdated and usually non-functional simple strainers that were installed back during the time of the USSR. In terms of traffic, it seems reasonable to pay attention to a mixture of functions ("Compact City and Regions") as well as the development of a sustainable transport system from the outset. This includes for instance a special consideration of public transportation as well as the bicycle and pedestrian traffic in accordance with the Pan-European Master Plan for Cycling Promotion – not only for the city itself but also for the urban hinterland. The objective should be that the types of transportation stated make up the highest possible percentages of transport performance and modal split. Cities and municipalities can be promoted by town twinning projects between the EU and Ukraine for instance. To reinforce sustainable mobility and green spaces in cities and at the same time, achieve compacted and space-saving building designs, the concept of triple inner urban development should be considered when building (Antunes/Barroca/Oliveira 2021; COM, 2022, 3; Documentation, n.d., 1; EGDU, 2020, 36; Federal Ministry 2021; GIZ n.d./n.d.c; International Initiative for a Sustainable Built Environment, 2022, 57; National Recovery Council, 2022, 35; OECD 2022; Shkaruba, 2021, 2440; UNECE 2022).

4.7 Building and living

In 2018, the emissions in the building sector accounted for approximately 8 % of Ukraine's total greenhouse gas emissions and the residential building sector alone was responsible for 30 % of the total Ukrainian final energy consumption. Most residential and non-residential buildings do not yet comply with the modern energy efficiency standards: The energy required in the Ukraine for heating purposes amounted to 250-450 kWh/m² compared to 180 kWh/m² in Germany or 150 kWh/m² in Scandinavian countries. Lesia Vasylenko, chair of the Climate Sub-Committee of the Ukrainian Parliament, suggested that the buildings, to which the Ukrainians return, should be rebuilt using the most energy-efficient materials and technologies. In the process, particularly modular building, serial restructuring with future-oriented energy standards and heating/cooling with renewable energy can be relied on. Avoidable conversions have ecological and economical disadvantages, which is why renovations and necessary new buildings should be immediately implemented in a future-oriented manner. Costs can be avoided as early as in the planning phase by using a lifecycle cost analysis to identify possible savings. The existing buildings in 2050 will essentially be from today's building measures and renovation and new buildings must be geared towards a zero-emission buildings performance in line with EU regulations. Furthermore, raw materials can be realized through the recycling of secondary raw materials from building stocks with the help of demolition, processing and recovery technologies. Recyclability and an optimal selection of resource-saving materials should be considered as early as in the planning stage of new buildings, which include the dismantling, separability and usability of building materials (BMI, 2019, 15; Centre, 2022, 24-26; Climate Action Tracker; EGDU, 2020, 25; Frankfurter Rundschau 2022; GIZ 2022a; International

Initiative for a Sustainable Built Environment, 2022, 47; National Recovery Council, 2022, 35; OECD, 2019, 39; Umweltbundesamt, 2019, 8; Umweltbundesamt, 2020b, 6; Yang/Cela/Yang, 2020, 876; WWF and BCG, 2022, 34).

4.8 Agriculture

Ukraine is an important exporter of agricultural produce. Water and wind erosion due to agriculture and the cultivation of land contribute to soil degradation in Ukraine. In the process of rebuilding agriculture, attention should be paid to sustainable food production, the protection of soil and biodiversity and the necessity of climate change adaptation, including a shift to climate smart irrigation. The use of mineral fertilizers and pesticides in Ukraine is much lower than in the European Union. Promoting healthy nutrition with a reduction of the amount of animal products seems reasonable. The prewar lifestyle of a large part of the population was considered unhealthy. 6 % of Ukraine's agricultural land could be economized by reducing food losses. This could be used to compensate for the loss of agricultural land caused by the war (e.g. due to war ammunition). There is great potential for the broad promotion of approaches according to agroecology and the sophisticated expansion of organic farming. To date, organic farming only makes up 1.1 % of the agricultural land. The government plans an increase to 3 % by 2030. Government support funding was introduced in 2021 (Bobrov, 2021, 21; EGDU, 2020, 41; EU4Environment, 2021, 28; Kotykova/Babych/Kuzmenko 2021, 4-15; Mapping, 2021, 26-29; National Recovery Council, 2022, 33; Nemitz, 2021b; Stukalu, 2021, 180; United Nations General Assembly, 2015, 15; Willet 2019; WWF and BCG, 2022, 31).

4.9 Governance and institutional design

Ukraine is regarded as a country with deficits in governance, a strong concentration of the economic power and widespread corruption. Therefore, significant key aspects of the recovery program would be strengthening governance, strengthening the civil society and combating corruption in compliance with SDG-16 (Bertelsmann Transformation Index 2022; Centre, 2022, 22; COM, 2022, 3; EBRD, n.d., 3; Kormycha, 2019, 311; Malyarenko, 2021, 42; National Recovery Council, 2022, 6; OECD, 2019a, 41; Rohland, 2002, iii; Sachs, 2021, 458; Shmyhal 2022; Stukalu, 2021, 178; Transparency International 2021; Ukraine Recovery Conference 2022/2022b; UNGA 2015; Worldwide Governance Indicators 2022; WWF and BCG, 2022, 61).

The existing plans in Ukraine for instance for energy supply, construction and transportation, should be reviewed regarding sufficient consideration of environmental and sustainability aspects, climate change adaptation and resilience against future emergency/disaster situations. A strategic environmental assessment, predominantly by Ukrainian authorities, of plans and programs is suitable as well as the environmental impact assessment of scheduled projects. Continuous updating of the plans is important, so that they can be immediately implemented after the war is over. This can avoid delays, as in the case of the Marshall Plan that did not come into force until three years later (Balla et al., 2010, 41f.; Centre, 2022, 13).

The international donor organizations from the EU and beyond should orient themselves to the existing legislation in the Ukraine instead of insisting on specifically tailored additional amendments, which increase the burden for the governments in the aftermath of the conflict. Amendments should only be made if they are absolutely necessary for a sustainable development of the country (Ghario/Farjalla/Hajj, 2021, 3683).

The implementation of the reconstruction program should be scientifically accompanied by Ukrainian and international experts and be routinely assessed regarding its contribution to a sustainable development of the country.

A framework is required that ensures the efficacy, transparency, public involvement and coordination of climate and energy governance (Mapping, 2021, 19; National Recovery Council, 2022, 9; Ukraine Recovery Conference, 2022a, 1).

The European Union could enter into a climate and energy partnership with Ukraine to promote energy transition in Ukraine; including the integration of Ukrainian producers into the relevant chains of economic value (DENA n.d.). The EU Member States should pool financial means on an EU level for this purpose and enable an efficient distribution to Ukraine with guidelines for expenses.

5 Policy recommendations

The German Environment Agency suggests the following measures for the policy design of the recovery program by the Ukrainian government, with the support of the EU and the international community:

- Ukraine should use the opportunities of the recovery program to establish itself as a model sustainable economy and society in the 21st century by means of a comprehensive transformation. The country's resilience should be reinforced, to be able to withstand future crises (such as the upcoming climate crisis). Existing environmental burdens should be reduced, environmental damages caused by the war eliminated and future ecological damages prevented. Reconstruction measures should be compatible and coherent with long-term eco-political objectives (such as climate neutrality, climate change adaptation, the European Green Deal and the Sustainable Development Goals e.g.), in order to avoid incorrect path dependencies and future failed investments (stranded assets). To achieve this, a comprehensive, social discussion process should take place in Ukraine as early as possible on what sustainable reconstruction could look like, to reach a social consensus on the necessity of transformation (COM, 2022, 3; OECD, 2022, 6; Resource & Analysis Center "Society and Environment", 2022, 3; Saha, 2022, 3; Ukraine Recovery Conference 2022).
- It is momentarily unclear what environmental damages were caused by the war. A post-conflict environmental assessment by the Ukrainian government should be conducted immediately after the end of the war – provided this was not yet done through the work of the National Council for Recovery – in cooperation with the United Nations Environmental Programme and the Organisation for Security and Co-operation in Europe, to determine the environmental damages caused by the war. At the same time, their decades of experience can be resorted to (United Nations Environmental Programme 2015; Organisation for Security and Co-operation in Europe 2017). Germany should participate in this (including the expertise of the German Environment Agency) in a suitable manner.
- Industry in Ukraine is to a considerable extent considered to be resource-intensive and inefficient. Recovery should be combined with comprehensive, sustainable modernization of the industry by increasing resource and energy efficiency (leapfrogging). Procurement of new facilities/equipment and reconstruction of infrastructure should focus on high resource and energy efficiency as well as the use of technologies that achieve the goal of greenhouse gas neutrality in the long term. This also applies to the content design of education and training. Instead of rebuilding resource-intensive facilities, resource-light and climate-friendly alternatives should be promoted (Centre, 2022, 8-26; IRP; National Recovery Council, 2022, 2; OECD, 2022, 6; Saha, 2022, 14; Shmyhal 2022; Stukalu, 2021, 181; WWF and BCG, 2022, 53-55; Yang/Cela/Yang, 2020, 866).
- Ukraine's energy system is very energy-intensive. Recovery in Ukraine should be carried out in combination with a social-ecological energy price reform including the dismantling of environmentally and climate harmful subsidies and the transformation of the energy system towards energy efficiency, prevention of energy poverty, energy sufficiency, use of renewable energies and climate neutrality by 2050 in line with EU targets. Ukraine should still phase-out coal by 2035 as planned by the government. Science and innovation should be the basis for political decisions and their consistent implementation. (Aliieva/Savitsky 2018; Fialko/Tymchenko, 2021, 113; GIZ n.d./2021/2021a/2022a; OECD, 2022, 6; Resource & Analysis Center "Society and Environment", 2022, 3; Trushkina, 2021, 135; Ukraine War Environmental Consequences Work Group 2022; WWF and BCG, 2022, 6; Yang/Cela/Yang, 2020, 877-9).
- Ukrainian agriculture makes an important contribution to feeding the world. Recovery should be used to push the development of sustainable agriculture and make it into a

globally recognized model for sustainable agriculture – for instance by promoting the broad implementation of agroecological approaches and expanding organic farming. The minimal use of mineral fertilizers and pesticides offers great potential to achieve these efforts (Mapping, 2021, 29; WWF and BCG, 2022, 47-51).

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