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**Research Report**

## Rebuilding Ukraine's infrastructure after the war

Policy Notes and Reports, No. 72

**Provided in Cooperation with:**

The Vienna Institute for International Economic Studies (wiiw) - Wiener Institut für Internationale Wirtschaftsvergleiche (wiiw)

*Suggested Citation:* Kosse, Iryna (2023) : Rebuilding Ukraine's infrastructure after the war, Policy Notes and Reports, No. 72, The Vienna Institute for International Economic Studies (wiiw), Vienna

This Version is available at:

<https://hdl.handle.net/10419/278562>

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# Rebuilding Ukraine's Infrastructure after the War

Iryna Kosse

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# Rebuilding Ukraine's Infrastructure after the War

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This paper was prepared as part of a series of studies devoted to Ukraine's reconstruction and recovery, in collaboration with the Bertelsmann Stiftung. We gratefully acknowledge the valuable input and financial support provided by the Bertelsmann Stiftung for our work on Ukraine's reconstruction.



# Abstract

Ukraine is a big country with a developed multimodal transport infrastructure that includes a network of roads, railways, airports and seaports, as well as pipelines. In addition, the country has significant infrastructure for electricity generation and distribution, and for gas transportation. Ukraine is an urbanised country, with 46% of its population living in an apartment. The ongoing armed aggression by the Russian Federation has had a significant impact on Ukrainian infrastructure, leading to the destruction of roads, rail tracks, power stations and housing units. Over the next few years, the infrastructure sector will require significant financing, prioritisation and coordination between the Ukrainian government and international actors, based on the principles of multimodality, flexibility, connectivity and sustainable urban mobility. Energy and housing infrastructure should rely on renewable energy sources, distributed generation and energy-efficient housing. In addition, domestic infrastructure policies should be combined with EU infrastructure initiatives.

**Keywords:** Ukraine, multimodal transport infrastructure, electricity generation, electricity distribution, gas transportation, Russian Federation, infrastructure destruction, EU infrastructure initiatives

**JEL classification:** R4, Q4, O1, O4, R1, H7



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# Rebuilding Ukraine's infrastructure after the war

## 1. WHAT WAS THE STATE OF UKRAINE'S INFRASTRUCTURE BEFORE THE WAR AND HOW DID IT COMPARE TO OTHER CENTRAL AND EASTERN EUROPEAN COUNTRIES?

### 1.1. Transport

**Ukraine is a big country with low population density of around 73 inhabitants per square kilometre.**<sup>1</sup> It has a large multimodal transport infrastructure that includes a network of roads, railways, airports and seaports, as well as pipelines. Transportation plays a crucial role in the functioning of the export-oriented economy. Together with warehousing, postal and courier services, the sector accounted for 6.5% of the country's GDP in 2021.

**Ukraine has a network of over 200,000 kilometres of roads.** In 2021, 41% of cargo (in tonnes) and 20% of volume (in tonne-kilometres) was transported by road – a big part of that being 'last mile' cargo (heavy freight, agricultural products and perishable goods) transported over relatively short distances by road. Lorries are also frequently used to deliver agricultural products to the ports and to import high-value products (electronics, appliances, apparel, etc.) from the EU. Road density in Ukraine is about a third of the road density in Europe, if measured by population; and a quarter, if measured by area.<sup>2</sup>

**The network of railways in Ukraine (excluding the temporarily occupied territories before the full-scale war) amounts to 19,800 km, of which 47% are electrified.** The density of railways in Ukraine even exceeds the density in Europe (496.27 km per million inhabitants vs. 429.97 km). The railway system connects major cities, towns and border crossing points with neighbouring countries, and is used for transporting both cargo and passengers. Before the war, the railways were used primarily to transport metal, coal, iron ore and construction materials, as well as passengers.

**Ukraine has 19 airports, which equates to 0.37 airports per million inhabitants – a third of the EU figure** (0.95 airports per million inhabitants). Before the airspace closure due to the war, 21 passenger airlines and 19 airlines carrying mail and cargo operated on the market, serving 16.2 million passengers in 2021.

**Ukraine has 18 seaports, 13 of which are located on the continental territory of Ukraine; the other five are in the temporarily occupied territory of the Autonomous Republic of Crimea.** Seaports are critical for the country's economy, given that more than half of Ukraine's total exports is transported

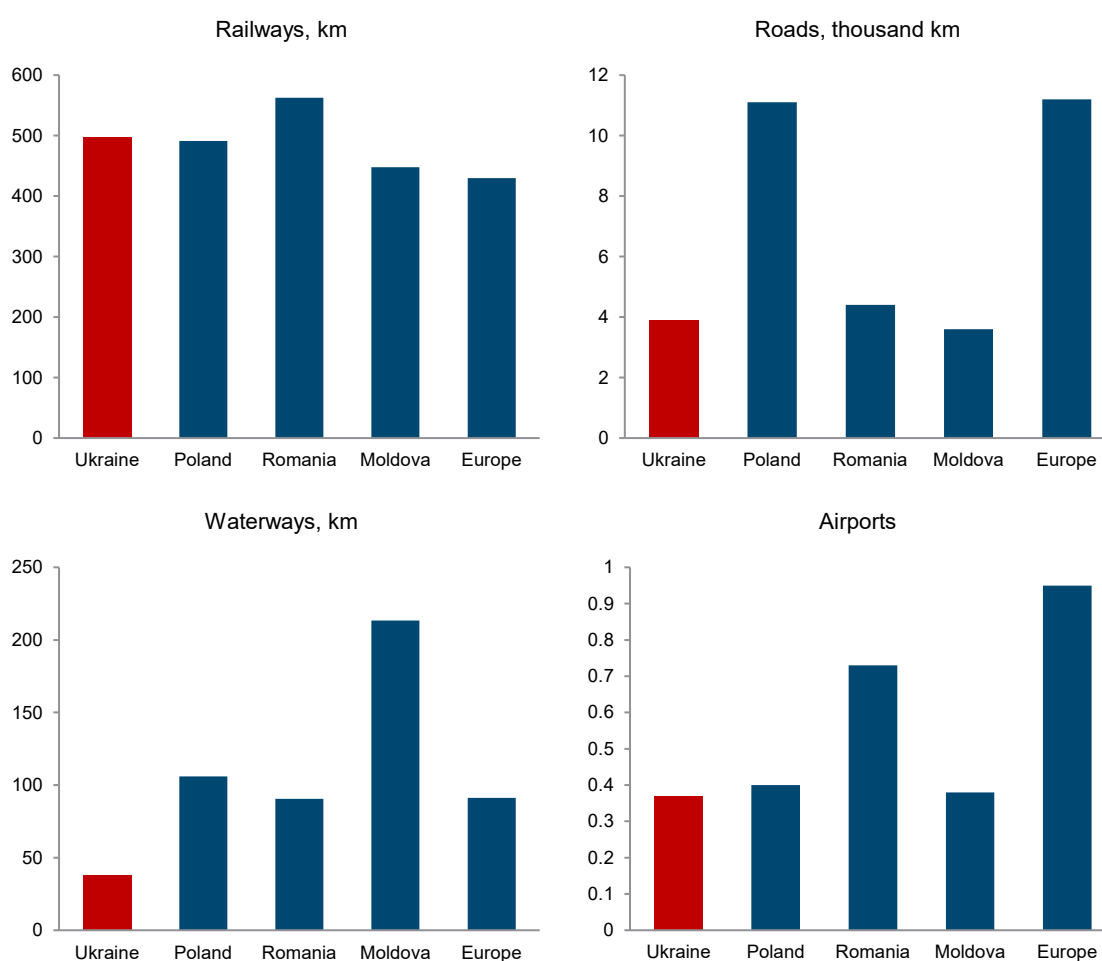
<sup>1</sup> <https://www.worlddata.info/population-density.php>

<sup>2</sup> <https://www.worlddata.info/europe/ukraine/transport.php>

through sea corridors – agricultural exports (90% of grain exports used to be shipped by sea), as well as exports of metals, chemicals and fertilisers.

**The inland waterways of Ukraine are 6,200 km in length, with the Dnieper, Desna, Pripjat, Danube and Southern Bug the main navigable rivers.** The country has 38.18 km of waterways and 9.34 harbours per million inhabitants – noticeably less than Europe (91.17 km of waterways and 25.39 harbours per million inhabitants).

**Figure 1 / Transport infrastructure density in Ukraine is generally low compared to Europe, with the exception of railways**



Note: Infrastructure density per million inhabitants.

Source: WorldData.info

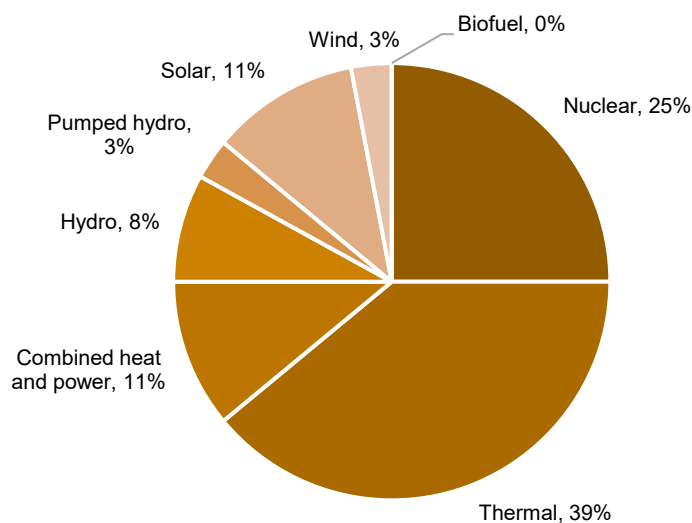
## 1.2. Energy

**Before the war, Ukraine's energy sector played a significant role in its economy, contributing 17% to its GDP.** Most of the energy was derived from fossil fuels, which accounted for 66% of the total primary energy supply in 2020. Nuclear power contributed 27.5%, while renewable energy sources comprised 6.5%. That same year, Ukraine relied heavily on imports to meet its energy needs, with 31% of gas, 48% of coal and 84.5% of oil and oil products imported.

**The country has four nuclear power plants, 13 thermal power plants, 33 combined heat and power (CHP) plants, eight hydro power plants and three pumped hydro power plants.** The total installed power-generation capacity in Ukraine is 56.2 GW, with the biggest share coming from thermal power plants (Figure 2) – particularly coal-fired power plants, which account for 80% of all thermal power plants.

**In addition to its electricity generation and distribution infrastructure, Ukraine has a significant infrastructure for gas transportation.** It has 36,700 km of gas pipelines for transferring gas from Russia to Europe and 31 billion cubic metres of underground gas-storage facilities.

**Figure 2 / Thermal plants accounted for the biggest share of installed capacity in 2021**



Source: World Bank (2022).

**The structure of electricity generation differs from the installed capacity structure.** Nuclear power plants contribute the largest share (55%), while thermal and CHP plants together generate 29%, and hydro and pumped hydro power plants produce 6.7%. The remaining 8% is generated from renewable energy sources, such as solar, wind and biofuel.<sup>3</sup> Until February 2022, Ukraine's electricity network was synchronised with the Integrated Power System/Unified Power System of Russia and Belarus. It has since switched to synchronising with the European Network of Transmission System Operators for Electricity (ENTSO-E) (for more details on the energy sector performance, see Movchan and Pindyuk, 2023, forthcoming).

<sup>3</sup> <https://www.ueex.com.ua/presscenter/news/osoblivosti-vitchiznyanogo-virobnitstva-elektroenergii/>

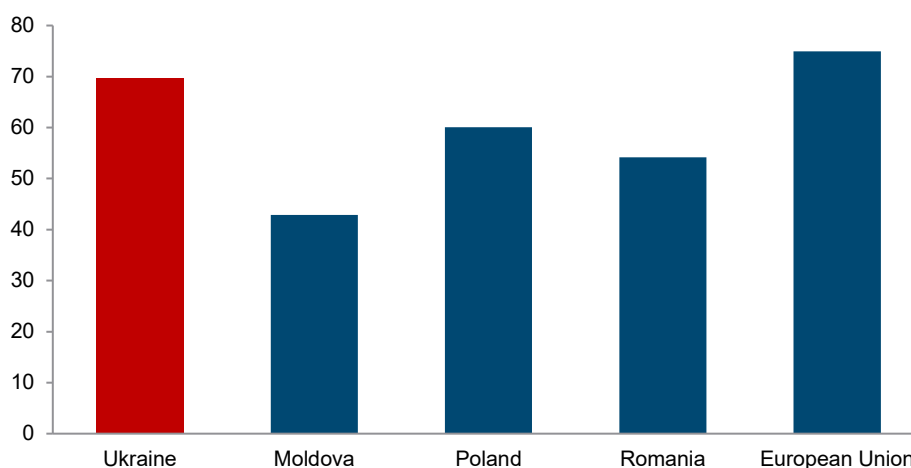
### 1.3. Housing

**Ukraine is a fairly urban country, with about 70% of the population living in built-up areas.** This is somewhat lower than the average for the EU, but higher than the share of the urban population in Moldova, Poland or Romania (Figure 3). The urban population resides primarily in apartment buildings (67% overall, but up to 79% in the big cities). This is comparable to the EU, where on average 71% of the urban population lives in apartments.

**The country's housing sector comprised approximately 18 million housing units in 2021.** In that year, only 46% of the population was living in an apartment – much lower than in many EU countries, such as Spain (66%), Latvia (65%), Estonia (61%), Lithuania (59%), Greece and Malta (both 57%). Some 53% of the population of Ukraine in 2021 lived in a house, while 1% was in some other type of accommodation, such as a houseboat or a van. Rural areas in Ukraine have predominantly single-family houses.

**The quality of housing has been poor and its availability low:** the average living space per person in urban areas was only about 13 square metres in 2020, according to data from the State Statistics Service of Ukraine. Many of the multifamily apartment buildings in Ukraine are old and in need of repair, with only 12% constructed after 1991.

**Figure 3 / Ukraine is an urbanised country, with the share of the urban population exceeding that of its peer countries**



Note: Share of the urban population in 2020, %.

Source: <https://ourworldindata.org/>

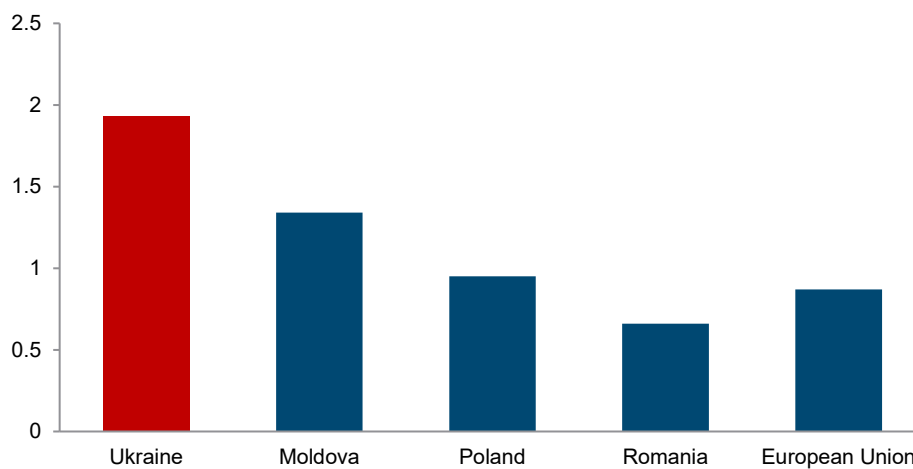
### 1.4. Main issues in the infrastructure sectors before 2022

Before the full-scale war, the main issues hindering the performance of Ukrainian infrastructure were the following.

**Low energy efficiency:** Ukraine has one of the most energy-intensive economies in Europe – two or three times more energy intensive than Poland or Romania (Figure 4). The iron, steel and machine-

building industries are particularly energy intensive. Ukraine's heating sector, which relies heavily on district heating infrastructure that uses coal- and gas-fuelled boilers, is also very energy intensive. The average energy consumption on heating in Ukraine is likewise considerably higher, at 250-400 kWh per square metre annually, compared to 180 kWh in Germany, 150 kWh in Sweden and 60-80 kWh in energy-efficient buildings (World Bank, 2022). The saving of energy has been discouraged by historically low electricity prices for households and industry (Figure 5). The inefficiency and poor condition of the heating infrastructure in Ukraine are further exacerbated by the lack of metering and thermostats in households, which rather undermines any incentive to save energy.

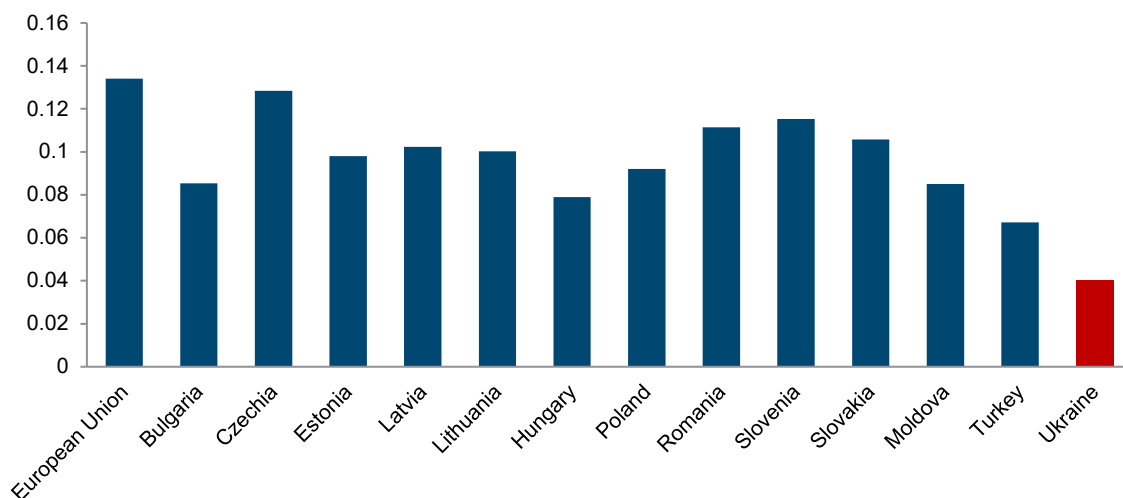
**Figure 4 / Ukraine has one of the most energy-intensive economies in Europe**



Note: Energy intensity of economies in 2019, kWh/ GDP measured in constant 2017 US dollars at PPP.

Source: <https://ourworldindata.org/>

**Figure 5 / Ukraine has very low household energy prices compared to its regional peers**

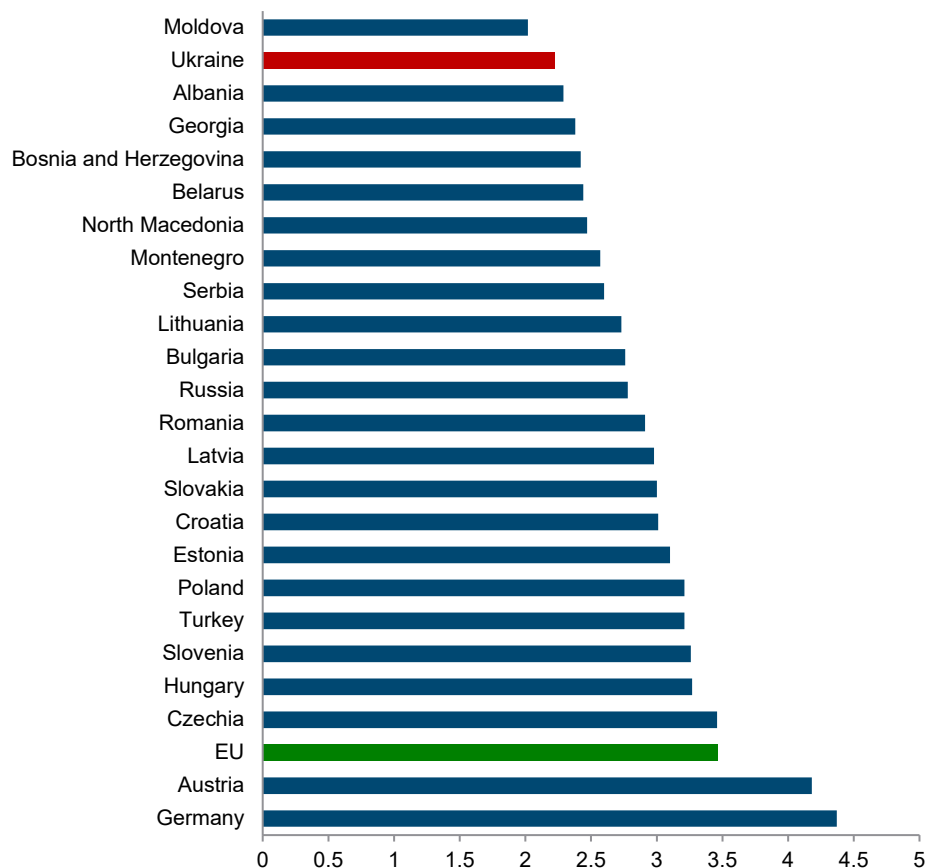


Note: Electricity prices for household consumers in 2021, EUR/kWh.

Source: Eurostat.

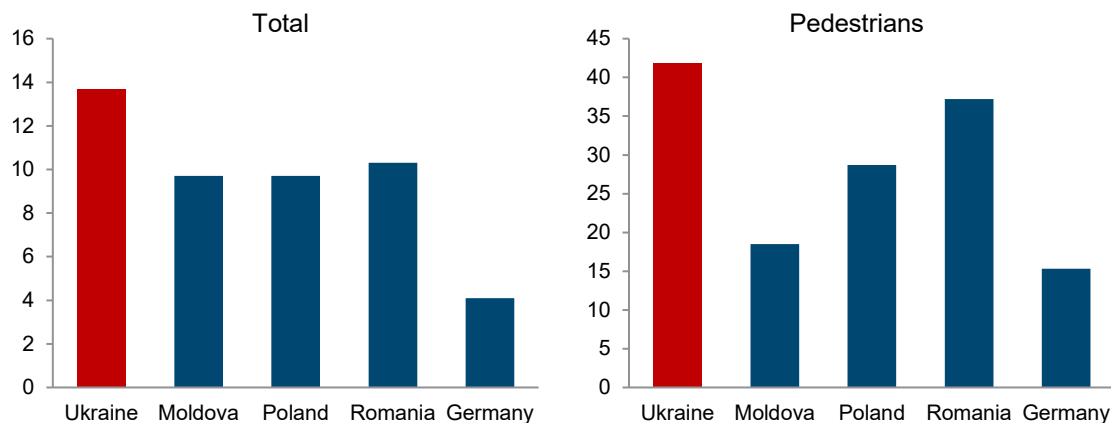
**Poor state of transport infrastructure:** According to the World Bank's logistics performance index, in terms of transport infrastructure quality Ukraine lags behind almost every European country (apart from Moldova). The most outdated infrastructure has been in the railway sector, as it is the most expensive to modernise. Certain railway stations, routes and indeed locomotives are in a critical condition. Another issue has been the poor state and low capacity of border checkpoints. There has been a lack of funding to improve and maintain the transport infrastructure: this has had repercussions for the safety of travellers and goods and has reduced the overall efficiency of the transport system. The rising popularity of private cars and the underdeveloped public transport in cities have led to heavy congestion on urban roads, a shortage of parking, increased air pollution, a greater frequency of road accidents and higher levels of stress for commuters (Merforth, 2014). Ukraine has a higher rate of road traffic fatalities than its peers, with the death rate among pedestrians especially high (Figure 7).

**Figure 6 / Ukraine's trade and transport-related infrastructure is of low quality compared to its peers**



Note: Logistics performance index: quality of trade and transport-related infrastructure. This is rated from 'very low' (1) to 'very high' (5). The International Logistics Performance Index and its indicators are constructed from information gathered in a worldwide survey of companies responsible for moving goods and facilitating trade around the world.

Source: World Bank World Development Indicators.

**Figure 7 / Ukraine has a higher rate of road traffic deaths than its peers**

Note: Road traffic death rate per 100,000 population in 2016, total and for pedestrians.

Source: World Health Organization.

**Corruption:** This takes many forms, such as bribery for licences and permits, kickbacks in the procurement process, and embezzlement of public funds allocated for transportation projects. This results in the misallocation of resources, the inefficient use of funds and reduced quality of services.

**Complex regulatory environment:** The regulatory environment in Ukraine is complex and often outdated, and there is a lack of harmonisation between European and domestic regulations. This sometimes leads to conflicting regulations and inconsistent enforcement, making it difficult for transportation companies to operate effectively.

## 2. WHAT ARE THE INFRASTRUCTURE NEEDS FOR POST-WAR RECONSTRUCTION IN TRANSPORT, HOUSING AND ENERGY?

### 2.1. Measuring the impact of the invasion

The ongoing armed aggression by the Russian Federation has had a significant impact on Ukraine's transportation system.

**Transport infrastructure:** As of February 2023, total damage was estimated at USD 35.7 billion (17.8% of 2021 GDP). The Russian Federation's aggression had led to the destruction of 25,000 km of roads and 344 bridges and overpasses. The greatest share of the losses was in Donetsk (26%), Kherson (15%), Luhansk (15%) and Zaporizhzhia (14%) regions.<sup>4</sup> Those are the regions that were occupied by Russia or that experienced protracted positional fighting. The railway system was also affected, with 507 km of track and 126 stations damaged. The greatest destruction was witnessed in Donetsk (36% of total rail infrastructure damage) and Zaporizhzhia (23%) regions. As of February 2023, 19 civilian airports had been damaged, with the runway destroyed at 12 of them.<sup>5</sup>

<sup>4</sup> <https://documents1.worldbank.org/curated/en/099184503212328877/pdf/P1801740d1177f03c0ab180057556615497.pdf>

<sup>5</sup> <https://damaged.in.ua/damage-assessment>



**Energy infrastructure:** According to the World Bank (February 2023), the total damage to the country's power, gas, heating and coal-mining infrastructure amounts to USD 10.6 billion (5.3% of 2021 GDP). The most significant losses have been in electricity generation, power transmission, gas distribution and oil refinery facilities. The estimated post-war reconstruction needs in the energy sector are much higher than the damage value and stand at USD 41.3 billion, with USD 34 billion required for power system reconstruction, USD 3 billion for the rebuilding of oil refineries and USD 2 billion for reconstruction of the gas transportation system.

**Housing:** The total cost of damage in the housing sector in Ukraine as of February 2023 is estimated at USD 50 billion (25% of 2021 GDP). Some 1.4 million residential units, 135,000 single-family houses and 39,000 dormitory units have been damaged, with over a third of them completely destroyed and two thirds damaged. The World Bank estimates<sup>6</sup> the total needs for post-war reconstruction in the housing sector at about USD 69 billion, with USD 31.5 billion required for immediate and short-term recovery needs and USD 37.1 billion for medium to long-term recovery needs.

## 2.2. Principles of reconstruction of Ukraine's infrastructure

**Over the next few years, the infrastructure sector will require significant financing, prioritisation and coordination between the Ukrainian government and international actors** (bilateral partners, multilateral institutions and the private sector). Foreign direct investment, including public-private partnership and concession contracts, will also be critical for the funding of large-scale projects and the provision of know-how (Bandura et al., 2022).

**Transport infrastructure:** A modern and efficient transport system is crucial for the post-war economic recovery of Ukraine, as it is a prerequisite for building a highly competitive, export-oriented manufacturing and agricultural sector. Among the main goals of the reconstruction should be increasing the quality and capacity of roads, modernising the rail network, upgrading the ports and developing inland waterways. To ensure that the 'Build Back Better' approach is realised, we believe the reconstruction programme in the transportation sector should adhere to the following principles:

- › **Multimodality:** To optimise the transportation sector, Ukraine should develop a multimodal transportation system, allowing for the rapid transfer of goods from one mode of transport to another, such as by means of containers. This will require the construction of multimodal terminals in the western and southern regions of Ukraine, which will serve as integrated transport and logistics centres and will offer customs services. The terminals should also include connections between railway and water transport, in order to encourage the development of inland waterways and redirect some freight traffic from the roads onto the water. Multimodal transportation should also be implemented in passenger transport, with the construction of multimodal stations to provide comfortable and convenient transfers. Additionally, the reconstruction of the rail infrastructure should include electrification for high-speed connections.
- › **Flexibility:** To overcome the challenges thrown up by the war, Ukraine's transport system must be adaptable and able to withstand potential damage. As well as making repairs to damaged infrastructure, alternative land transportation routes should be established to resolve bottlenecks. New

<sup>6</sup> <https://documents1.worldbank.org/curated/en/099184503212328877/pdf/P1801740d1177f03c0ab180057556615497.pdf>

logistics centres and border crossings with the EU are needed to increase trans-shipment capacity and to comply with interoperability. The seaport infrastructure should be modernised and improved. As road transport has started to play an increasingly important role in Ukraine's international trade (in the wake of the partial closure of sea routes), the development of road infrastructure – border crossing points, inspection points for agricultural products, parking for trucks and accommodation for drivers, storage terminals – has become a priority.

- › **Connectivity:** The railway gauge employed in Ukraine is different from the gauge in use across most of the EU, and this presents a huge obstacle to interoperability. Migrating its railway lines to the European standard track gauge should be a priority for Ukraine. In the long term, Ukraine should consider building railways with the European track width to connect major Ukrainian cities.
- › **Sustainable urban mobility:** According to the EU's Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan (Rupprecht Consult, 2019), a shift towards sustainable mobility requires a strategic and integrated approach to deal effectively with the complexities of urban transport across different modes. The general aim of strategic planning for urban mobility is to improve its accessibility and quality and ensure its sustainability, balancing that with the need for economic viability, social equity, health and environmental quality.

**Energy and housing infrastructure:** In the aftermath of the war, Ukraine must rebuild and modernise its energy and housing infrastructure sustainably, which implies reducing greenhouse gas emissions and air pollution by promoting renewable fuels. The principles of post-war reconstruction of the Ukrainian energy system are based on the idea of distributed generation and the development of renewable energy sources. The goals are to increase the quality of energy received by consumers and industry; ensure reliability of the local infrastructure; and reduce the risk of power outages in homes.

- › **Renewable energy sources:** Reconstruction of the energy sector should help Ukraine increase the share of green energy in its energy mix, as well as make its energy production and distribution less centralised. As Movchan and Pindyuk (2023, forthcoming) show, Ukraine has great investment potential in terms of its renewable energy sources, including solar power, wind power, hydropower, offshore wind energy and biomass energy. Building green hydrogen and geothermal energy infrastructure would allow the country to become a major provider of green energy both domestically and in Europe. Private buildings and multi-apartment buildings are also potential sites for small solar power plants.
- › **Distributed generation:** Construction of a decentralised energy system based on multiple small-scale sources that are located close to the point of consumption will allow the country to reduce its vulnerability to potential enemy attack and minimise the risk of blackouts and other disruptions that can occur when a centralised power plant goes offline. In addition, a decentralised system will reduce transmission losses and increase energy efficiency, since electricity generated from small-scale sources does not have to travel long distances before it is consumed. Distributed generation may also create opportunities for the development of local energy cooperatives, which could enable residents to participate in the production and consumption of energy within their communities.
- › **Energy-efficient housing:** Housing reconstruction efforts should focus not only on repairing damaged buildings and removing the debris, but also on drawing up plans for sustainable urban development

and ensuring that new housing is more energy efficient. Energy-efficient designs should include such features as insulation, efficient windows, and energy-efficient heating and cooling systems: this would all help to reduce energy consumption and the cost to residents. The use of sustainable materials and construction practices should be prioritised in the reconstruction of housing. This could include the use of locally sourced materials, the incorporation of green spaces and other sustainable design features, and the use of environmentally friendly construction methods. Principles of the circular economy should be adopted to ensure circular consumption and urban resources management to stimulate the reuse, repair, refurbishment and recycling of existing materials and products.

### 3. WHAT REGIONAL INFRASTRUCTURE POLICIES MIGHT ACCOMPANY THE STRONG REGIONAL SHIFT IN ECONOMIC ACTIVITY AND SUPPORT CROSS-BORDER ECONOMIC LINKAGES?

**Since the war has led to a regional shift in economic activity away from the east of Ukraine and more towards its central and western regions, the government needs to draw up comprehensive regional development plans to reflect the new reality.** These plans should consider the needs and opportunities of the relocated enterprises and displaced people, and should include strategies for economic diversification, job creation, infrastructure development and social welfare programmes to ensure balanced and sustainable regional development.

**In the short run, the government should prioritise infrastructure development in Ukraine's western and central regions, in order to accommodate the influx of relocated enterprises.** This would include investing in transportation networks, power supply, telecommunications and other key infrastructure elements to support the establishment and operation of businesses. Improved infrastructure will also help facilitate cross-border economic linkages with European countries, making it easier for Ukrainian enterprises to connect with markets and establish trade relationships. The government can facilitate and ease the adaptation process for relocated enterprises by streamlining the bureaucracy involved, making it easier for such enterprises to register and operate in the new locations. In particular, it should assist companies in accessing the power grid and help in temporarily accommodating relocated personnel.

**The government needs to address the mismatch between the needs of relocated enterprises for skilled personnel and the needs of internally displaced persons (IDPs).** Due to classified information on enterprise relocation, many IDPs do not know about employment opportunities at the relocated companies, while the companies do not have access to the IDP pool. Often, IDPs are mothers with small children who, lacking available daycare facilities in their new place of abode, are unable to work. Also, a significant proportion of Ukrainian IDPs have relocated not to the western regions of Ukraine, but within the country's eastern regions. According to the Ukraine Internal Displacement Report of the International Organization for Migration (IOM), those regions with the largest numbers of incoming IDPs are Dnipropetrovsk (15%), Kharkiv (14%) and Kyiv City (9%).<sup>7</sup> Among those things that the government could do to help IDPs would be to assess their needs; provide platforms for finding new local business partners

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<sup>7</sup> <https://dtm.iom.int/reports/ukraine-internal-displacement-report-general-population-survey-round-12-16-23-january-2023?close=true>

and hunting for a job; arrange more daycare opportunities; and organise training in partnership with the relocated enterprises. After the war, these programmes should be redesigned to include war veterans.

**In the longer run, the focus of the regional development policies should shift to the eastern regions, which will require significant investment in reconstruction of the devastated infrastructure.** This will form part of the broader post-war reconstruction effort and will have to include policies to support the return of refugees and IDPs (see Tverdostup, 2023).

**Overall, the government should foster public-private partnerships (PPPs) to support the regional shift of enterprises and cross-border economic linkages.** This could involve partnering with private-sector entities to invest jointly in infrastructure development, promoting investment and trade, and implementing regional development plans. PPPs could leverage private-sector expertise, capital and networks to accelerate economic growth and create sustainable business ecosystems in Ukraine's western and central regions.

#### 4. HOW SHOULD DOMESTIC INFRASTRUCTURE POLICIES BE COMBINED WITH EU INFRASTRUCTURE INITIATIVES?

**As the war has shown, the Ukrainian transportation system is an important element of EU connectivity; therefore, the European Commission has proposed extending four EU Transport Corridors to Ukraine** (and Moldova), including the ports of Mariupol and Odesa.<sup>8</sup> Successful reconstruction would allow Ukraine to further deepen its economic integration with the EU via trade and participation in regional value chains. To achieve that, the Ukrainian government should align its domestic infrastructure policies with the strategic priorities of the EU infrastructure initiatives. As a first step, it is essential to identify areas of mutual interest and synergy, such as transportation networks, energy infrastructure, digital connectivity and social infrastructure, and then to coordinate efforts with the EU to maximise the impact of investments. This includes aligning project pipelines, timelines and funding mechanisms to ensure coherence and complementarity between domestic and EU initiatives.

**The Ukrainian government can benefit from technical assistance and expertise offered by the EU in such areas as project preparation, feasibility studies, regulatory frameworks and capacity building.** This can help enhance the quality and bankability of infrastructure projects and accelerate their implementation. When combining domestic infrastructure policies with EU infrastructure initiatives, it is important to prioritise sustainability and resilience, in order to build infrastructure that is durable, efficient and able to withstand shocks, and that will contribute to long-term regional economic growth and development.

**Ukraine should aim at collaboration with neighbouring EU countries on cross-border infrastructure projects that promote regional connectivity and economic integration.** This includes joint investments in transportation networks, energy infrastructure and digital connectivity that benefit both Ukraine and neighbouring EU countries. Collaborative projects can also foster trust and cooperation among countries, leading to increased economic linkages and opportunities for businesses in Ukraine.

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<sup>8</sup> [https://transport.ec.europa.eu/news/commission-amends-ten-t-proposal-reflect-impacts-infrastructure-russias-war-aggression-against-2022-07-27\\_en](https://transport.ec.europa.eu/news/commission-amends-ten-t-proposal-reflect-impacts-infrastructure-russias-war-aggression-against-2022-07-27_en)

**Alignment of the regulations should be carried out in accordance with the EU-Ukraine**

**Association Agreement.** This includes ensuring accessibility for persons with disabilities and other groups with low mobility; complying with environmental and sanitation safety regulations when removing debris and reconstructing buildings and structures; producing freight cars that meet EU dimension requirements; and considering the transition to alternative energy sources.

Considering modes of transport individually, Ukraine and the EU should prioritise the following:

- › **Roads:** Currently, the regulation of motor transport in Ukraine and the EU is fairly similar, as Ukraine and the EU/EU member states are parties to multiple agreements in this field and have incorporated these requirements into their national legislation. However, some differences still need to be addressed before full liberalisation of road transport between Ukraine and the EU can occur. This includes Ukraine's commitment to ensuring compliance with the rules on transportation safety, driver training and qualifications, working hours and the installation of tachographs.
- › **Railways:** Ukraine needs to align its legislation with those EU norms related to market access and infrastructure, technical conditions and safety. The country is expected to implement seven EU directives and four regulations: these cover rules on the development of railways, the licensing of rail companies, capacity requirements for railway infrastructure, railway safety, the certification of workers and railway infrastructure, the interoperability of rail infrastructure, common rules on combined freight transportation, competitive freight, standardisation of the financial statements of rail companies, public passenger traffic, and the rights and obligations of passengers.
- › **Air:** The process of bringing Ukraine's legislation in the field of civil aviation into line with the Common Aviation Area (CAA) Agreement is designed to be implemented in two stages, with a first transition period allowing for limited market access and a second transition period allowing full market access and recognition of Ukraine-issued certificates. A Joint Committee consisting of representatives from Ukraine and the EU will oversee the implementation and interpretation of the agreement. Additionally, Ukraine will participate as an observer in the work of the European Union Aviation Safety Agency (EASA) and the Single Sky Committee and will be accountable to EASA for aircraft certification. The second transition period of the CAA Agreement will involve implementation of EU regulations and standards on primary airworthiness, on maintaining airworthiness and on maintenance of aircraft and their components, and will see convergence of the Ukrainian and EU certification systems. During this period, Ukraine will also have to implement those EU regulations related to free access to the air transportation market, air transport management, the granting of licences for air traffic inspectors, provisions relating to aviation security and the environment, and social aspects. This period will also require monitoring and evaluation of the implementation of these regulations by the EU and Ukraine. Completion of the second transition period will result in the complete application of the CAA Agreement and its benefits.
- › **Maritime and internal waterways:** In order to gain access to the EU internal market for maritime transport services, Ukraine must align its legislation on marine safety, technical and operational rules, seafarer qualifications and social protection with EU norms. It must also align its legislation on inland waterway transport with EU norms, including market access and infrastructure, technical conditions and safety. This includes implementing six EU directives, such as Council Directive No. 96/75/EC on the functioning of the transportation market, Council Directive No. 87/540/EEC on access to the

transportation market and Directive 2006/87/EC on transport safety. The agreement sets a five-year deadline for Ukraine to bring its legislation into line with EU standards omitting cabotage regulations.

**Ukraine should continue to align its regulatory framework for the energy market with European standards.** The country has already made significant progress: gas and electricity market reforms have been developed in coordination with the Energy Community and have contributed to a significant liberalisation of the wholesale market. The gas market, which was already closely linked to the European Network of Transmission System Operators for Gas (ENTSO-G), demonstrates clear signs of healthy competition, judging by the large number of traders and the low margins of these companies. However, the slow integration of energy markets has limited competition in the electricity market, resulting in market imbalances (for example, low efficiency of selling nuclear energy). Synchronisation with ENTSO-E and an increase in the capacity of power grids between Ukraine and the EU should help boost market efficiency and overcome most of the existing imbalances in the wholesale market.

**Ukraine needs to prepare for partnership with the EU in the 'green transition'** by assessing the potential for converting pipelines to transport hydrogen and confirming the potential of renewable energy sources in Ukrainian regions with lower risk, such as Poltava or Volyn regions. It is important to create a secure investment environment even in the midst of the current military situation. Ukraine also needs to gradually adopt the European mechanism for regulating carbon emissions and join the European Union Emissions Trading System (ETS). In the long-term perspective, Ukraine can play a crucial role in supporting the European energy transition by supplying 'carbon-free' energy on favourable terms.

**To incorporate EU standards into housing reconstruction, Ukraine should take account of the principles of the New European Bauhaus initiative.** This emphasises the need for a new architectural and construction style that is sustainable, inclusive and shared. Ukraine should prioritise the urgent problem of housing construction and explore innovative approaches to the circular economy in post-war reconstruction. This could include the use of sustainable materials and designs, energy-efficient technologies and the incorporation of renewable energy sources in the construction process. To ensure successful implementation of the New European Bauhaus initiative in Ukraine, it is essential to involve local communities and stakeholders in the decision-making process. This would ensure that reconstructed buildings meet the needs of the local people and are designed with their input and preferences in mind.

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## IMPRESSUM

Herausgeber, Verleger, Eigentümer und Hersteller:

Verein „Wiener Institut für Internationale Wirtschaftsvergleiche“ (wiiw),  
Wien 6, Rahlgasse 3

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Nachdruck nur auszugsweise und mit genauer Quellenangabe gestattet.

Offenlegung nach § 25 Mediengesetz: Medieninhaber (Verleger): Verein „Wiener Institut für Internationale Wirtschaftsvergleiche“, A 1060 Wien, Rahlgasse 3. Vereinszweck: Analyse der wirtschaftlichen Entwicklung der zentral- und osteuropäischen Länder sowie anderer Transformationswirtschaften sowohl mittels empirischer als auch theoretischer Studien und ihre Veröffentlichung; Erbringung von Beratungsleistungen für Regierungs- und Verwaltungsstellen, Firmen und Institutionen.



