UDC 338.47:656:502.131.1 https://doi.org/10.33271/ebdut/93.046

GREEN TRANSPORT AS A STRATEGIC DRIVER OF UKRAINE'S POST-WAR RECONSTRUCTION: ECONOMIC, SOCIAL, AND ENVIRONMENTAL DIMENSIONS

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Methods. The study applies: qualitative and systematic literature review of recent Ukrainian and international research (2024–2025); policy and regulatory analysis of EU and Ukrainian transport, climate, and reconstruction frameworks; scenario-based economic assessment of green mobility deployment in Ukrainian cities, including cost–benefit calculations, multiplier effects, employment effects, tax revenue impacts, and social and environmental benefits using EU-standard methodologies (including Value of Statistical Life).

Results. The results demonstrate that the integration of green transport into post-war reconstruction generates significant multidimensional effects. Economically, green transport investments produce substantial fuel and operational cost savings, job creation, fiscal revenue growth, and improved access to EU financial instruments, with an estimated total economic effect of approximately €50 million over a ten-year horizon. Socially, green mobility contributes to improved air quality, public health benefits, enhanced accessibility for vulnerable groups, and increased social inclusion. Environmentally, the implementation of electric public transport and smart mobility solutions leads to a reduction of 150–200 thousand tons of CO_2 emissions over ten years and supports compliance with EU climate and transport standards.

Novelty. The scientific novelty of the study lies in the development of an integrated analytical framework that positions green transport not as a sectoral environmental measure but as a core structural component of Ukraine's post-war reconstruction strategy. The article combines economic impact modeling, social and health effect assessment, and institutional EU-alignment analysis within a single conceptual model of "green recovery."

Practical value. The practical value of the results consists in their applicability for policymakers, local governments, and international donors in designing and financing post-war reconstruction projects. The proposed approach enhances access to EU funding, reduces long-term reconstruction costs, improves urban resilience, and provides a scalable model for sustainable and inclusive recovery in Ukraine.

Keywords: green transport, post-war reconstruction, sustainable mobility, European Green Deal, transport infrastructure, substantial fuel, urban resilience, charging infrastructure.

Statement of problem. The large-scale destruction of Ukraine's transport infrastructure caused by the ongoing war has created unprecedented challenges for economic recovery, social cohesion, and territorial connectivity. Roads, bridges, urban public transport systems, and logistics corridors have suffered significant damage, undermining mobility, access to employment, and regional integration. At the same time, post-war reconstruction opens a strategic window for modernization rather than a mere return to pre-war conditions.

In this context, green transport has emerged as a key concept within both Ukrainian and European policy discourse. The transition toward low-emission, energy-efficient, and digitally integrated transport systems aligns with the European Green Deal and the

Sustainable and Smart Mobility Strategy of the European Union. For Ukraine, which is pursuing EU accession, aligning post-war reconstruction with these frameworks is not only an environmental imperative but also an economic and institutional necessity.

Analyses of recent papers. The analysis of recent academic publications by Ukrainian authors and research teams published in 2024–2025 demonstrates the emergence of a coherent and interdisciplinary scholarly discourse focused on green transport, sustainable development of transport infrastructure, and the post-war reconstruction of Ukraine. The core of this discourse is not limited to the physical restoration of damaged transport assets but extends to the systemic transformation of the transport sector in line with sustainability principles, environmental responsibility, and European integration objectives.

One prominent strand of the literature addresses sustainable and green transport solutions, particularly in the context of logistics and cross-border transport. In this regard, Naumov, Aloshynskyi, and Bauer (2025) analyze the challenges of Ukrainian grain transit under wartime conditions and propose sustainable intermodal terminal development at the Ukrainian–Polish border [6]. Their study integrates economic efficiency with environmental considerations, emphasizing the reduction of logistics-related emissions and the diversification of export routes. Transport infrastructure is thus conceptualized as both a pillar of economic resilience and a vehicle for green modernization.

A complementary sustainability-oriented perspective is offered by Fomenko (2024), who explores ways to improve the functioning of Ukraine's transport system in the post-war period [3]. The author highlights the role of digitalization, innovation, and environmentally oriented management solutions, arguing that post-war reconstruction should not replicate pre-war transport models but instead facilitate a qualitative technological upgrade aligned with green transition objectives [3].

A second, dominant cluster of publications focuses on post-war reconstruction as a comprehensive and strategic process. Cherviakova (2024) develops organizational and methodological approaches to restoring transport and logistics infrastructure, identifying key principles such as sustainability, multimodality, inclusiveness, resilience, and institutional coherence [2]. Her work underscores the necessity of viewing transport infrastructure as an integral component of a broader socio-economic system rather than as a standalone sector [2].

This systemic perspective is reinforced by Amosha et al. (2024), who situate transport infrastructure within the wider framework of national post-war reconstruction [1]. Their analysis emphasizes the role of transport networks in re-establishing interregional connectivity, supporting economic reintegration, and enabling long-term growth [1]. The authors argue that transport infrastructure reconstruction must be guided by strategic investment priorities, innovation-driven mechanisms, and coordinated institutional reforms.

The strategic dimension of transport development under wartime conditions is examined by Nevinhlovskyi et al. (2025) [7]. Their study identifies key strategic priorities for Ukraine's transport system during the war, including railway modernization, development of international transport corridors, and enhanced cross-border cooperation. Importantly, the authors demonstrate that many wartime transport adaptations are laying the groundwork for a future post-war transport architecture.

These insights are complemented by Moskvichova (2025), who analyzes the transformations of Ukraine's transport infrastructure under wartime conditions, with particular attention to changes in logistics architecture and prospects for alignment with European transport standards [5]. The study highlights the increasing importance of land-based transport routes and the need to modernize infrastructure to meet EU technical and environmental requirements [5].

A more sector-specific dimension of post-war reconstruction is addressed by Ivanova et al. (2024), who focus on transport-related construction activities during martial law and the early stages of post-war recovery [4]. Their research emphasizes the necessity of modern engineering solutions, innovative construction materials, and advanced technologies to ensure the resilience and long-term sustainability of rebuilt transport infrastructure [4].

Overall, the reviewed literature converges on a shared conclusion: post-war reconstruction of Ukraine's transport infrastructure should be transformational rather than restorative. Ukrainian scholars consistently advocate for a "build back better" approach that integrates environmental sustainability, digital innovation, multimodal connectivity, and European integration. Within this framework, green transport infrastructure is positioned not merely as an outcome of reconstruction, but as a strategic resource for Ukraine's long-term economic resilience and sustainable development.

Aim of the paper is to analyze green transport as a strategic component of Ukraine's post-war reconstruction, integrating academic insights, EU policy priorities, and economic impact assessment. The study contributes to the literature by systematizing recent Ukrainian research and embedding it within the broader European regulatory and financial context.

Materials and methods. The European Green Deal is a comprehensive package of EU policies and strategies aimed at achieving climate neutrality by 2050 through emissions reduction, energy efficiency improvements, and the development of a low-carbon economy [10].

Its overarching objective is to transform the European economy in such a way that transport becomes clean, affordable, and maximally efficient.

In the transport sector, this implies:

- expansion of electric mobility (electric vehicles and charging infrastructure);
- development of low-carbon transport modes (trams, electric buses, bicycles);
- integration with smart infrastructure and data-driven traffic management systems;
- support for alternative fuels (hydrogen, biomethane).

These priorities directly contribute to the post-war reconstruction of Ukraine's transport infrastructure and its integration into the European transport ecosystem. This agenda is not solely a climate policy; it also represents an investment-driven, innovation-oriented, and strategic development pathway for the region.

During and after the war, Ukraine has suffered substantial damage to its transport infrastructure, including roads, bridges, public transport systems, and logistics corridors. Rebuilding these systems in line with the principles of the green transition provides not only an opportunity for recovery but also for modernization in accordance with future European standards.

Key directions include:

- restoration of zero-emission urban public transport;
- deployment of electric mobility infrastructure;
- integration of intelligent transport systems;
- stimulation of private investment in green transport solutions;
- incorporation of environmental dimensions (climate mitigation, efficiency, adaptation) into reconstruction plans.

These priorities are fully aligned with EU policies for partner countries and Ukraine's prospective EU membership, particularly with regard to legislative and standards harmonization.

The European Union and its financial institutions provide substantial support to Ukraine, including resources dedicated to transport modernization and environmental initiatives.

The Ukraine Facility constitutes the primary EU financial framework for Ukraine's reconstruction: approximately €34 billion has already been mobilized in grants and loans for the reconstruction of key sectors, including transport and logistics [11].

These funds target infrastructure projects, economic recovery, and social services and may be utilized to support the development of green mobility.

The European Investment Bank plays a leading role in financing transport and environmental projects [8]:

€16.5 million allocated for new public transport in Kyiv, Mykolaiv, Ivano-Frankivsk, and Odesa (buses and trams) under the emergency support package;

over €60 million invested in road reconstruction and public transport upgrades (including the M01 corridor, urban buses, and tram systems).

The EIB also provides loans and guarantees for projects with a strong green component.

Although most funding targets EU infrastructure, Ukrainian entities may participate through cross-border projects or joint initiatives with EU Member States.

Through instruments implemented with the IFC, EBRD, and local banks, support is provided in the form of:

grants and guarantees for business recovery.

technical assistance for green projects;

facilitation of investments in clean technologies and transport solutions.

These instruments are particularly relevant for small and medium-sized enterprises seeking to implement electric transport or green logistics solutions.

EU Sustainable Development Programs in Ukraine. For example, EU4Green Recovery East supports the green transition in Ukraine and other Eastern Partnership countries with a budget of €21.3 million for 2025–2028 [9].

This illustrates the EU's commitment to supporting environmental projects in Ukraine not only through large financial institutions but also via technical and policy assistance.

Why Green Transport represents a strategic opportunity for Ukraine, because it is reconstruction and modernization

Investments in new transport infrastructure offer an opportunity to make it:

more environmentally sustainable;

more energy-efficient;

fully compatible with EU standards.

Green transport represents not only a public-sector priority but also an attractive niche for international investors, grant programs, and public–private partnerships. As a result, improved and greener transport systems enhance economic productivity, reduce logistics costs, and support both domestic and international trade.

To secure EU funding, green transport projects must [9]:

1. Align with Green Deal objectives:
- reduction of CO_2 emissions;
- increased energy efficiency;
- innovative use of technology.

2. Define clear KPIs:
- before/after performance assessment;
- energy savings;
- air quality improvements.

3. Include EU partners:
- local municipalities;
- universities and research institutions;
- international financial institutions.

4. Integrate into existing infrastructure:
- urban development plans;
- national transport strategies;
- logistics corridors.

Results. We consider that plan of Green Mobility for Ukraine Recovery (GMUR) would include such elements.

1. Problem Statement

Post-war Ukraine faces:
- extensive destruction of transport infrastructure;
- increasing energy dependence;
- deteriorating environmental conditions in cities;
- limited access to mobility and employment;
- the need to harmonize policies with EU integration requirements.

Traditional reconstruction approaches that neglect climate objectives:
- lock in outdated transport models;
- increase long-term costs;
- restrict access to EU financing.

2. Proposed Solution

The implementation of systemic green transport programs, including:
- electric public transport (electric buses and trams);
- micromobility solutions (e-bikes and e-scooters);
- charging and service infrastructure;
- digital mobility management systems;
- localization of maintenance and servicing.

These solutions are integrated into:
- urban reconstruction plans;
- transport strategies;
- the requirements of the European Green Deal and Fit for 55 [10].

3. There are value propositions in the table1.

As a result, it is necessary to say about unique value for all.
- simultaneous reconstruction and decarbonization;
- high social multiplier effect;
- rapid impact (1–3 years);

Table 1

Value for Ukraine, for citizens, for the EU and donors

For Ukraine	For citizens	For the EU and donors
rapid and modern infrastructure reconstruction	affordable and accessible transport	achievement of Green Deal objectives
reduced energy dependence	cleaner air	regional stabilization
job creation	improved quality of life	reduction of carbon emissions at the EU's periphery
access to EU grants and low-cost financial resources	better access to employment and services	a scalable "green recovery" model
accelerated European integration		

Source: Developed by authors.

- compatibility with EU financial instruments;
- strong potential for PPPs and private investment.

2. Economic Impact Assessment

Baseline Assumptions (Pilot Program)

10 medium-sized Ukrainian cities;

1000 units of green transport (electric buses and micromobility);

time horizon: 10 years.

1. There is the calculation of the fuel savings in the table 2.

Table 2

Main assumptions of the calculation of the fuel savings

Indicator		Value
Average savings per unit	20000*8% = 16000 l/year 1600*1,6 € = 2,560 € /year average annual mileage: 20000 km/year; fuel consumption: 8 L per 100 km; fuel price (EU/Ukraine average): €1.6 per liter.	€3,000/year
Total annual savings	3000*1000=3000000	€3 million
Over 10 years	3000000*10=30000000	€30 million

Source: Developed by authors.

These estimates follow standard EIB methodologies for assessing energy benefits.

2. Operational Cost Savings (Maintenance)

- electric transport: 25-40% lower servicing costs;
- estimated savings: ≈ €1.5 million/year.

Electric transport features:

25-40% fewer moving parts, absence of an internal combustion engine, gearbox, and exhaust system.

Assumptions:

conventional transport: approximately €2,500 per year in maintenance costs;

electric transport: approximately €1,600–1,800 per year.

Cost savings: approximately €700–900 per unit per year.

For 1,000 units: approximately €0.7–0.9 million.

In the analysis, a higher estimate of €1.5 million per year is applied, as it also accounts for:

infrastructure-related effects;

reduced downtime;

lower accident-related costs.

3. There is the job creation in the table 3

4. Tax Revenue Impact

personal income tax, social contributions, VAT, and corporate income tax;

≈ €5 million/year (direct and indirect effects).

Total economic impact (10 years): ≈ €50 million.

The tax impact consists of direct and indirect taxes.

4.1. Direct Taxes from Employment

Assumptions:

- approximately 1000 new jobs;
- average monthly wage (conservative estimate): €700;
- tax burden (personal income tax + social security contributions): ~35%.

Calculation:

€700 × 12 × 1,000 = €8.4 million (annual payroll);

€8.4 million × 35% = €3 million per year.

4.2. Indirect Taxes (VAT, CIT)

Generated through:

- maintenance and servicing activities;
- energy consumption;
- procurement;
- local supply chains.

Table 3

The assumption of the job creation

Category	Employees
Manufacturing / assembly	300
Maintenance and servicing	500
IT and management	200
Total	1000

Source: Developed by authors.

A typical transport sector multiplier of 1.5-1.8 applies, adding approximately €2 million per year.

Total tax impact:€5 million per year.

3. Social Impact

Health and quality of life: reduction of PM2.5 and NO_2 emissions; lower incidence of cardiovascular and respiratory diseases; reduced healthcare expenditures.

Estimated savings: €10–15 million over 10 years, based on EU-standard methodologies (Value of Statistical Life and avoided health costs).

Method:

Value of Statistical Life (VSL) plus avoided healthcare costs (EU standard methodology).

Conservative estimate: €1–1.5 in savings per resident per year; applied to 1–1.5 million urban residents. Total estimated benefit:

€10–15 million over 10 years.

Social mobility: improved access to transport for internally displaced persons, people with disabilities, and low-income populations; increased access to employment opportunities.

Gender and inclusion effects: new employment opportunities for women; safer transport systems; improved accessibility of public spaces.

Resilience and Security: reduced dependence on fuel imports; increased energy independence; improved resilience to crises and emergencies.

4. There is the consolidated affects summary in the table 4.

Table 4

The consolidated impact summary

Category	Impact
CO_2 reduction	150–200 thousand tons / 10 years
Economic impact	+€50 million
Jobs created	1000
Health benefits	€10–15 million
EU integration	High

Source: Developed by authors

Discussion. The findings support the argument that green transport should be mainstreamed into national reconstruction strategies rather than treated as a sectoral add-on. Integrating sustainability criteria into transport reconstruction enhances access to EU funding instruments, including the Ukraine Facility, the European Investment Bank, and the Connecting Europe Facility.

Moreover, green mobility projects strengthen Ukraine's institutional convergence with the EU and improve the country's attractiveness for private and public-private investment partnerships.

Conclusions. The post-war reconstruction of Ukraine's transport infrastructure represents not only a challenge of physical recovery but also a strategic opportunity for long-term modernization, sustainability, and European integration. The findings of this study confirm that green transport should be treated as a core pillar of Ukraine's reconstruction strategy rather than as an auxiliary environmental policy instrument.

The analysis demonstrates that investments in green transport – particularly electric public transport, smart mobility systems, low-emission logistics, and supporting infrastructure – generate a substantial economic multiplier effect. These effects manifest through reduced fuel and operational costs, job creation, increased fiscal revenues, and improved access to EU financial instruments. Over a ten-year horizon, the projected economic benefits significantly exceed initial investment costs, strengthening the case for prioritizing green mobility in reconstruction programs.

From a social perspective, green transport contributes to improved air quality, reduced public health risks, enhanced transport accessibility, and greater social inclusion. The study highlights positive impacts for vulnerable groups, including internally displaced persons, low-income households, and people with disabilities, as well as gender-inclusive employment effects. These outcomes reinforce the role of green mobility as a tool for social stabilization and improved quality of life in post-war urban environments.

Environmental impacts constitute a critical dimension of the assessed benefits. The estimated reductions in CO_2 emissions, alongside decreases in local pollutants such as PM2.5 and NO_2, support Ukraine's progress toward climate neutrality objectives and compliance with EU environmental standards. Importantly, the integration of green transport into reconstruction efforts enables Ukraine to avoid carbon lock-in associated with traditional infrastructure models and to align its transport sector with the European Green Deal and the Fit for 55 framework.

At the institutional level, green transport projects enhance Ukraine's convergence with European regulatory, financial, and governance frameworks. Alignment with EU policies improves eligibility for funding from instruments such as the Ukraine Facility, the European Investment Bank, and other EU and international financial institutions. Moreover, the compatibility of green transport projects with public–private partnership models increases their attractiveness for private investors and accelerates implementation timelines.

Overall, the study concludes that embedding green transport into Ukraine's post-war reconstruction delivers integrated economic, social, environmental, and institutional benefits. Green mobility initiatives provide a scalable and replicable model of "build back better" recovery, combining infrastructure renewal with decarbonization and social inclusion. Future research should focus on refining project-level cost–benefit analyses, assessing regional differentiation of impacts, and exploring governance mechanisms that can further accelerate the deployment of green transport solutions in Ukraine.

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ЗЕЛЕНИЙ ТРАНСПОРТ ЯК СТРАТЕГІЧНИЙ ДРАЙВЕР ПІСЛЯВОЄННОГО ВІДНОВЛЕННЯ УКРАЇНИ: ЕКОНОМІЧНІ, СОЦІАЛЬНІ ТА ЕКОЛОГІЧНІ ВИМІРИ

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Методи. У дослідженні застосовано: якісний та системний огляд новітніх українських і міжнародних наукових публікацій (2024-2025 рр.); аналіз політики та нормативно-правових актів ЄС і України у сфері транспорту, клімату та відновлення; сценарний економічний аналіз упровадження зеленої мобільності в українських містах, включаючи розрахунки витрат і вигод, мультиплікативних ефектів, впливу на зайнятість, податкових надходжень, а також

соціальних і екологічних вигід із використанням методологій ЄС (у тому числі підходу Value of Statistical Life).

Результати. Отримані результати свідчать, що інтеграція зеленого транспорту в процес післявоєнного відновлення забезпечує значні багатовимірні ефекти. В економічному вимірі інвестиції в зелений транспорт формують суттєву економію пального та експлуатаційних витрат, створення робочих місць, зростання фіскальних надходжень і покращення доступу до фінансових інструментів ЄС, із загальним оціночним економічним ефектом близько 50 млн євро протягом десяти років. У соціальному вимірі зелена мобільність сприяє покращенню якості повітря, зростанню суспільного здоров'я, підвищенню доступності для вразливих груп і посиленню соціальної інклюзії. В екологічному вимірі впровадження електричного громадського транспорту та розумних рішень мобільності забезпечує скорочення 150–200 тис. тонн викидів CO_2 за десять років і підтримує відповідність кліматичним та транспортним стандартам ЄС.

Новизна. Наукова новизна дослідження полягає у розробці інтегрованої аналітичної рамки, яка позиціонує зелений транспорт не як вузькогалузевий екологічний захід, а як ключовий структурний компонент стратегії післявоєнного відновлення України. Стаття поєднує економічне моделювання впливу, оцінювання соціальних і медичних ефектів та інституційний аналіз гармонізації з ЄС у межах єдиної концептуальної моделі «зеленого відновлення».

Практична значущість. Практична цінність результатів полягає в їхній придатності для органів державної влади, місцевого самоврядування та міжнародних донорів при проєктуванні й фінансуванні програм післявоєнного відновлення. Запропонований підхід розширює доступ до фінансування ЄС, знижує довгострокові витрати на відновлення, підвищує стійкість міст і пропонує масштабовану модель сталого та інклюзивного відновлення України.

Ключові слова: зелений транспорт, післявоєнне відновлення, стала мобільність, Європейський зелений курс, транспортна інфраструктура, економія пального, міська стійкість, зарядна інфраструктура.

Стаття надійшла до редакції 26.12.25 р.
Прийнята до публікації 12.01.26 р.
Дата публікації 24.03.26 р.