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GREEN RECOVERY OF UKRAINE IN THE POST WAR PERIOD: INTERNATIONAL EXPERIENCES AND CARBON FOOTPRINT

Introduction. The Russian full scale invasion of Ukraine in 2022 caused devastating damage to infrastructure, the environment, and the economy. According to a joint assessment by the World Bank, United Nations, European Commission, and the Government of Ukraine, the total cost of reconstruction and recovery may reach USD 524 billion over the next decade [1; 2]. Such an extensive rebuilding effort presents a unique opportunity to pivot toward a sustainable and green recovery that both rebuilds and decarbonizes the Ukrainian economy [3; 4].

Green recovery refers to reconstruction strategies that integrate environmental sustainability, climate resilience, and low-carbon development into economic planning. In the context of Ukraine, this approach involves strengthening energy security, investing in renewable energy sources, and reducing carbon emissions while rebuilding war-damaged infrastructure. Therefore, Ukraine's green reconstruction is of particular importance, as it requires comparison with relevant international experiences, assessment of carbon footprint implications, and the development of actionable strategies for effective implementation.

Main part. Ukraine's renewable energy sector was growing prior to the war, with renewable capacity at 9.9 GW, including wind (≈2 GW) and solar (≈6 GW) [4; 5]. War damage reduced electricity supply capacity to a range of 9–10 GW, highlighting urgent needs for distributed renewable generation, grid modernization, and energy sector adaptation [6; 7].

These frameworks demonstrate the value of integrating renewables, energy efficiency, and low carbon infrastructure into post conflict recovery plans.

War conditions have significantly increased greenhouse gas emissions in Ukraine. A recent environmental study estimated that emissions from warfare and its consequences – including forest fires and reconstruction activities – reached ≈230 million tonnes of CO_2 equivalent since 2022, with ≈17 $MtCO_2e$ emitted from landscape fires alone in 2024 [5; 6; 11]. Such data underscore the dual challenge of recovery and climate mitigation.

Table 1

International Experiences in Green Recovery

Country / Program	Key Strategies	Relevance to Ukraine
Germany – Energiewende	Long term renewables transition, feed in tariffs	Framework for scaling renewables and grid reform
EU Green Deal	Carbon neutrality by 2050, Just Transition Fund	Policy alignment with EU climate goals
Post Syria Reconstruction (hypothetical)	Solar microgrids to rebuild resilient infrastructure	Community level distributed energy lessons
Rwanda Green Recovery Framework	Reforestation + clean minibus deployment	Low carbon transport solutions

Source: [5; 7; 10; 13], author's analysis

Table 2

Carbon Footprint Implications

Sector	Estimated Emissions (Mt CO_2e)	Notes
Warfare operations	82.1	Direct fuel combustion, military vehicles
Reconstruction infrastructure	62.2	Building materials, logistics
Forest & landscape fires	49.0	Climate impacts + war effects
Civil aviation displacement	≈5	Air travel rerouting
Displaced populations	≈32	Increased transport emissions

Source: [2; 3; 4; 5; 6; 9; 14], author's analysis

Adopting green recovery policies can strategically *reduce future carbon emissions* while modernizing Ukraine's infrastructure.

Reconstruction and decarbonization require significant capital. The EBRD plans to invest approximately €1 billion in 2025 alone to support Ukraine's energy sector, focusing on decentralization and renewable expansion. International funds, including frozen Russian assets (≈$300 billion) proposed for reconstruction, could be mobilized for green transitions [6; 8; 9].

Table 3

Green Investment Opportunities in Ukraine

Financing Source	Amount / Scale	Key Focus
World Bank / UN / EU Reconstruction Fund	> $524 billion	Nationwide reconstruction with green priorities
EBRD Energy Funding	~€1 billion (2025)	Renewable energy systems & grid resilience
Private Sector Solar & Wind Investment	>$150 million (2023)	Distributed renewable energy
EU4Climate & Paris Agreement Programs	Ongoing	Policy alignment & technical support

Source: author's analysis on [7; 8; 9; 13; 15]

Renewable potential is exceptional: studies estimate Ukraine could generate up to 2,200 TWh annually from renewable sources – ≈80 % of the EU's electricity consumption [7; 8; 9]. Such potential makes Ukraine a candidate for exporting green energy and hydrogen once rebuilt.

The scale of destruction in Ukraine offers an unprecedented chance to combine reconstruction with long term climate objectives. Green recovery principles not only rebuild infrastructure but also reduce future carbon burdens and enhance economic resilience.

Conclusions. Green transition is feasible: Ukraine has vast renewable potential (solar, wind, biomass). War increases carbon emissions, but reconstruction can counteract this by cutting future emissions. International models provide valuable insights for policy alignment and financing structures. So, our policy proposals for renewable energy deployment: prioritize solar rooftop programs, utility scale wind farms, and distributed generation in rural areas; upgrade grids to smart, resilient systems able to integrate intermittent renewables. For carbon pricing and emission accounting we need to adopt a national carbon pricing mechanism aligned with the EU Green Deal to incentivize low carbon investments. We need to implement green building standards – enforce energy efficiency standards for reconstruction projects (A class buildings, passive design); decentralized generation incentives – provide feed in tariffs or tax incentives for community solar and biomass projects; monitoring and evaluation – to ensure accountability, Ukraine should: track annual emissions and energy mix changes; publish annual Green Reconstruction Progress Reports linked to carbon goals; align reporting with Paris Agreement commitments.

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