INTERNATIONAL MONETARY FUND

Policies to Address Climate Change

Geoffrey Keim and Mariia Sydorovych

SIP/2024/001

IMF Selected Issues Papers are prepared by IMF staff as background documentation for periodic consultations with member countries. It is based on the information available at the time it was completed on December 4, 2023. This paper is also published separately as IMF Country Report No 23/400.

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SELECTED ISSUES PAPER

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IMF Selected Issues Paper
European Department

Policies to Address Climate Change, Ukraine

Prepared by Geoffrey Keim and Mariia Sydorovych*

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ABSTRACT: While the near-term priorities are national defense and macroeconomic stabilization, gradually incorporating climate change considerations into policy design will become increasingly important after the war and into the long term. As regards climate change adaptation, investments will need to be made with a view to maintain long-term debt sustainability. Policy reforms will also be needed to move to a low-emissions economy to deliver international commitments and achieve the broader objective of European Union accession. Potential exists to deliver on climate priorities alongside implementing recovery and reconstruction efforts, while maintaining macroeconomic stability, and ensuring social protection and equity.

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SELECTED ISSUES PAPERS

Policies to Address Climate Change

Ukraine

Prepared by Geoffrey Keim and Mariia Sydorovych

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Policies to Address Climate Change[1]

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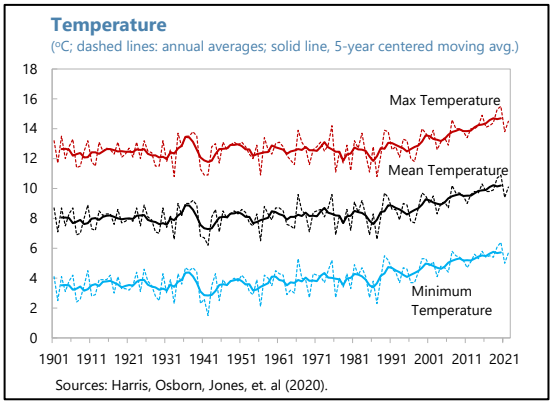
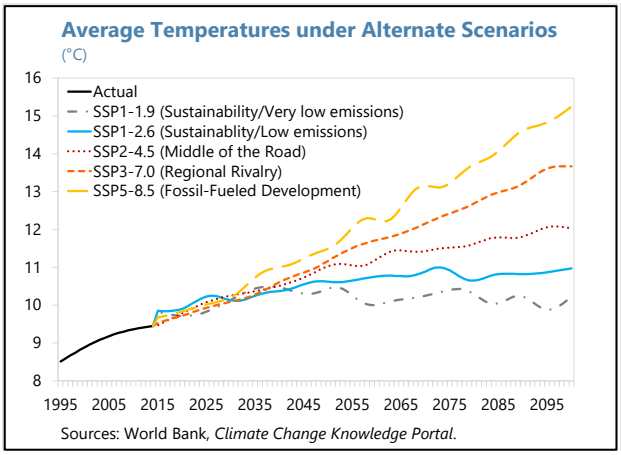
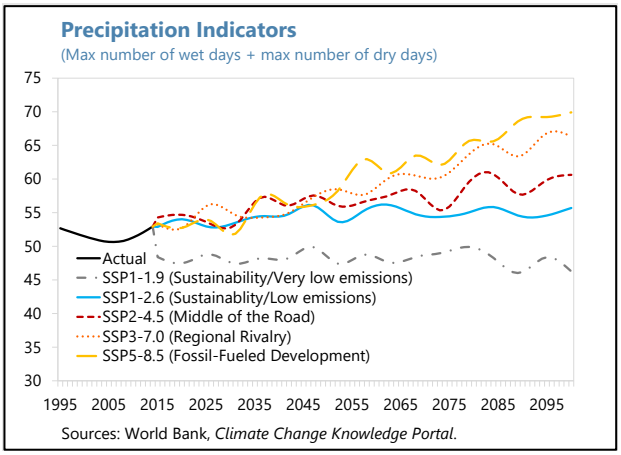
A. Introduction

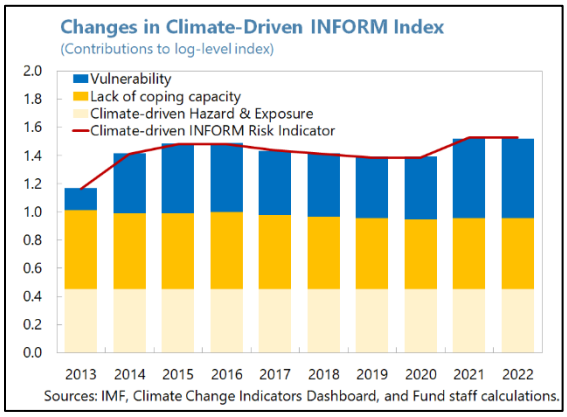


1. Ukraine has already begun to experience the effects of global warming, and the trend will continue in the future. Average temperatures already began a clear upward trend from at least the 1990s, and over 2010–22, average annual temperatures were 9.9°C, well above the comparable figure of 8°C observed over 1901–1980. Moreover, under the Intergovernmental Panel on Climate Change's Shared Socioeconomic Pathway scenarios, temperatures would rise further, including in a scenario where globally, Paris Agreement commitments are realized and temperatures increases are kept below 2°C. Beyond warmer temperatures, rainfall patterns are expected to become more volatile. As a consequence, damaging droughts and floods would become more frequent and river discharge (flows) could decrease, resulting in more arid lands (Didovets, et. al., 2020).

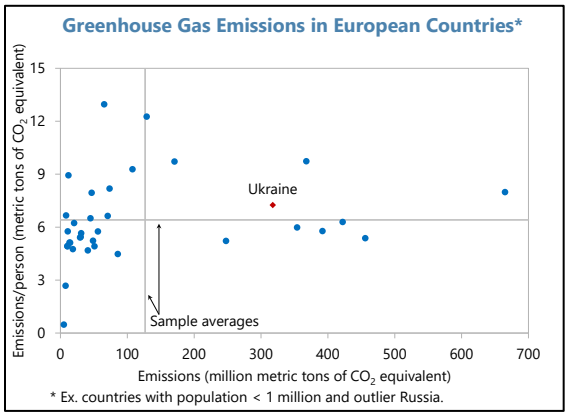




[1] Prepared by Geoffrey Keim and Mariia Sydorovych.



2. Climate change will gradually add to risks the economy faces, and in the longer termUkraine's ability to contain these vulnerabilities will be challenged by the legacies of the war. In terms of the economy, the implications for the large agriculture sector will likely be complex. Production might benefit from mild-to-moderately warmer temperatures—although more volatility and more extreme temperature rises would be damaging (Muller, et. al. 2016). Additionally, more volatile rainfall patterns would weigh on agricultural production. There would also be a regional dimension to climate change impacts on agriculture within Ukraine and as a result on the population's wellbeing, with the south and center being more exposed (World Bank, 2021).The continuing shifts in the natural climate zones suitable for farming from the south to the north of Ukraine and the reduction of production capacity resulting from the increased frequency and magnitude of the extreme weather events are the main physical risks considered by Ukrainian agricultural producers (Kernel, 2023). Beyond agriculture, capacity to manage the higher frequency of natural disaster events like flooding and forest fires could be weakened by important vulnerabilities. In particular, higher poverty, an aging population, and high urbanization—which to some degree have been exacerbated by the war—could magnify the fallout from and hamper the ability to mitigate the effect of disaster events. Thus, sustained efforts in the years ahead to contain this vulnerability, alongside with other challenges that post-war Ukraine is likely to face, will be important to maintain economic stability over the longer term.



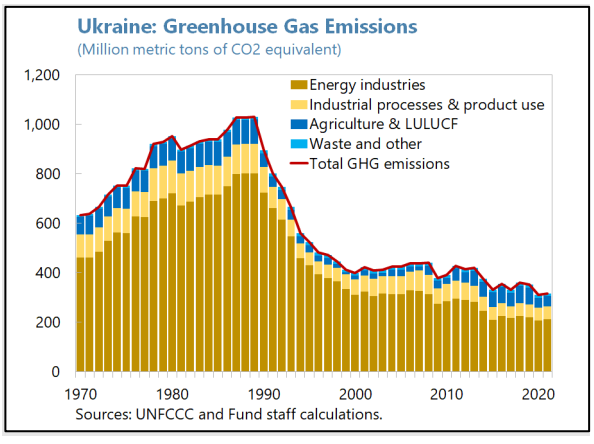
3. At the same time, Ukraine has a role in contributing to lower greenhouse gas (GHGs) emissions. Ukraine has been an above-average emitter of GHGs in Europe, both in terms of aggregate and per-person emissions. Progress in this area will involve complex and wide-ranging policies as well as substantive investment needs. However, these efforts could carry key benefits such as future-proofing Ukraine's infrastructure, improving energy efficiency, and lowering pollution, which is expected to be beneficial to public health and, by extension, economic performance. Beyond domestic priorities, Ukraine will also need to take steps to deliver sustained emissions reductions to meet its international commitments and longer-term development priorities. First, as a member of the Paris Agreement, Ukraine has revised its Nationally Determined Contribution to reduce emissions by 65 percent below 1990 levels by 2030 and to zero by around 2060. Additionally, as an EU candidate country, the government will need to adjust key tax, spending, and regulatory policies in line with the EU acquis as part of the accession negotiations. Moreover, given that the EU is Ukraine's key trading partner, and Ukraine is among the countries most exposed to the Carbon Border Adjustment Mechanism (CBAM) introduced by the EU with the financial impact gradually phasing in starting 2026, Ukraine should consider prioritizing its decarbonization agenda in the coming years. Relatedly, putting in place climate-informed public investment management (PIM) systems now

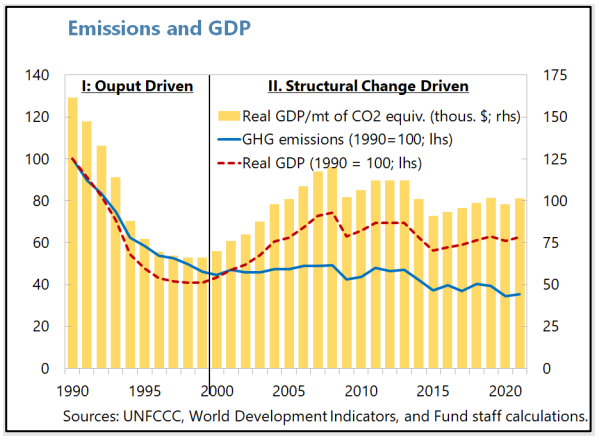
is crucial to ensure that the significant reconstruction investments ahead enable "carbon leapfrogging" to a future-proof economy, overcoming "carbon lock-in" (Seto, 2016, OECD 2022). Delivering on these objectives will require a wide-ranging reform agenda, with numerous substantive reforms being steadfastly introduced over an extended period.

4. Given these imperatives, longer-term policies will need to increasingly internalize climate issues, and this chapter looks at several areas that should form part of the agenda. First, the next section covers the evolution of GHG emissions and their potential trajectory, as well as key damages to the environment, carbon sinks, and green infrastructure arising from the war. The next section illustrates the impact of necessary investments in climate change adaptation on long-term debt sustainability. Mitigation policies are the subject of the next section, particularly simulations of the impacts of potential reforms to carbon taxation and introduction of an emissions trading system. The final section contains concluding observations.

B. GHG Emissions in Ukraine: Past, Present, and Future

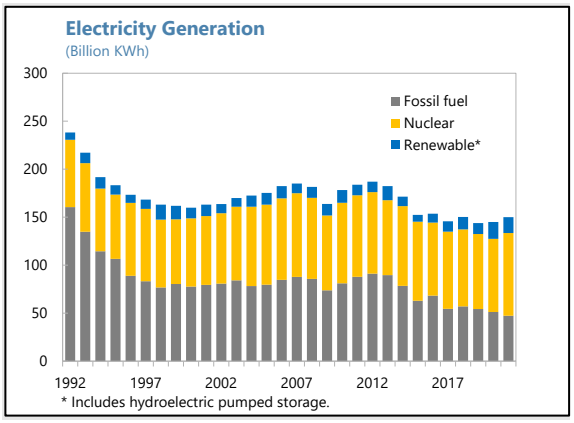
5. Ukraine's GHG emissions have dropped substantially. In 1989—the peak year—Ukraine emitted GHGs amounting to 1,030 million metric tons of CO_2 equivalent,[2] making it the 7th largest emitter in the world. The structure of the economy contributed to this result, with substantial activities concentrated in energy intensive sectors such as coal, metallurgy, and defense-related industries. However, over the 1990s, in the early stages of Ukraine's independence, emissions fell sharply, reflecting the initial output decline that was typical of most post-Soviet economies as they transitioned to a market economy. A second phase began in the early 2000s, when the economy began growing again, while emissions continued to decrease, albeit at a slower rate. This dynamic was driven by structural change of Ukraine's economy over this period, as the economy diversified and the services sector, which is typically associated with lower emissions, began to make a stronger contribution to the economy. By 2021, the latest year for which data are available, GHG emissions reached 318 million metric tons of CO_2 equivalent, down 69 percent from the peak, making Ukraine the 31st largest emitter globally.

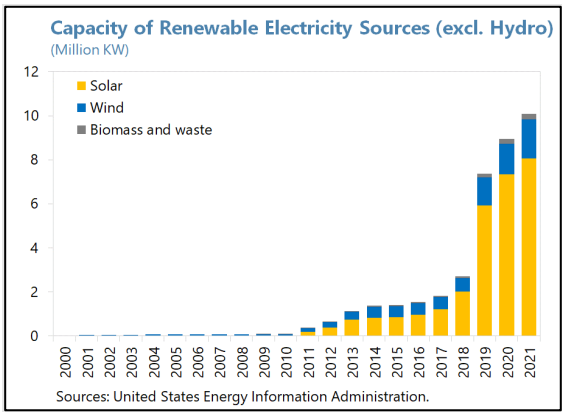




[2] Including land use, land use change, and forestry (LULUCF).

6. While the reduction in emissions was largely a side effect of broader economic trends, shifts in the energy mix also played an important role. In 1992, fossil-fuel based generation sources dominated electricity production, with a share of 67 percent. There was, however, significant installed nuclear and hydropower capacity. Over the course of the decade, and in the 2000s, the utilization of fossil fuel powerplants decreased, while the share of nuclear plants expanded, including with a boost from additional capacity installation in the early 2000s. In line with this trend, nuclear caught up with fossil fuel-based generation in the mid-2000s and has been Ukraine's main source of generation every year since 2014. Renewable sources of generation other than hydropower were fast-growing in the years immediately before the war (2019–21) and the installed capacity of solar and wind had overtaken hydropower.



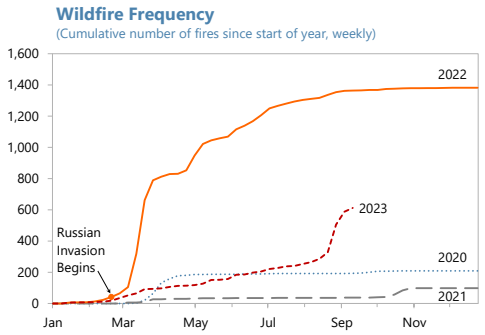


7. The effects of the war will constitute major setbacks to progress on climate objectives (Box 1). Analyses of the damages from the war point to substantial and wide-ranging environmental effects including to a number of sectors of the economy (e.g., World Bank (2022, 2023)). The frequent forest fires arising from the war not only lead to direct emissions but also entail damage to carbon sinks, limiting their absorptive capacity. Additionally, many low-carbon energy sources have sustained heavy damages, being located in temporarily occupied territories (and thus beyond the government's control) or taken offline as a protective measure. As a consequence, the progress that Ukraine had made on transitioning toward a lower emissions economy has been compromised. However, in the future, restarting the transition to renewable energy has potential to lower the costs of electricity generation, and improve energy security which could carry important benefits.

Box 1. Ukraine: Key Ecological Damages Arising from the War

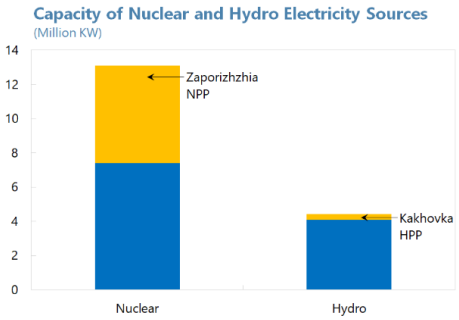
The environmental damages from the war have been severe and wide ranging. It has triggered much higher-than-usual incidence of fires, which have both released carbon emissions and damaged Ukraine's forests, a critical natural sink. It has also resulted in the loss of major clean energy assets, which form a major part of Ukraine's overall energy mix.

Combat operations have contributed to frequent outbreaks of wildfires and triggered emissions of carbon dioxide (CO_2; World Bank 2022 and 2023). In 2022, the European Forest Fire Information Service (FFIS) tabulated 1,382 fires—an extremely high level—with over half of the incidents occurring in the first six weeks after the February invasion. These fires are estimated to have covered 260,588 hectares and cumulative weekly CO_2 emissions were about 118 percent above the pre-war (2021) level. In 2023, while fire activity has been less severe than 2022, FFIS detected a notable uptick around August-September, a period coinciding with active counteroffensive operations. Cumulative weekly CO_2 emissions were 24 percent above the same period in 2021.



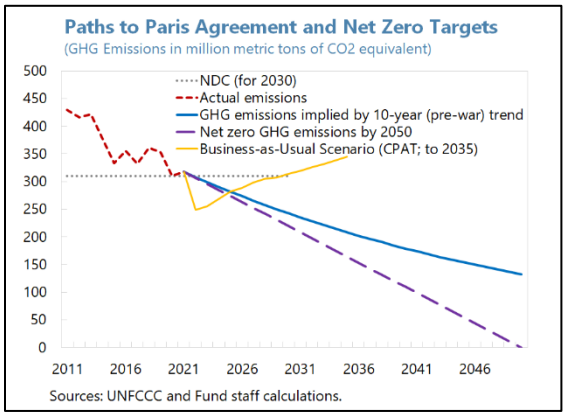
Source: European Forest Fire Information System (EFFIS).

Attacks on renewable and low-carbon energy powerplants have contributed to a drop in generation and installed capacity from clean sources. Several nuclear power plants (NPPs) have at times been located around areas of active hostilities and have been damaged due to the war. The situation has been particularly severe with the Zaporizhzhia NPP, which is currently located in temporarily occupied territories. In addition to the immediate safety concerns concerning the facility, it is the largest nuclear plant in both Ukraine and Europe. With installed capacity of 5.7 million MW, it accounts for a material proportion of Ukraine's pre-war installed generation capacity (almost 10 percent) and its permanent shutdown would have important implications for low-emissions energy in Ukraine. Hydropower plants (HPPs) have sustained severe damages from the war, with available power generation capacity dropping by about 7½ percent between 2021 and end-2022. The most notable loss was the Kakhovka HPP, which was located in temporarily occupied territory and was destroyed on June 6, 2023. While it had the smallest capacity of the Dnipro Cascade HPPs, its loss eliminated about 3 percent of Ukraine's pre-war generation capacity. Finally, while comparatively small, wind and solar power generation fell by over half in 2022, as some units are located in temporarily occupied territories, were destroyed, or taken offline as a protective measure.

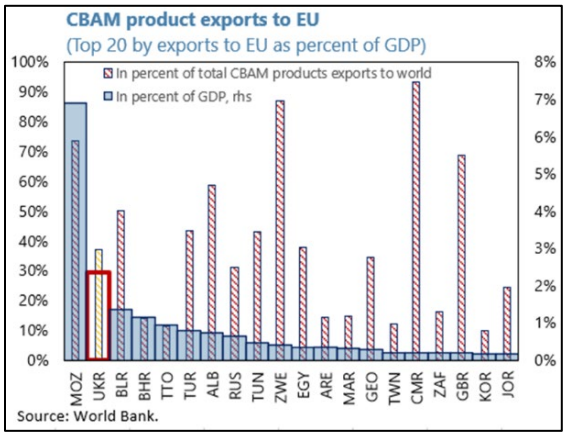


Sources: U.S. EIA, News Reports and Fund Staff Estimates

Other environmental impacts triggered by the war are also important. While less straightforward to quantify, attacks on facilities that warehouse hazardous materials like oil depots have resulted in GHG emissions and release of other pollutants. Additionally, the loss of agricultural lands due to mining could also entail an adverse impact on emissions. The resulting environmental contamination will further challenge the attainment of climate objectives in the post-war period.



8. However, the war-related drop in output has largely offset the emissions increases described above, though recovery and reconstruction after the war may launch an uptrend in emissions. During the period of martial law, the publication of statistics on emissions has ceased. However, estimates of potential emissions since the start of 2022, as well as projections going forward can be obtained from model-based estimates in the Fund's Climate Policy Assessment Tool (CPAT; Black, et. al., 2023). The scenario considered here, is built on projections on the basis of: (i) real GDP growth matching the Second Review baseline through 2033, and staying at that level thereafter; (ii) no policy changes to environmental/carbon taxation; and (iii) other standard parameters in the model.[3] Given these assumptions, the model estimates that GHG emissions dropped by about 20 percent in 2022, given the economic fallout of the war. Going forward, considering the expected post-war economic recovery, emissions would start to trend upward, crossing their pre-war (2021) level around 2030 and continuing to rise in subsequent years. In this projection, the main factor driving the longer-term upward path is GDP growth, although the energy intensity of GDP is also contributing in the earlier years of the horizon. If this trend was not reversed, GHG emissions would continue increasing, eventually returning to levels above Ukraine's Paris Agreement commitments around 2030 and the European Union's requirements for its members.



9. Currently Ukraine is among the countries that are most exposed to the Carbon Border Adjustment Mechanism (CBAM) introduced by the EU as part of the "Fit for 55" climate package. Starting 2026, the CBAM tax will be paid on imports to the EU of carbon-intensive goods such as iron, steel, aluminum, cement, fertilizers, and electricity. While two thirds of Ukraine's exports of goods are sent to the EU, shipments of about 2.4 percent of GDP are directly exposed to the CBAM (WB index). Some industries have already started projecting losses from the CBAM introduction (GMK Center, 2023). Thus, for Ukrainian businesses and policymakers this is a call for green modernization as well as for reforms of carbon pricing that need to be synchronized with the EU's climate policies and infrastructure.

[3] See Annex I of Black, et. al., 2023 for further details.

C. Long-Term Debt Sustainability and Investment Needs in Climate Change Adaptation

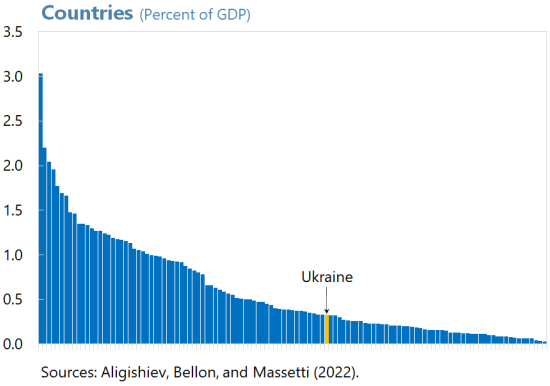
10. Ukraine will need to take action over a longer-term horizon to build resilience and adapt to climate change. As described earlier, climate events are expected to become more frequent, and economic, social, and demographic trends will likely aggravate vulnerability. Thus, efforts to promote climate change adaptation will become increasingly important. However, making these investments over the longer term will need to be done in a way that does not jeopardize debt sustainability, which is expected to be delivered under the EFF.

11. This analysis of long-term debt sustainability relies on deterministic paths for debt-to-GDP and gross financing needs-to-GDP. The long-term debt and GFN paths begin in 2034 and extend through 2053, and assume that: (i) Ukraine will have implemented the reforms embedded in the program (especially the revenue-based fiscal adjustment); (ii) donors and other development partners will have provided financing on appropriately concessional terms through 2033; and (iii) external commercial and official bilateral creditors will have agreed to a restructuring that provides an adequate amount of debt relief. The implications of these assumptions are that the starting points for the scenario analysis are a public debt level of around 65 percent of GDP and GFNs that would have averaged 8 percent of GDP in the 5 years leading up to the scenario. Because under the Fund's EHU policy, these targets must be delivered under both the medium-term baseline and downside scenarios, there is a common starting point, and thus no distinction between these scenarios for the long-term analysis.

12. The methodology is inspired by the long-term projections generated by the Sovereign Risk and Debt Sustainability Framework's (SRDSF) climate change adaptation module (IMF, 2022). It relies on projections for key macro-fiscal debt drivers, such as the primary balance, real GDP growth, inflation, and exchange rates. In addition to new borrowing for current fiscal needs, the module incorporates debt service associated with outstanding debt. All borrowing needs are met through an assumed financing structure that reflects an assumed currency composition of new borrowing, weighted average marginal interest rates, and an effective maturity schedule (both interest rates and maturities are specified by currency). The rollover of maturing obligations is expected to occur according to the overall projected financing structure and terms on new debt.

13. The estimated annual fiscal cost of adaptation investments is a key variable in this analysis. In line with the long-term climate change adaptation module in the SRDSF, the cost of investments in climate change adaptation includes strengthening physical assets (both existing and new) and enhancing costal protection. These estimates are taken from Aligishiev, Bellon, and Massetti (2022) and in Ukraine's case, they amount to 0.3 percent of GDP annually. Of this amount 0.22 percent of GDP relates to strengthening existing assets, 0.06 percent of GDP is for new assets, and 0.06 percent of GDP is the component related to costal protection against sea level rise. This level of investment is relatively moderate by cross-country standards across market access countries, where the sample average is 0.6 percent of GDP. While the Aligishiev, Bellon, and Massetti (2022) estimates cover the 2021–2030 period, for the purposes of modeling the

long-term impact of investments in climate change on debt, they are forecasted to persist at this level until 2053. This assumption assumes that investment needs do not change over this period, which introduces a key source of risk to the projections presented in this analysis.



Sources: Aligishiev, Bellon, and Massetti (2022).

Note: Investments include (i) retrofitting of all existing public capital to stand present flood risks, with the exclusion of capital that is expected to depreciate before 2030. The adaptation gap with respect to present flood risks is large, and flood risks are not expected to change significantly in the next decade; (ii) strengthening of new public capital investment against present flood risks; and (iii) investment for protection against present and future sea-level rise with Benefit-Cost ratio≥1 in the period 2015-2030.

14. Three scenarios provide ranges of possible outcomes for public debt and GFNs assuming efforts to implement adaptation to climate change. These scenarios aim to isolate the impacts of relevant policy decisions that will need to be taken in the future. Thus, while variables used for the debt and GFN forecasts, like real GDP growth, inflation, exchange rate assumptions, and critically, the level of investment in climate change adaptation are common across scenarios, other variables are allowed to differ across scenarios as follows:

- *Continued trends*: This scenario is the benchmark, which illustrates public debt in the event that macroeconomic and fiscal variables reside indefinitely at the levels observed in 2033, the last year of the medium-term scenario. Additionally, borrowing terms, including marginal interest rates and effective maturities persist at their 2033 levels.

- *Harder borrowing terms*: In this scenario, the macro-fiscal variables are held the same as in the continued trends benchmark. However, this scenario relaxes the baseline's assumption that external concessional financing will remain abundant over the longer term. Instead, borrowing in U.S. dollars, and particularly in Euros is expected to be subject to market interest rates and shorter maturities.

- *Faster fiscal relaxation*: Under the baseline, Ukraine is expected to maintain a high primary surplus through 2033 as part of its contribution to restoring fiscal and debt sustainability. In contrast to the previous two scenarios, this alternative allows for a fiscal relaxation starting in 2034. In this calibration, the underlying primary deficit (without climate change adaptation investments) is allowed to weaken to a deficit of about 2

percent of GDP, which is just enough to stabilize debt near 65 percent of GDP before considering investments in climate change adaptation. However, borrowing terms are the same in the (first), continued trends scenario and still allow for significant amounts of concessional financing.

Key Assumptions for Long-Term Scenario Analysis

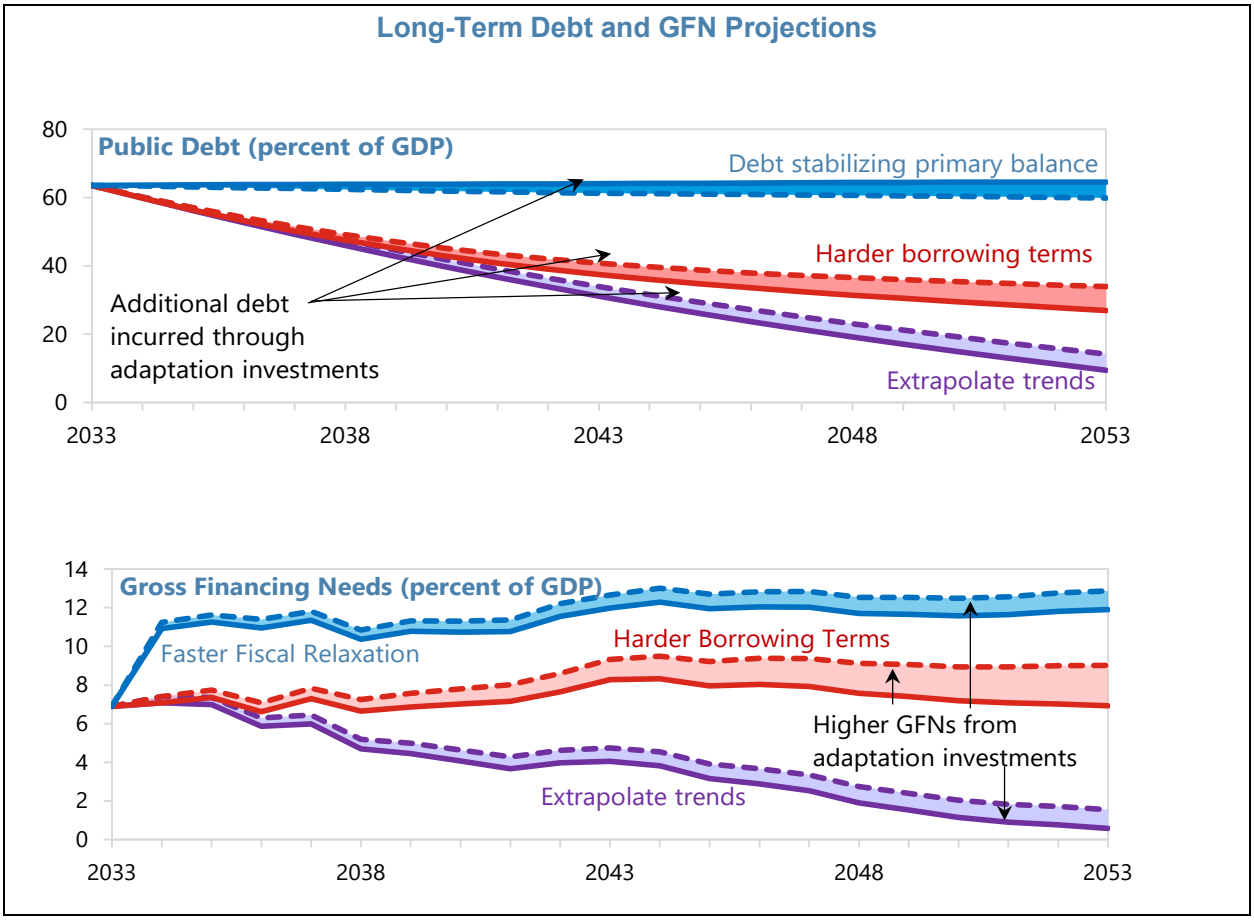
	Continued trends	Harder terms	Fiscal relaxation
Macro-fiscal variables			
Real GDP (percent change)	4.0%	4.0%	4.0%
Inflation (percent; GDP deflator)	5.0%	5.0%	5.0%
Primary deficit (percent of GDP)	-1.1%	-1.1%	2.4%
Underlying primary deficit	-1.4%	-1.4%	2.1%
Adaptation investments	0.3%	0.3%	0.3%
Borrowing terms and conditions			
Marginal interest rates (in percent)			
Local currency	6.4%	6.4%	6.4%
U.S. dollar denominated debt	4.9%	7.5%	4.9%
Euro denominated debt	0.3%	7.5%	0.3%
Effective average maturity (years)			
Local currency	4.6	4.6	4.6
U.S. dollar denominated debt	6.0	5.0	6.0
Euro denominated debt	9.8	5.0	9.8

15. The projected debt and GFN paths differ across the three scenarios.

- *Continued trends*: This scenario incorporates the most favorable assumptions—favorable borrowing terms and tight fiscal policy. As a result, debt would fall to extremely low levels before considering climate change adaptation investments. With a moderate level of required investments, debt would rise only a little and remain at low levels. Given the benign debt burden and maintained primary surplus, GFNs would also be modestly sized.

- *Harder borrowing terms*: With less concessional financing assumptions, public debt would end up around 34 percent of GDP by 2053, with the impact of investing in adaptation adding about 7 percentage points to the debt ratio. This level of indebtedness would still normally be associated with well-contained risks. However, the need to finance these investments on less favorable terms would lead to rising GFNs, although they would be within generally manageable levels.

- *Faster fiscal relaxation*: Given the assumption that the primary balance is relaxed to only just stabilize debt excluding the investments in climate change adaptation, debt rises weakly to 64 percent of GDP by 2053 in this scenario. This level of indebtedness would be more risky, but risks could be mitigated if substantial portions of new debt issuance continued to occur on concessional terms. Such borrowing could leave the GFN-to-GDP ratio relatively stable, but elevated at around 11–13 percent of GDP.



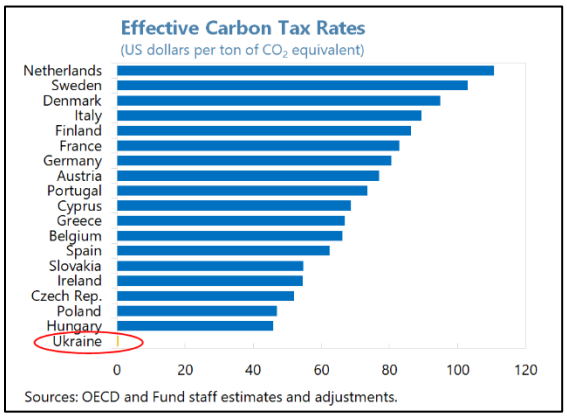
16. There are important caveats to this analysis. First, the exceptionally high near- and medium-term uncertainty that is characteristic in Ukraine is even more evident at longer horizons. The course of the war, the level of recovery and reconstruction, and the post-war economic and social structure could cause outcomes to differ significantly from the outcomes modeled in this section. The risks to the projections are in both directions and have different sources. First, key macro-fiscal variables (e.g., growth, inflation) could differ drastically from the levels currently projected. The requirements for investments in climate change could also differ from the assumptions in this analysis including based on ecological or physical infrastructure damage arising from the war. On the upside, build-back better principles during the post-war reconstruction could reduce the level of required investments later. However, if the legacies of the war exacerbate vulnerability to climate change, then fiscal costs could be higher.

17. Based on these scenarios, adequate adaptation investments would appear likely to leave debt and GFNs within manageable ranges, but important considerations remain. First, it will be imperative to avoid excessive fiscal relaxations after debt sustainability is decisively restored. Keeping the primary surplus at a somewhat elevated level for an extended period will enable climate programs to be incorporated in the budget without crowding out other priorities and while leaving adequate buffers for potential future shocks. Mitigation policies discussed in the next section could help with this effort. Additionally, seeking financing on adequately concessional terms—including for climate-related policies—will also remain important to keep

GFNs within manageable ranges. Provided that primary balances and financing terms remain prudent, debt would likely stabilize, and rollover risks would remain manageable, meeting the Fund's definition of debt sustainability (IMF, 2022).

D. Policies to Lower Greenhouse Gas Emissions

18. A carbon tax exists in Ukraine, although it remains low and carbon prices lag European Union standards by a significant margin. Carbon taxation in Ukraine began in 2011 with the adoption of the Environmental Tax. This tax is paid by the entities that emit pollutants into the atmosphere from stationary sources, discharges of pollutants into water, disposal of waste, and generation and temporary storage of radioactive waste (Tax Code of Ukraine). The part of the tax related to carbon emissions covers the stationary sources of pollution (i.e., electricity and industry). While the tax rate was substantially increased in 2019 and subsequently in 2022 (from UAH 0.2 back in 2011 gradually up to UAH 0.41 in 2018; up to UAH 10 in 2019 and up to UAH 30 per ton of CO2 equivalent in 2022), it remains very low and the government's collections on this tax are only a minor share of total tax collections (0.3 percent of total tax revenues in 2022). By comparison to other EU countries, Ukraine's effective carbon tax rates are around $1 per ton of CO2 equivalent, significantly less than the average of $73 per ton of CO2 equivalent in the sample. As a result, and as discussed in Breuing (2021), the carbon tax rate and coverage are currently too low to have a material impact. More generally, as described below, meeting EU requirements will require substantial policy actions that would entail significantly raising carbon taxes.



19. Ukraine's broader development objectives and international commitments imply that several reforms will be necessary in the coming years.

- *Paris agreement and EU net-zero requirements*: In July 2021, Ukraine submitted its revised Nationally Determined Contribution (NDC) raising its emissions reduction target to 65 percent by 2030 compared to 1990 levels. With the substantial reduction in emissions described earlier, the pre-war (2021) level is nearly already at the target. As described earlier, the severe output contraction caused by the war has likely restrained emissions in the last 2 years (notwithstanding the war's environmental damages). However, as recovery and reconstruction efforts manifest themselves, emissions are expected to rise. In a business-as-usual baseline, emissions would be on an upward trend and rise above the NDC level in the long term. Avoiding this outcome is thus essential, including to align with the European Union's climate objectives of net zero greenhouse gas emissions by 2050. Thus, more determined mitigation policies will be required.

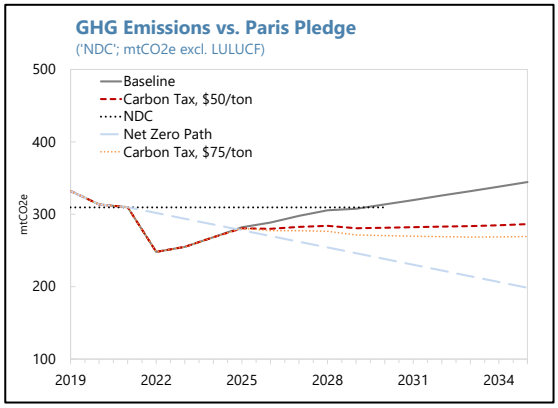
- *Emissions trading system*: Additionally, the EU Association Agreement entails adopting an Emissions Trading System (ETS) by 2025 that covers power and industry, which are the current sectors covered by the EU ETS. Despite the challenges posed by the war, the Minister of Environmental Protection and Natural

Resources indicated in April 2023 an intention to introduce legislation on the ETS next year. According to the European Business Association concept note on the ETS released in September 2023 (EBA, 2023), Ukrainian businesses are also interested in gradual, well-tailored and predictable introduction of the domestic ETS with subsequent transition to the EU ETS that would allow businesses to adopt on the path towards the EU accession.

20. The IMF-World Bank Climate Policy Assessment Tool (CPAT) can help illustrate the emissions, fiscal, and economic impacts of mitigation policies to achieve these objectives. Given the looming changes to environmental taxation, either to meet emissions objectives, or to introduce an emissions trading system, analysis of the potential options is warranted to ensure that they are well calibrated to satisfy their purposes. One such tool is the CPAT, which is a set of models that can help estimate the effects of various mitigation policies. It includes the use of a mitigation model, which uses projections of income growth, fuel prices, and technological improvements to project consumption for a variety of energy sources and across sectors. The outputs from the model include fiscal indicators (e.g. revenues raised, saved, and allocated), GHG emissions, GDP and welfare effects etc. Moreover, CPAT has other modules that cover issues like distribution (household/firm impacts), air pollution, and transport. Further information about CPAT can be found in Black, et. al. (2023).

21. In an illustrative scenario, the authorities could gradually target a carbon price of US$50 per ton.[4] This scenario is consistent with one of the scenarios in the analysis performed by Fund staff in other EU neighboring countries in Cevic, et. al. (forthcoming). To summarize:

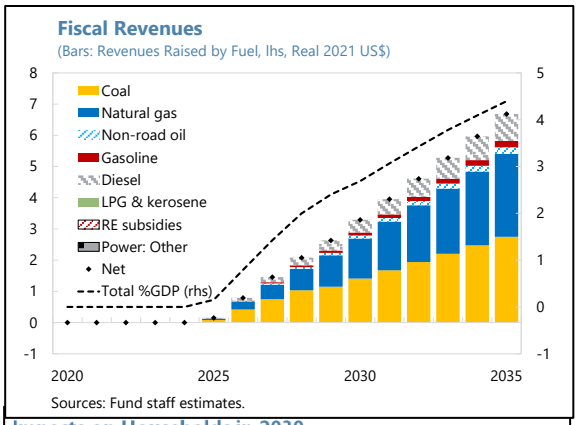
- *Calibration of the scenario*: From the current level of about $0.8 per ton of CO2, Ukraine would begin raising carbon prices gradually in 2025, reaching a price of $50 per ton of CO2 by 2035. Coverage would extend to all fuels, sectors, and industries. The revenues generated from the higher taxation would be recycled, with their uses allocated equally among public investment, to support recovery and reconstruction efforts; transfers, to cushion the impact of the policy on vulnerable households (in this scenario, the bottom 40 percent of the income distribution); and other current spending, in line with the government's need to implement a revenue-based fiscal adjustment.

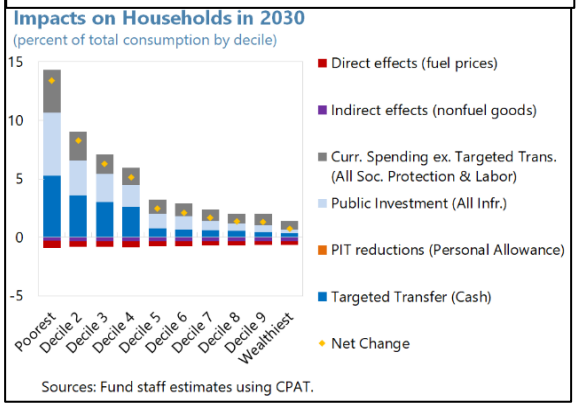


[4] While an ETS and carbon taxes are different types of policies, for modeling purposes, their effects are essentially equivalent when ignoring the impact of overlapping policies and price uncertainty (see Parry et al 2022 for more). However, there may be differences between ETS and carbon taxes in practice. Carbon taxes (i) can provide a more predictable price signal for directing private sector investments; (ii) be implemented upstream; (iii) based on existing fuel tax/subsist systems facilitating their implementation; and (iv) provide a stable revenue source. Conversely, ETSs (i) provide more certainty over emissions levels; (ii) can be implemented by Environment Ministries; and (iii) limited free permit allocations may garner political support (while diminishing the revenue gain).

- *Emissions trajectory*: This policy path for carbon taxation would cease the upward trend in emissions under the business-as-usual baseline. However, it would only just broadly stabilize the path for emissions. A more ambitious target price of $75 per ton of CO2 would lower emissions further. Although it would be more politically difficult, in addition to lowering emissions, it would be closer aligned to recent EU carbon prices.

- *Fiscal impacts*: The revenue potential from targeting carbon taxation is substantial. If the target of $50 per ton of CO2 is reached by 2035, the total fiscal revenues as a percent of GDP would reach around 4½ percent of GDP in that year. Under the more ambitious $75 per ton of CO2 target, fiscal revenues would rise to 6.1 percent of GDP. Additionally, carbon taxation may be more difficult to evade, reinforcing its revenue generating potential.



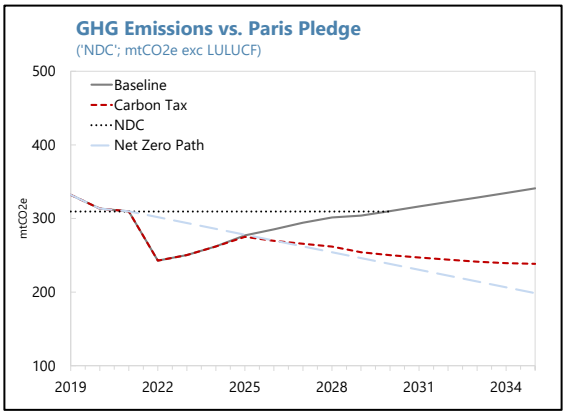


- *Social/distributional impacts*: While the effects of higher fuel prices are larger for the bottom 40 percent of the income distribution, they are more than offset by positive impacts of the recycled revenues. The targeted transfers have a substantial impact and are specific to this group. However, the model indicates that these households also benefit more thoroughly from the higher capital expenditures and current expenditures. Efforts to support vulnerable households affected by these changes should be developed in tandem with more general social expenditure reforms during the post war period, which will need to be carefully designed to maximize their efficiency. In contrast, the net impact of the taxation/recycling policies is relatively small for higher income households. As for industry, the uncertain future (post-war) economic structure makes it difficult to predict the impact of such reforms in terms of both aggregate performance, industry trends, and relative usage of various factors of production (capital versus labor). However, for producers of EU-directed exports that are exposed to the CBAM,[5] carbon taxation reforms would have limited additional impact. In line with these considerations, the impact on real GDP growth is estimated to be small.

22. An alternative calibration shows the effects of an even more ambitious alignment with EU policies.

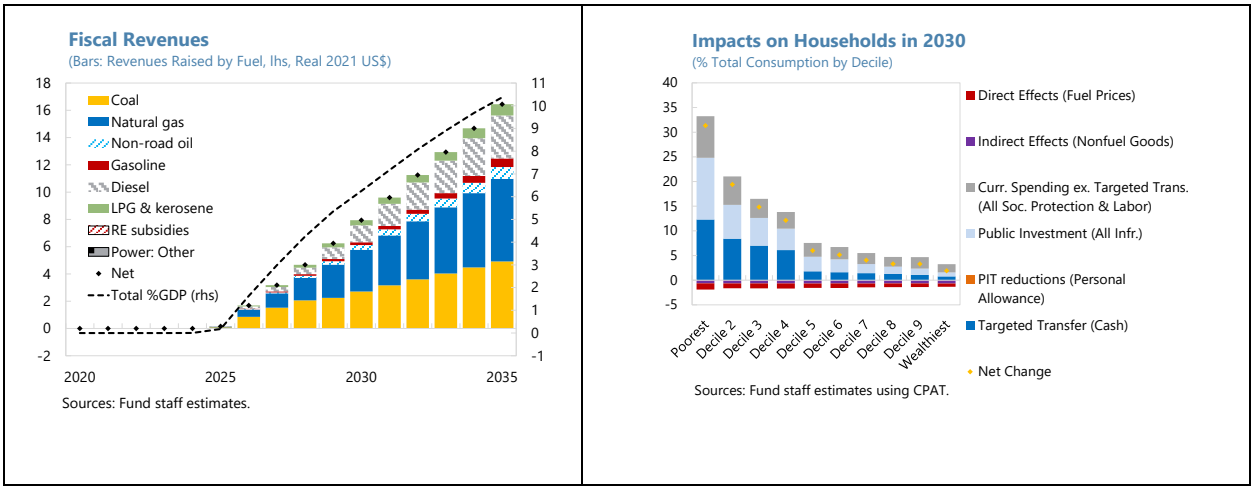
[5] In the modeling performed, carbon pricing covers more sectors than those covered by CBAM.

- *Calibration of the scenario*: As in the previous scenario, carbon prices begin to rise in 2025. However, in this scenario, there is a sectoral differentiation: for power and industry (the sectors covered by the EU's ETS), carbon pricing rises to around $100/ton, similar to current levels on the EU ETS by 2035. For buildings and transport, which broadly conform to the sectors covered by the EU's ETS 2 that will be introduced in 2027–28, the targeted carbon price rises from $0.8/ton to around $50/ton by 2035, broadly in line with the initial EUR 45/ton cap. Additionally, the scenario assumes that excise taxes comply with the EU's proposed energy tax directive and that carbon prices for industrial sectors covered by the CBAM are reduced by the share of allowances that are freely allocated.



- *Emissions trajectory*: These policies imply a much higher effective carbon price than the prior scenario, and GHG emissions are put on a gradually downward trend throughout the projection horizon. By 2035, emissions are about 28 percent lower than the 2019 (pre-war, pre-COVID) level.

- *Fiscal and social/distributional impacts:* In line with the substantially higher carbon price, the implied fiscal revenue impact about doubles from the previous scenario. Additionally, with the same pattern of revenue recycling, lower income households are made better off, while the impact is negligible for high-income households.



23. Carbon pricing can be part of a broader package of climate action to achieve mitigation objectives. For example, subsidy reform is another area that could assist the attainment of climate objectives and deliver fiscal savings. Fuels for heating are heavily subsidized in Ukraine, currently estimated at 1 percent of GDP (Aav, et. al, 2023). As substantial fuel subsidization incentivizes neither efficiency gains in energy consumption, nor a transition to renewable resources, such policies are at odds with Ukraine's climate objectives. A comprehensive reform of subsidies could be taken in tandem with the carbon taxation policies

described above. In such a case, the additional revenues generated could be directed to cushioning the impact of the subsidy reform on vulnerable households and to other major development priorities. Other measures could include feebates, tradable performance standards, and other regulations, including in the financial sector (Box 2).

Box 2. Ukraine: Implementing ESG Standards in the Area of Financial Services (concluded)

In July 2023, the National Bank of Ukraine, Ministry of Finance, National Securities and Stock Market Commission, and Deposit Guarantee Fund approved a new Strategy of Financial Sector Development as committed under the June 2023 MEFP, ¶48. In this document, along with other policy priorities and objectives, regulators noted the need to update the NBU's Sustainable Finance Development Policy. This policy embeds an important element aimed at stabilizing the economy during wartime as well as fostering the post-war recovery and reconstruction.

The NBU views that its strategy to implement ESG standards in the financial services sector (including sustainable financing) should be part of a broader national initiative aimed at achieving national ESG development goals. Such an initiative would be developed and approved at the Government level and would serve as a prerequisite for the NBU to move ahead with updating its Sustainable Finance Development Policy. This broader national ESG agenda would act as a roadmap identifying measures and policies within the competencies of many government agencies and designate a government agency that would handle coordination among stakeholders. Based on this ESG agenda necessary legislative requirements as well as a green taxonomy shall be introduced for the real sector. This would enable the financial sector's ability to analyze and account for the respective risks.

In the course of implementing the pre-requisites, the National bank of Ukraine (NBU) will be able to update and operationalize its 2021 Sustainable Financing Policy. Russia's war against Ukraine forced the NBU to re-prioritize the financial sector agenda aiming at maintaining financial stability. According to the updated roadmap of measures aimed at promoting sustainable financing, the NBU's measures will face delays in certain areas due to the challenges of the war.

To promote sustainable financing, the NBU will act within its current mandate and is planning to be mostly focused at ensuring that the financial sector institutions internalize climate risks. At the same time the NBU plans to abstain from incentivizing the channeling of financial flows towards more sustainable investments. Gradual implementation of the Policy and introduction of new instruments will help build the management system of climate risks which will be done as the data, methodological, legal and capacity gaps across the sectors and regulators are closed. The NBU is planning to start the transition with banks and gradually extend the regulations to non-bank financial institutions. Climate-related risks are seen as the contributors to credit, operational, liquidity, and market risks. Assessment of the exposure to climate risks will be integrated into the traditional supervisory toolkit such as assessment of the business model, corporate governance, and risks to the capital position of the financial institutions.

Policy tools include developing regulation, supervisory assessments, climate stress-testing and monetary policy that aim to meet emerging international best practices. For the purpose of promoting sustainable financing, updating will be made to the regulations on corporate governance, risk management and disclosures to include Environmental, Social and Governance (ESG) risks, defining data reporting templates, assessment of the exposure of financial institutions to physical and transitional risks, incorporating climate-related risks into supervisory review and evaluation process, internal capital adequacy assessment process and internal liquidity adequacy assessment process, introduction of the climate stress-testing as well as implementing green monetary policy tools. In parallel, the NBU is aiming at formulating the National Bank framework on Sustainable development for itself. The NBU Policy is consistent with the work done in other countries, where financial authorities have been targeting firm-level disclosures, data, vulnerabilities analysis, and regulatory and supervisory practices and tools.

The NBU is planning to closely follow the Basel Committee on Banking Supervision (BCBS) and Financial Stability Board (FSB) recommendations. It will also benefit from the participation in the Network for Greening the Financial System (NGFS) and in the Sustainable Banking Network (SBFN) as the specialized fora with the central banks and supervisory institutions exchanging views and identifying best practices on the measurement and management of climate-related risks.

E. Summary and Conclusions

24. The war has been a setback to continued progress on Ukraine's climate objectives. In its time as an independent country, Ukraine has achieved significant reductions in GHG emissions. To a large extent, this performance reflected broader trends in output dynamics and the structural change of the Ukrainian economy. However, Ukraine had made important investments in renewable energy in the years preceding the full-scale war. In addition to the broader damage inflicted on Ukraine, the invasion has resulted in damage to or loss of control of low carbon energy power plants, wildfires that have damaged forests (a natural carbon sink), and caused significant environmental damage.

25. Over the longer term, Ukraine has potential to implement policies that internalize climate-related priorities as well as reconstruction, macroeconomic stability, and social protection priorities. Ukraine is vulnerable to climate change from substantially warmer temperatures and more volatile rainfall patterns that may arise under more severely adverse climate scenarios. Appropriate longer-term climate policies can bring important benefits in terms of reducing exposure to disasters, fostering economic stability and efficiency, energy security, and public health. At the same time, continued progress on GHG reductions over the longer term will help Ukraine meet its commitments under the Paris Agreement and to align itself to accede to the European Union—a vital and overarching national priority. Major recovery and reconstruction efforts–if not implemented with consideration of climate impacts–risk creating further setbacks on achieving these targets. Ukraine has also committed to introducing an ETS as a part of its EU Association Agreement, and it will need to be designed and introduced carefully with a view to avoiding uncertainty. A well-designed system could also help Ukraine to avoid risks related to the introduction of the EU's CBAM.

26. Essential investments in climate change adaptation will need to be taken with a view toward avoiding debt vulnerabilities. Ukraine's investment needs in this area are moderate sized. Ukraine should be in a position to make these investments over the longer term, including after debt sustainability has been restored, without causing debt vulnerabilities to reemerge. However, indicative scenario analysis shows that it will be important to preserve fiscal space for these investments by avoiding excessive policy relaxations over the longer-term. It will also be important to continue seeking financing for these investments on the softest available terms so that the debt service payments arising from these investments do not exacerbate financing needs.

27. Carbon pricing policies can help achieve climate objectives and deliver significant revenue generation. Ukraine's Environmental Tax is a form of carbon taxation, but it is currently too small to make an impact. Modeling using the IMF-World Bank CPAT indicates that raising the price of carbon to $50/ton can help contain GHG emissions and generate substantial revenues. Policy measures on carbon pricing could be taken in tandem with a comprehensive subsidy reform to further promote climate change mitigation. If implemented carefully, a portion of the revenues generated by the carbon pricing should be directed toward targeted support to vulnerable households so that these environmental policies are implemented in an equitable manner.

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