

**Report on Damages to Infrastructure  
Caused by Russia's War against Ukraine  
One Year after the Start of the Full-Scale Invasion**

March 2023

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## PREFACE

This report presents the results of an assessment of the damages to Ukraine's economy incurred through damage and destruction of physical assets caused by Russia's military aggression. **The report covers the period from 24 February 2022 to 24 February 2023.**

The assessment of direct physical damage was carried out within the framework of the National Council for the Recovery of Ukraine from the War by the analytical team of the Kyiv School of Economics (KSE) together with the Ministry of Community and Territorial Development of Ukraine, the Ministry of Infrastructure of Ukraine, the Ministry of Health of Ukraine, under the coordination of the Ministry for Reintegration of the Temporarily Occupied Territories of Ukraine and in cooperation with other relevant ministries and the National Bank of Ukraine.

The overall assessment of direct investments was carried out in accordance with the World Bank methodology and in close cooperation with the relevant World Bank team, taking into account a significant amount of microdata collected by relevant authorities, local civil-military administrations since the beginning of the full-scale war.

The assessment methodology involves the use of indirect methods, statistical data and certain assumptions, in particular regarding the extent of damage in areas where active hostilities are still ongoing, where physical inspection is limited due to danger (e.g., mined areas), or in areas occupied by the aggressor. To calculate the value of damaged and/or destroyed assets, the average values calculated on the basis of data from the State Statistics Service, line ministries, Prozorro tenders, etc. and adjustment factors according to the level of damage to the objects are used. To calculate the value of damaged or destroyed assets of large commercial facilities and identified institutions, the financial statements as of the latest available date are used.

At the same time, information on the actual (compared to the previous assessment) state of damage to facilities in the liberated and government-controlled territories of Ukraine is used as a proxy to clarify assumptions about the level of damage and the extent of destruction.

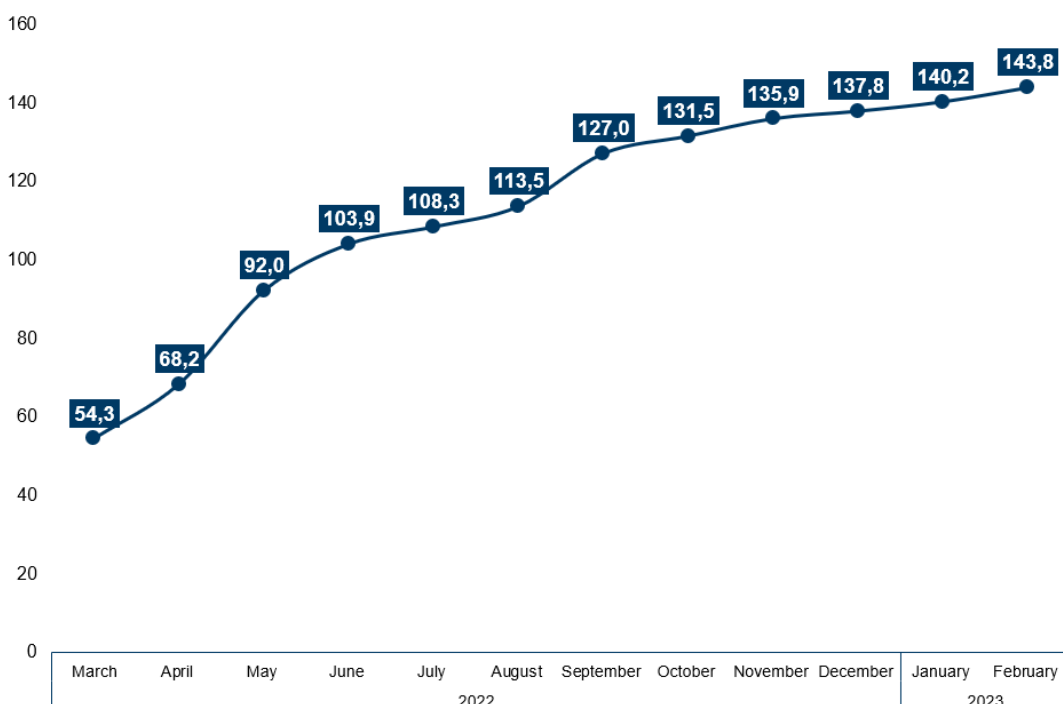
The research methodology is described in more detail in the materials of the working group “Audit of damages caused by the war” by the link:

<https://www.kmu.gov.ua/storage/app/sites/1/recoveryrada/ua/audit-of-war-damage.pdf>.

## Direct damages to the economy due to the asset destruction. Key findings

Over a year since the start of Russia's full-scale military invasion, the total amount of direct documented damage to residential and non-residential real estate and other infrastructure has amounted to more than **\$143.8 bn** (at replacement cost).

### Dynamics of the aggregate assessment of direct damages to Ukraine's economy, \$ bn

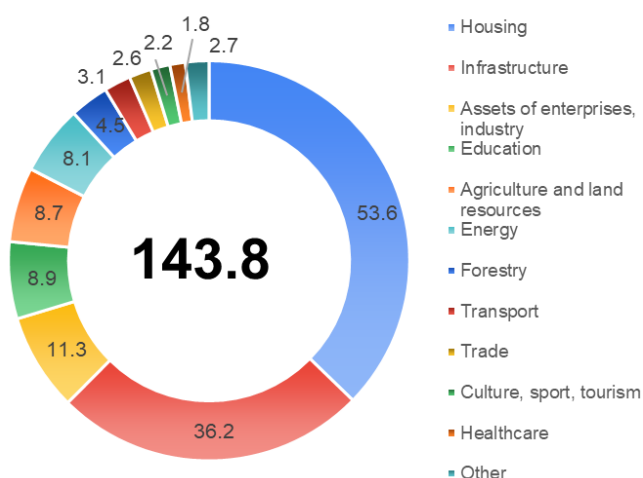


Source: Kyiv School of Economics

Residential buildings (37.3% and \$53.6bn) and infrastructure (25.2% or \$36.2bn) accounted for the largest share of total direct damages. Business asset damages amount to at least \$11.3bn and continue to grow. Another \$8.7 bn are direct damages of the agricultural sector as a result of the war.

The total direct damages caused by the destruction and devastation to public sector facilities (social facilities and institutions, educational, scientific and healthcare institutions, cultural facilities, sports facilities, administrative buildings, etc.) amounted to about \$13.69bn.

### Direct damages by type of property, \$ bn



Source: Kyiv School of Economics

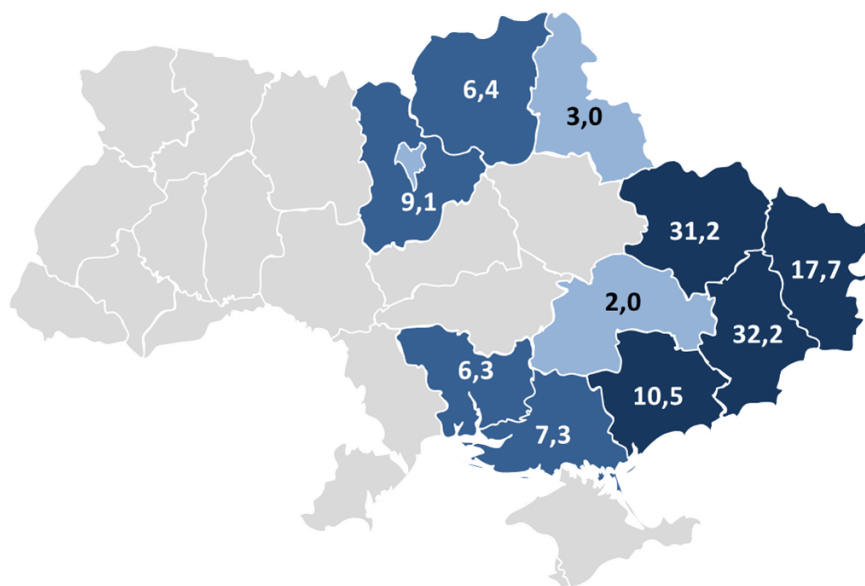
In the first weeks of the war, in late February and early March, hostilities took place in 10 regions. As of early March 2023, hostilities continued in Kharkiv, Luhansk, Donetsk, Kherson and Zaporizhzhia regions. The regions of Ukraine most affected by the hostilities are those where the fighting took place: Donetsk, Kharkiv, Luhansk, Mykolaiv, Zaporizhzhia, Kyiv and Chernihiv regions. Among the cities that suffered the most during the war are Maryinka, Mariupol, Irpin, Kharkiv, Chernihiv, Sievierodonetsk, Lysychansk, Vuhledar, Sumy, Rubizhne, Izium, Mykolaiv, Bakhmut, Volnovakha.

#### Total estimate of direct infrastructure damages in monetary terms as of February 2023.

Type of property	Assessment of direct damages, \$ bn	Share of direct damages by type of property, % of total
Residential buildings	53,6	37,3%
Infrastructure	36,2	25,2%
Assets of enterprises, industry	11,3	7,9%
Education	8,9	6,2%
Agro-industrial complex and land resources	8,7	6,1%
Energy sector	8,1	5,6%
Forestry fund	4,5	3,1%
Transport vehicles	3,1	2,2%
Trade	2,6	1,8%
Communal services and utilities	1,4	1,0%
Culture, tourism, sports	2,2	1,5%
Healthcare	1,8	1,2%
Administrative buildings	0,5	0,4%
Digital infrastructure	0,6	0,4%
Social sector	0,2	0,1%
Financial sector	0,04	0,01%
<b>Total</b>	<b>143,8</b>	<b>100%</b>

Source: Kyiv School of Economics

#### The 10 most affected regions of Ukraine, \$ bn



Source: Kyiv School of Economics

### Total estimated direct damages by region in monetary terms as of February 2023

Regions	Direct Damaged,\$mIn
Vinnytsia	529
Volyn	25
Dnipropetrovsk	2,045
Donetsk	32,217
Zhytomyr	750
Zakarpattia	14
Zaporizhzhya	10,528
Ivano-Frankivsk	447
Kyiv region	9,099
Kirovograd	330
Luhansk	17,681
Lviv	171
Mykolaiv	6,326
Odesa	555
Poltava	263
Rivne	79
Sumy	2,968
Ternopil	53
Kharkiv	31,206
Kherson	7,310
Khmelnysky	48
Cherkasy	130
Chernivtsi	68
Chernihiv	6,364
Kyiv city	1,198

*\*Not all categories of damage are subject to decomposition at the regional level*

*Source: Kyiv School of Economics*

The final assessment of the extent of damage and destruction will be possible only after the end of hostilities on the territory of Ukraine.

The report is organized by sector: for each sector, a general estimate of direct damages is provided. The report concludes with summary tables with data for each sector/industry.

## Analysis of the growth factors of direct damages to physical infrastructure in June-August 2022

The continued aggression of the Russian Federation in 2022 and early 2023 led to an increase in the amount of damage caused by missile attacks on the country's infrastructure, especially the energy sector, as well as shelling of cities and towns, and active hostilities in the south and east of Ukraine. Regular monitoring of the damages caused in September 2022 – February 2023, conducted by civil-military administrations and ministries, allows for regular assessment of the current state of damage caused by Russian aggression. In the almost six months since 1 September 2022, Ukraine has incurred an additional \$18.4 bn in damages\* to its assets.

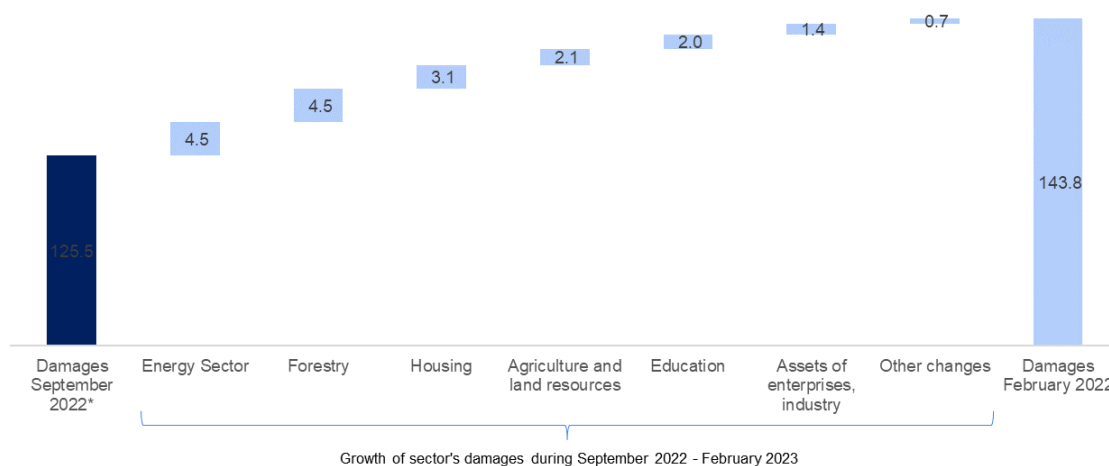
The largest increase is due to the rise in housing damages. Over the past three months, this amount rose to \$53.6bn in February. The three most affected sectors, in addition to the destruction of the residential sector, include infrastructure with \$36.2bn in damages and industry and affected businesses with \$11.3bn in damages. Russia destroyed and damaged another \$8.9bn worth of educational institutions where Ukrainians and students from other countries studied. Damage to land resources and the agricultural sector during the active phase of armed aggression since 24 February 2022 is estimated at \$8.7 bn.

Compared to the beginning of June 2022, there has been a significant increase in the number of destroyed and damaged infrastructure: the number of residential buildings affected by the war has increased from 121,000 to 153,000, the number of medical facilities has increased from 777 to 1,216, the number of administrative buildings has increased from 111 to 630, and the number of private cars has increased from 105,200 to 207,500.

The tactic aimed at disrupting Ukraine's energy sector with massive missile strikes, which Russia began using in October 2022, has led to direct damages in the energy sector estimated at \$8.1 bn, most of which are in the electricity sector.

The quantitative calculations were also affected by the liberation of the Kharkiv and Kherson regions in September and November 2022, which provided access to the previously occupied territories. Some sectors (such as communal services and utilities and administrative buildings) were recalculated downwards due to the revision of data on average area and value of objects.

## Analysis of the growth of direct damages to residential and non-residential real estate and other infrastructure in Ukraine for September 2022 – February 2023



\*Environmental damages are excluded from this calculation and are presented in a separate section

Source: Kyiv School of Economics

## SOCIAL SECTOR

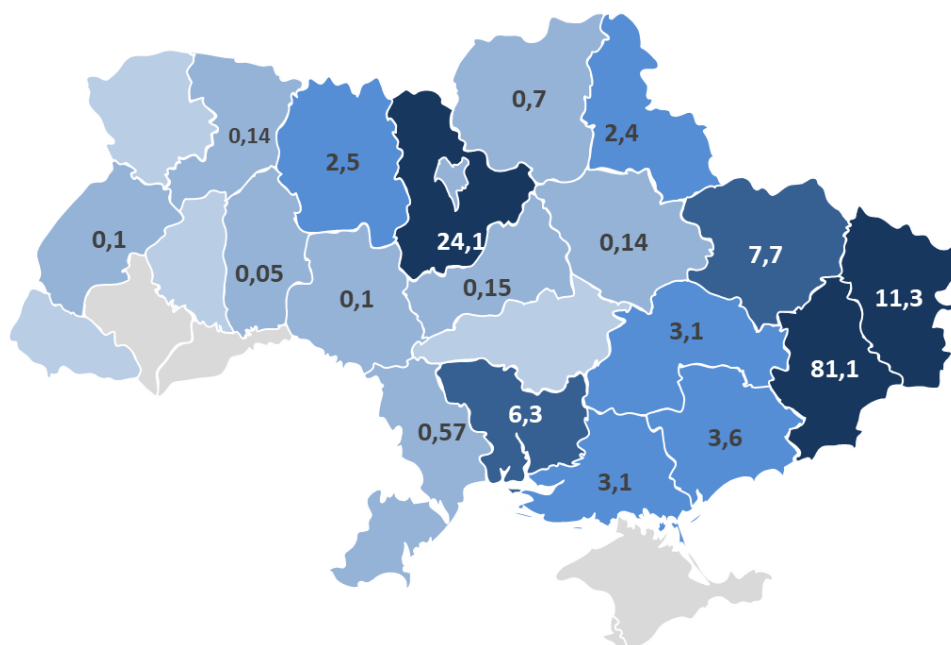
### Housing and administrative buildings

Active shelling of cities with missiles and artillery is part of Russia's tactics of warfare, which leads to significant destruction of housing in cities and towns, especially those located near the front line. As of February 2023, more than 50% of the housing stock in a significant number of cities and towns was damaged or destroyed as a result of the Russian Federation's hostilities. This requires not only the restoration of individual buildings, but also the comprehensive restoration of cities, the development of new urban planning documentation and other measures.

The most heavily damaged housing stock was found in the cities of Mariupol, Kharkiv, Chernihiv, Sievierodonetsk, Rubizhne, Bakhmut, Maryinka, Lysychansk, Popasna, Izyum and Volnovakha. For example, according to preliminary estimates, 90% of the housing stock in Sievierodonetsk was damaged, while cities such as Bakhmut and Maryinka have almost no undamaged buildings. At the same time, the number of damaged residential buildings (both multi-storey and individual houses) is increasing due to the ongoing active hostilities in Kharkiv, Luhansk, Donetsk, Zaporizhzhia, Kherson regions and the temporary occupation of part of Ukraine's territory, as well as throughout the rest of the country due to regular missile attacks.

According to preliminary data from the regional military administrations, as of 24 February 2023, the total number of destroyed or damaged housing objects is **about 153.86 thousand buildings**, of which 136 thousand are private (individual) houses; 17.5 thousand are apartment buildings; 0.3 thousand are dormitories.

**Regional distribution of the number of destroyed or damaged housing objects, thousand units**



Source: Kyiv School of Economics

The total area of damaged or destroyed objects is **83.1 million square metres<sup>1</sup>**, which is **8.2% of the total housing stock** of Ukraine. According to preliminary estimates, 15.4 thousand residential buildings (with a total area of 18.6 million square metres) were partially damaged (the degree of destruction is less than or equal to 10%); 65.7 thousand residential buildings (with a total area of 35.3 million square metres) were moderately damaged (the degree of destruction is more than 10% or less than 40%); 72.7 thousand residential buildings (with a total area of 29.6 million square

<sup>1</sup> In calculating the total area of individual houses, apartment buildings and dormitories, the average area of buildings was used, which was calculated as an arithmetic mean based on the analysis of object-by-object data on damage and destruction by region and by building type. In the regions where site-specific data was not available, the average area of buildings in neighbouring regions was used as a basis. Based on the results of detailed object-by-object technical inspections of buildings, these values may vary.



metres)<sup>2</sup> were completely destroyed (the degree of destruction is more than 40%). Based on the results of detailed site-specific technical inspections of buildings, this ratio may vary.

**Thus, the housing of about 1.3 million households (about 3.2 million people) is damaged or destroyed.**

**According to preliminary estimates, the value of direct losses for the housing stock is \$53.6 bn.<sup>3</sup>** This is more than a third of Ukraine's total direct damages as of 24 February 2023.

Only to return the housing to its previous condition, the following costs will need to be incurred:

- current repair of residential buildings;
- major repairs or reconstruction of residential buildings;
- new construction;
- restoration of the adjacent territory near residential buildings (fences, benches, landscaping, children's and sports grounds, etc;)
- purchase of durable goods (furniture, household appliances).

In addition, according to preliminary data, 630 administrative buildings were destroyed or damaged as a result of hostilities, including: 580 – buildings of state and local authorities; 50 – administrative service centres. According to preliminary calculations, the value of direct damages to administrative buildings is \$0.54 bn.

## Healthcare

**Direct documented damages caused by the destruction of healthcare facilities amounted to \$1.8 bn.** In total, at least 1216 healthcare facilities have been damaged or destroyed since the beginning of the war.

Under the project, the calculation of damages includes an assessment of damage to healthcare facilities, which include hospitals, polyclinics, dentists, consultative diagnostic centres, medical offices, paramedic and obstetric stations, outpatient clinics, rehabilitation and health centres, laboratory and blood centres, and outbuildings of healthcare facilities. Damage to private medical facilities is calculated separately.

Data on the destruction of relevant healthcare facilities were obtained from the Ministry of Health for public facilities, microdata for private facilities, and open sources.

To calculate the losses, we use information on the number and cost of beds, the area of the facilities, the average cost per square metre, the cost of similar facilities in the Prozorro public procurement system, as well as data from open sources on the degree of damage to the facilities.

Damage to healthcare facilities accounts for about 1.2% of Ukraine's total damages. In terms of types of healthcare facilities, the war has destroyed or damaged the most outpatient clinics – 430 – and hospitals – 362, with hospitals accounting for 80% of the total damage to the sector. As of 24 February, at least 24 private medical facilities were damaged. However, the documented damage primarily concerns state-owned facilities.

More than half of the direct damages to the healthcare sector are concentrated in two regions – Donetsk and Kharkiv ones.

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<sup>2</sup> The distribution of data on the degree of damage was based on the analysis of object-specific data and expert assumptions.

<sup>3</sup> In calculating direct damages, the values of the indirect cost of housing construction by regions of Ukraine as of 1 January 2022, approved by [the Order of the Ministry of Regional Development dated 17 February 2022 No. 53](#), as well as other components of the replacement cost, which were calculated based on market values and expert assumptions, were used as the base values.

## Educational institutions and scientific infrastructure facilities

The education sector is one of the most affected by the war in terms of the number of destroyed, damaged and lost infrastructure facilities. In total, the hostilities damaged more than 3,000 educational institutions, and in many regions, the educational process in schools and other institutions was suspended for a long time. This has forced the government to cut spending on education from the state budget in order to allocate part of the money to more urgent needs, such as defence, recovery and increased social protection needs.

**Direct documented damages caused by the destruction of educational institutions amounted to \$8.94 bn.** In total, at least 915 educational facilities have been destroyed and 2,165 damaged as a result of hostilities.

The educational institutions whose damages are being assessed as part of the project include pre-school (kindergartens), secondary (schools), out-of-school, pre-university (colleges and technical schools), higher (institutes, universities, academies) and specialised education institutions.

The main damages in the educational sector concerned secondary, pre-school and vocational schools, due to their prevalence and attractiveness for use by the aggressor's forces during hostilities. Despite the fact that active hostilities took place in 11 regions, educational institutions were damaged in 18 regions. No losses caused by the above damages and destruction of educational institutions were reported in Volyn, Zakarpattia, Ivano-Frankivsk, Poltava, Ternopil and Chernivtsi regions.

The largest losses from the destruction and damage to educational facilities were recorded in Kharkiv, Donetsk, Chernihiv, Zaporizhzhia and Kyiv regions. Among the damaged and/or destroyed educational facilities, the largest number were schools (1497) and kindergartens (909).

The scientific infrastructure has also suffered losses: according to preliminary estimates, 117 movable and immovable property items of 34 institutes and other institutions of the National Academy of Sciences of Ukraine have been destroyed, damaged and seized for the needs of the Armed Forces of Ukraine. The preliminary total assessment of damages for the NAS scientific institutions alone is \$7.8 million.

## Social protection

As a result of large-scale hostilities in various regions of Ukraine, social facilities have been affected, including destroyed or damaged social security institutions, geriatric institutions, sanatoriums, children's camps and orphanages, boarding schools, and institutions for the homeless.

**Over a year of full-scale war, direct losses to the infrastructure of social services provided by the state amounted to \$0.2 bn (at replacement cost).**

In the analysis of damages, the methodology includes destruction and damage to social infrastructure facilities under the jurisdiction of the Ministry of Social Policy as direct losses. The assessment is based on the data on destruction and damage to social facilities provided by the Ministry of Community and Territorial Development of Ukraine.

Social centres, sanatoriums and boarding schools accounted for the largest share of the total number and cost of damages.

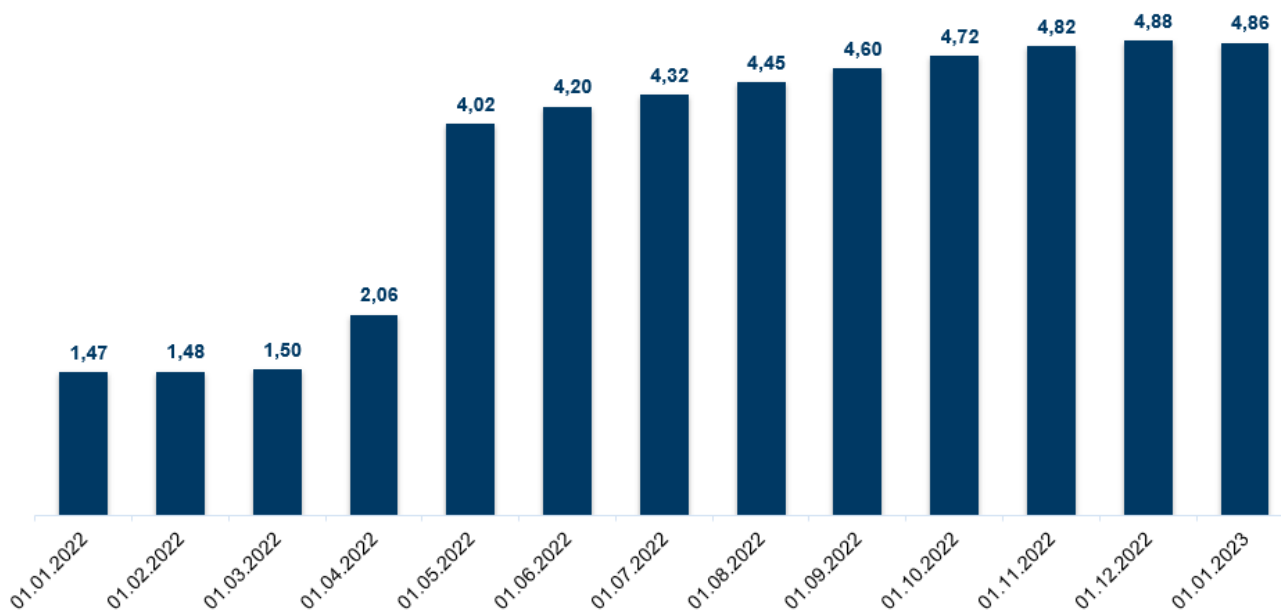
Social facilities have the lowest number of destroyed or damaged institutions and, consequently, the lowest number of damages compared to other infrastructure facilities in the country. The damaged social facilities are located in Kyiv and the following regions: Kyiv, Donetsk, Dnipropetrovsk, Zhytomyr, Zakarpattia, Zaporizhzhia, Luhansk, Mykolaiv, Sumy, Odesa, Kharkiv, Kherson, and Chernihiv regions. The destroyed social facilities are located in Luhansk, Donetsk, Zaporizhzhia, Kyiv, Mykolaiv, Sumy, Kharkiv, Kherson, Chernihiv regions and in Kyiv.

As a result of Russian aggression, the number of people in need of social protection from the state has increased significantly. According to the Pension Fund of Ukraine, in 2022, payments were

made to 32.9 thousand people who became disabled as a result of the war, 33.5 thousand people who were discharged from military service as a result of a disability, and 21.9 thousand family members who lost a breadwinner – a military serviceman/servicewoman. A total of UAH 5.1 bn was allocated for these pensions.

During the year of full-scale war, millions of Ukrainians were forced to become internally displaced or migrants abroad. According to the Ministry of Social Policy, the number of registered internally displaced persons increased by 3.3 million during martial law and reached almost 5 million. In 2022, a third of them needed housing assistance. The total expenditures in 2022 for the payment of living allowances to IDPs amounted to more than UAH 50 bn compared to the conditionally peaceful year of 2021 due to an increase in recipients by 1.4 million people.

#### **Dynamics of the number of IDPs for 2022, million people**



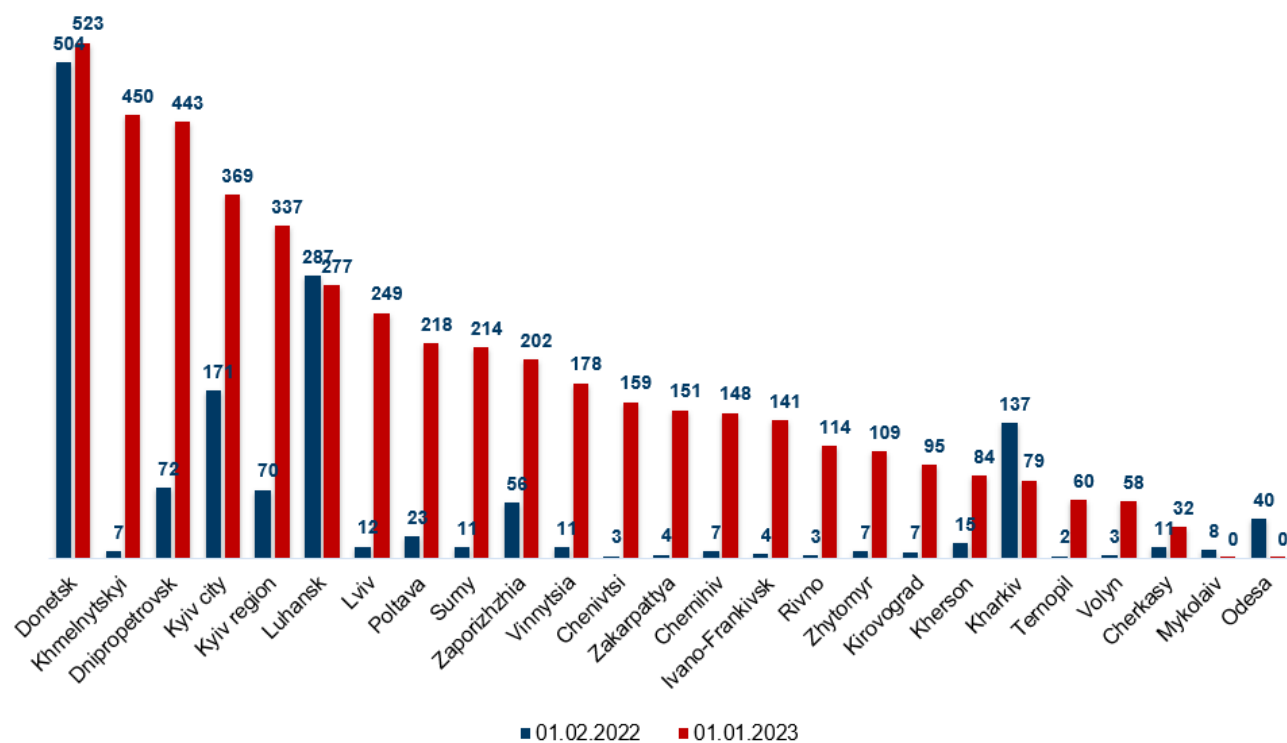
*Source: Ministry of Social Policy of Ukraine*

The largest number of people moved from the areas where active hostilities were taking place at the beginning of the full-scale invasion, namely Donetsk region – 526.1 thousand people, Kharkiv region – 461.9 thousand people, Dnepropetrovsk region – 448.3 thousand people, Kyiv region – 334 thousand people and Kyiv city – 374.1 thousand people.

In March 2022, more than 500,000 people moved within the country. In April, the number of registered IDPs increased to the maximum for the entire war period and amounted to 4.02 million people. In the following months, registered IDPs increased by 21%. As of February 1, 2023, IDPs reached 4.86 million people.

The regional structure of IDP registration has changed significantly. At the beginning of 2022, the most significant number of IDPs was registered in the Donetsk region – 504 thousand people; Luhansk region – 287 thousand people; Kyiv city – 171 thousand people; in the Kharkiv region - 137 thousand people and in Dnipropetrovsk region - 72 thousand people. At the beginning of 2023, the most registered IDPs were in the Donetsk region - 523 thousand people, Khmelnytskyi region - 450 thousand people, Dnipropetrovsk region - 443 thousand people, Kyiv city - 369 thousand people, Kyiv region - 337 thousand people.

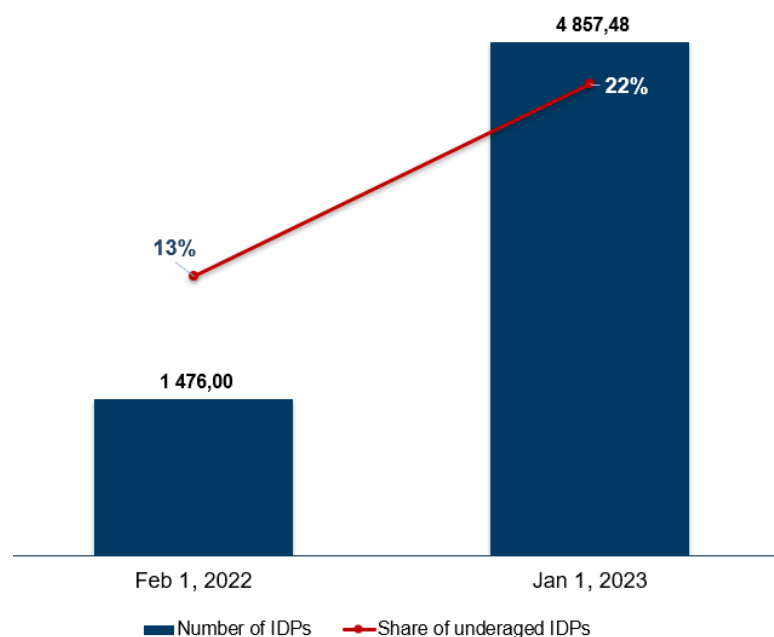
## Number of IDPs by region, thousand people



Source: Ministry of Social Policy of Ukraine

In 2022, the gender structure among IDPs has changed slightly, with fluctuations amounting to 1%: displaced men make up 40% of the total number of IDPs, and women - 60%. The number of minors in the structure of IDPs increased significantly from 13% on February 1, 2022, to 22% on January 1, 2023.

## Share of children in the total number of IDPs



Source. Ministry of Social Policy of Ukraine

## Culture, sports, tourism

Since the beginning of the large-scale invasion, the cultural sphere has suffered the greatest historical losses in the history of independent Ukraine. For each country, culture is the basis of self-determination for every citizen, and the destruction of cultural facilities such as museums, historical buildings, monuments and artworks by prominent people is a very painful blow to Ukrainians, as with the ruining of each cultural facility, a part of the history of Ukraine and the Ukrainian people is lost.

Due to the high intensity of hostilities in the east and south of Ukraine, as well as regular missile attacks throughout the country, most cultural and sports institutions have ceased to operate or have significantly reduced their work. As a result, 12.5 million people in at least 6 regions of the country (Donetsk, Zaporizhzhia, Luhansk, Mykolaiv, Kharkiv, Kherson) have lost access to services, and another 13 million people in 7 regions have limited access to them.

The loss of national cultural heritage is difficult to assess not only because of the physical value of the objects, but also because of their cultural value. The 1954 [Hague Convention](#), to which Ukraine acceded in 2020, obliges countries to refrain from committing acts of hostility against cultural property during armed conflict

According to the [registers](#) of national cultural heritage, there are about 15.5 thousand cultural heritage sites in Ukraine, of which about 1.2 thousand are sites of national importance and 14.3 thousand are local. These sites are categorised into eight types: historical, architectural, archaeological monuments, landscape, monumental art, urban planning/urban development sites, landscape gardening sites, as well as science and technology sites.

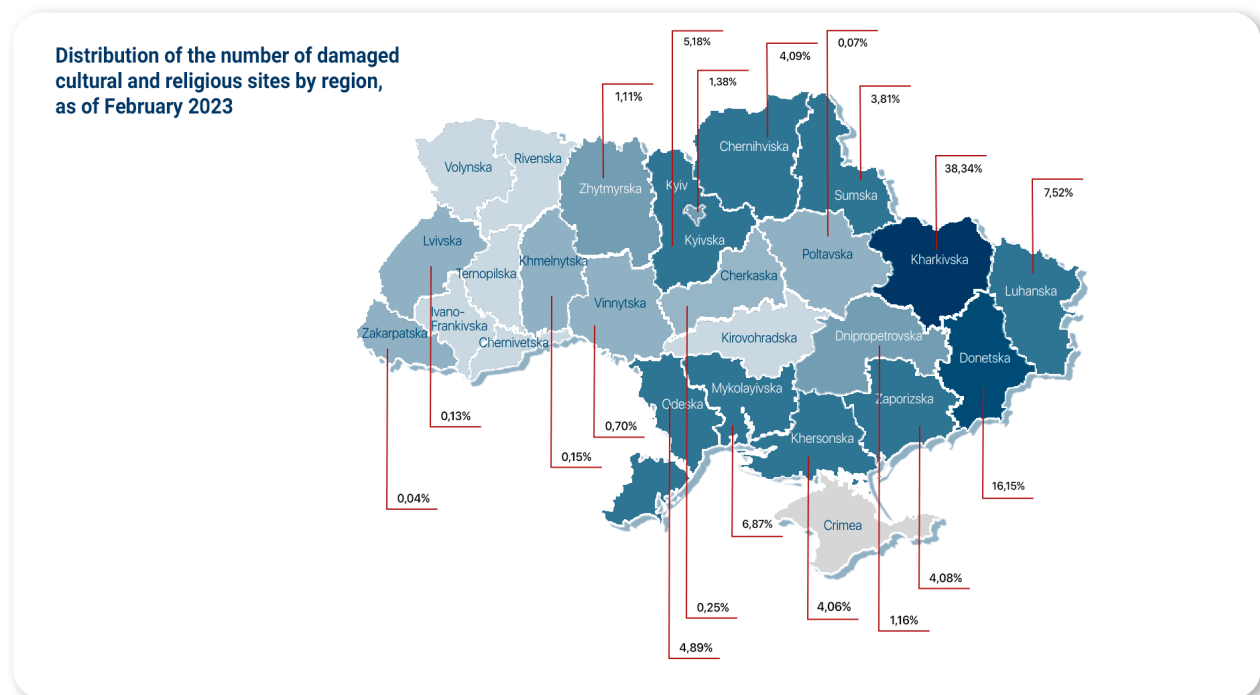
Among the most painful losses of this war on the cultural front are the Sviatohirsk Lavra of Holy Dormition, which is included in the UNESCO World Heritage List, the museum of Hryhoriy Skovoroda, author of world-famous philosophical and artistic works, and even a collection of Scythian gold found by archaeologists in the 1950s. In addition, other important cultural and religious sites were heavily damaged, including the Mykolaiv City Palace of Culture “Korabelnyi”, the Mariupol Drama Theatre, the Kharkiv State Academic Opera and Ballet Theatre named after Mykola Lysenko, the Chernihiv Museum of Ukrainian Antiquities, the Kharkiv House “Slovo” and many others.

Currently, the assessment of cultural heritage losses is based on the data on the object-by-object list of damaged/ruined objects provided by witnesses and local administrations, which creates the risk of incomplete data on the list of damaged objects. Due to the lack of access to most of the damaged objects because of their location in the areas of hostilities, the list is incomplete and keeps growing.

Since the beginning of Russia's military aggression, according to documented losses, 348 religious sites, 703 houses of culture/palaces of culture, 82 museums, 157 hotels/restaurants and 8 sports stadiums in Ukraine, mostly located in 14 regions of the country – Dnipro, Donetsk, Zhytomyr, Zaporizhzhia, Kyiv, Luhansk, Lviv, Mykolaiv, Odesa, Sumy, Kharkiv, Kherson, Chernihiv regions and Kyiv city – have been damaged.

As of 1 September, the share of direct damage to the infrastructure of culture, religion and tourism totalled **\$2.2 bn**. In total, at least 1,800 cultural facilities, 348 religious buildings, 343 sports facilities, and 164 tourism facilities have been damaged or destroyed since the war began.

## Number of destroyed/damaged objects of culture and religion, units



Source: Kyiv School of Economics

An important methodological limitation of this calculation is that the financial value of cultural objects is calculated without taking into account the actual value of the cultural value of these objects, given the difficulties in calculating such value remotely, as well as the lack of a single and comprehensive register of cultural buildings that would contain detailed data on cultural heritage, art objects, and a list of museum artefacts in each of the objects. Also, given this limitation, at the current stage, the losses of libraries, museum collections, costs of relocation of museum collections, etc. were not calculated. Projects for the restoration, conservation, and museumification of cultural heritage sites are developed individually for each site, taking into account the totality of survey data and best international practices, which requires the involvement of international experts; estimating the cost of such projects takes time and is based primarily on the results of a comprehensive survey and thorough documentation.

The valuation of damaged or destroyed cultural property is complicated by the difficulty of indirectly assessing the value and cost of the interior decoration of religious and other cultural institutions, art objects, decorations, exhibits, icons, frescoes, etc. contained in the buildings. Accordingly, the value of damaged objects of cultural value may be changed in accordance with the ability to restore these objects and its cost.

## PRODUCTIVE SECTOR

### Industry and business services

**The total direct losses of companies' assets are estimated at \$11.3 bn.** In total, at least 426 large and medium-sized private enterprises, as well as state-owned enterprises, and tens of thousands of small private enterprises, have been damaged or destroyed since the beginning of the war. The true figure is likely to be higher, as not all businesses are reported, especially those in the temporarily occupied territories.

Enterprises can be divided into two groups. The first is those destroyed by accident or "along for the ride" during shelling of military units and settlements. The second group was destroyed intentionally as part of targeted strategic missile strikes. In addition to transport and energy infrastructure facilities described in the relevant sections, these are primarily military and dual-use production facilities. Unlike the first group, which is concentrated in the frontline regions, the second group is evenly distributed throughout Ukraine.

**Direct damages** include:

- Loss of fixed assets (the original valuation is used, since it is not possible to purchase an asset at its carrying amount in most cases);
- Loss of capital investments in progress;
- Loss of inventories of finished goods and intermediate materials (we assume that in most cases the inventories were located close to the main production facilities).

Depending on the availability of data, losses are calculated in one of the following ways:

- For private enterprises for which the owner has reported his/her own estimate of losses after verification, the said estimate is used.
- For large and medium-sized private enterprises for which the extent of damage is known, we use financial statements as of the latest available date. We distinguish between destruction (100%) and damage (40%).
- For public utility enterprises, we use assessments provided by the ministries and departments under whose jurisdiction the respective enterprises are managed (if available, the financial statements are used, as in the case of private enterprises).
- For small private enterprises, an indirect calculation based on the level of damage to residential property in the regions is used as a proxy.
- For individual entrepreneurs, the value of assets was first assessed (through ratios to revenue based on the financial statements of legal entities), and then losses were calculated similarly to small private enterprises.

**The main conclusions regarding the damages to enterprises are as follows:**

1. Business assets are the third largest item of direct infrastructure damage. It accounts for about 10% of total losses.
2. In terms of industries, metallurgy suffered the most. In particular, two of the largest enterprises on the list of damaged/destroyed were destroyed – Azovstal and Ilich Steel and Iron Works (both in Mariupol, see the list in Annex 7).
3. In terms of regions, Donetsk region suffered the most, accounting for almost half of the total direct damage to businesses. There were also significant losses in Kharkiv, Luhansk and Kyiv regions.



## Retail trade

The information on direct damages of **retailers** was obtained by analysing data from two waves of the survey conducted by the Ukrainian Council of Shopping Centres (the first wave was conducted jointly with the Ukrainian Retailers Association).

The study was conducted through a standardised online survey of top managers of retail companies. Representatives of 271 companies took part in the survey, including both chain and nonchain businesses. A number of respondents were interviewed twice – during each of the survey waves.

According to the survey, at least 2,900 retail outlets were significantly damaged.

Retail business includes the following:

- Shops;
- Pharmacies;
- Kiosks;
- Petrol stations.

However, retailers' damages are not limited to losses at their outlets. Thus, the question on direct damages included the following items:

- Damage to the building/ premises of the company-owned outlets, engineering networks and decoration/interior;
- Damage to equipment;
- Damage to inventory at retail outlets (at purchase price);
- Damage to warehouse, production, office buildings/ premises owned by the company and equipment therein;
- Damage to inventory in warehouses (at purchase price);
- Other damages.

The amount of direct damages incurred by retailers reached **\$2.19 bn**. It does not include the retail outlets of individual entrepreneurs.

Another source of direct damages to the retail sector are the losses of shopping centres (SCs). Shopping centres are not participants in the retail market, but provide space for retailers to carry out their professional activities.

According to the ICSC definition, a shopping centre is a retail property that is planned, constructed and managed as a whole, including shops and common areas, with a leasable area of at least 5,000 sq m.

According to the Ukrainian Council of Shopping Centres (UCSC), which maintains a register of shopping centres and provided data on their damages, there are 329 shopping centres in Ukraine, of which 8 were destroyed and 18 damaged.

The direct damages incurred by the shopping centres caused by the hostilities amounted to **\$402 mln**.

The expert assessment of the damage took into account the area and nature of the damage, based on the construction cost of \$800-1100 per 1 sq m, depending on the type of facility. The calculation of direct damages to shopping centres does not include tenants' losses (equipment and goods), as they are already included in the losses of retailers.

Thus, the **total amount** of direct damages to the industry since the start of the full-scale war in Ukraine is **\$2.59bn**.



## Agro-industrial complex and land resources

**As of 24 February 2023, the amount of direct damages caused to the Ukrainian agro-industrial complex is \$8.7 bn.**

The assessment of direct damages to the agro-industrial complex and agricultural infrastructure includes the following main components: loss of agricultural machinery; loss of elevators and other grain storage facilities; losses in livestock production from animal deaths and slaughter due to the inability to keep animals; losses of perennial crop producers due to damage to plantations; losses in beekeeping; and losses of production inputs and finished goods due to damage and theft. Estimates of land losses will be assessed in the next editions of the report.

The above damages are estimated using indirect methods, a combination of relevant state and regional statistics, as well as data from surveys of agricultural producers conducted in 2022.

The largest share of losses is due to the destruction and damage to agricultural machinery, resulting in estimated losses of over **\$4.65 bn**. The second largest category is damages due to the destruction and theft of manufactured products, with the total value of destroyed and stolen products estimated at \$1.87 bn.

The infrastructure for storing agricultural products has suffered significant losses. The total capacity of the destroyed grain storage facilities reaches 8.2 million tonnes of output, and the capacity of the damaged grain storage facilities reaches 3.25 million tonnes of simultaneous storage capacity. The cost of restoring the damaged facilities is estimated at \$1.33 bn.

According to the Zoï Environment Network, the total area of forest fires in the areas where active hostilities took place is almost 298 thousand hectares. This area of forest fires in 2023 exceeds the average annual area of forest resources destroyed by fires throughout Ukraine by more than 50 times. According to the KSE's calculations based on the State Statistics Service of Ukraine, the average annual area of forest plantations destroyed by forest fires is 5,270 hectares. During the 11 years of observations of the extent of forest resources lost due to fires (2010-2020), the highest value was recorded in 2020. At that time, the area of affected forest plantations reached 28 thousand hectares. One of the key factors behind this volume of forest fires is the difficulty of extinguishing forest fires in areas where active hostilities are or have been taking place. Even in the liberated territories, fighting forest fires is significantly complicated by the threat of mine contamination.

Damages to the forest fund as a result of forest fires are estimated at more than 82.9 million cubic metres of timber with an estimated value of \$4.5 bn.

## INFRASTRUCTURE

### Transport infrastructure

Infrastructure facilities have become one of the key areas that have been subjected to the greatest attacks by the aggressor since the outbreak of a full-scale war against Ukraine. In particular, in the first weeks of the war, Russian troops carried out massive shelling of aviation infrastructure, primarily airfields not only for military but also for civilian and military-civilian (dual) purposes. Subsequently, railway infrastructure, including power substations, became the targets of active attacks.

Thus, road infrastructure facilities suffered the greatest damage, both in absolute and value terms. Firstly, because they are naturally targeted during artillery attacks, and secondly, because Russian tanks have been actively moving along Ukrainian roads throughout the entire period of military aggression. In particular, motorways were used as communication lines between Russian troops in Ukraine and their rear in Russia and Belarus.

Since the beginning of hostilities in Ukraine, 19 airports and civilian airfields, at least 126 railway terminals and stations have been damaged.

According to preliminary estimates, the total loss of infrastructure in Ukraine amounted to \$36.2 bn.

### Public road system

A detailed analysis of the condition of the roads damaged by shelling and tank traffic is only possible with a specialised technical inspection, which is not possible in a situation where active hostilities are still ongoing in a large part of Ukraine, and some roads and bridges are located in the temporarily occupied (after 24.02.2022) territory.

However, analysing the map of hostilities and comparing it with the road network allows us to make preliminary calculations of the approximate length of roads damaged by the war, both as a result of missile attacks and tank traffic. According to the study (Damaging Effect of Moving Tank Loads on Flexible Pavement, Journal of Engineering, 2010), the damaging effect of a tank can reach 2.36 times the damaging effect of a standard axle load from civilian vehicles. In this study, T-72 tanks were considered, which is a good approximation in the case of the war in Ukraine, as most tanks are similar in physical characteristics or even heavier. The surface layer of the roads is severely damaged by metal tracks. Also, the destructive effect of tank braking is 2.38 times greater than the destructive effect of the tank's weight on the road's stretching. Finally, the destructive effect of tank manoeuvres is 1.22 times greater than the effect of the destructive effect of the tank's weight on the road's tensile strength. What's important is that the stress from the tank is not only horizontal but also vertical, and according to research, the maximum stress is at a depth of up to 3 metres, which affects the degree of destruction not only of the road surface.

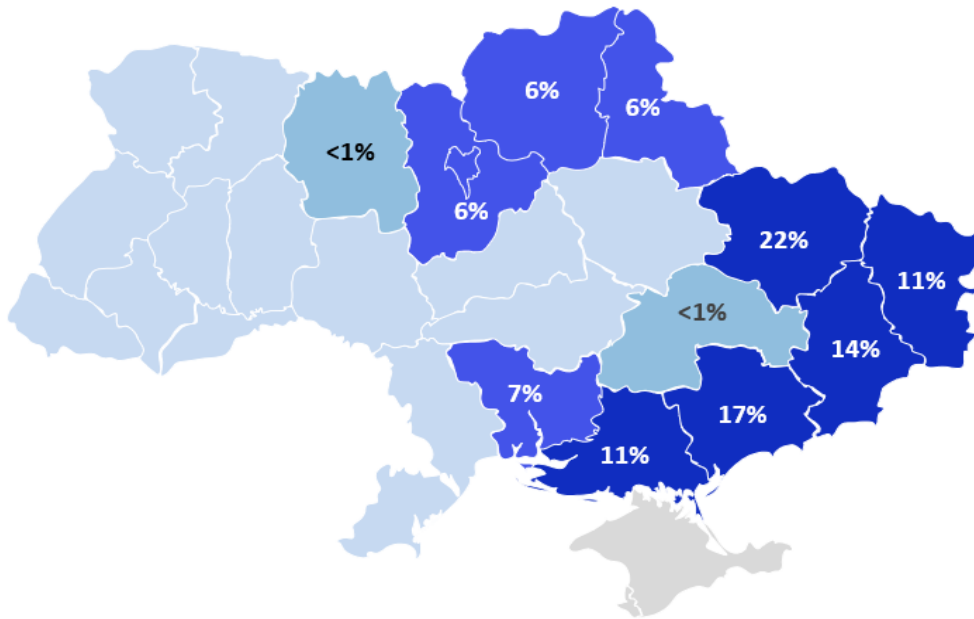
The peculiarity of road assessment is also that the average cost of damage and restoration of one kilometre of road in a city is usually significantly more expensive (the difference can be one third or more) compared to the cost of roads outside the city, since road construction in cities, in addition to the construction of the roadbed, also involves the construction of communication networks, sidewalks, lighting, etc.

According to preliminary estimates, a total of **25.1 km of roads and 344 bridges and bridge crossings of state, local or municipal importance were damaged as a result of the hostilities** (for bridges and roads, see the Ministry of Infrastructure). According to the Ministry, a preliminary inspection of the state of roads in the de-occupied regions (Chernihiv, Kyiv, Sumy, and Kharkiv oblasts) confirms the information on preliminary estimates of significant damage to the road structure caused by the traffic of tanks and other heavy military equipment, which will require the reconstruction of a significant part of the damaged roads. Preliminary estimates show that the level of damaged roads (state and local roads, as well as municipal roads) varies from 0% to 95% and averaged approximately 10% of the total number of roads in the areas that were occupied by Russian troops or where hostilities took place (are taking place).

According to Ukravtodor (State Agency of Automobile Roads of Ukraine), the weighted average cost of road reconstruction in 2021 (taking into account different categories of roads) was about UAH 29 million per 1 km of road (excluding the cost of restoring bridge crossings). Taking this into account, a preliminary estimate of the total losses due to direct road destruction could be around **\$26.7 bn** in equivalent, at end-2021 prices. Damage and destruction of bridges and bridge crossings adds another **\$2.6 bn** to infrastructure losses.

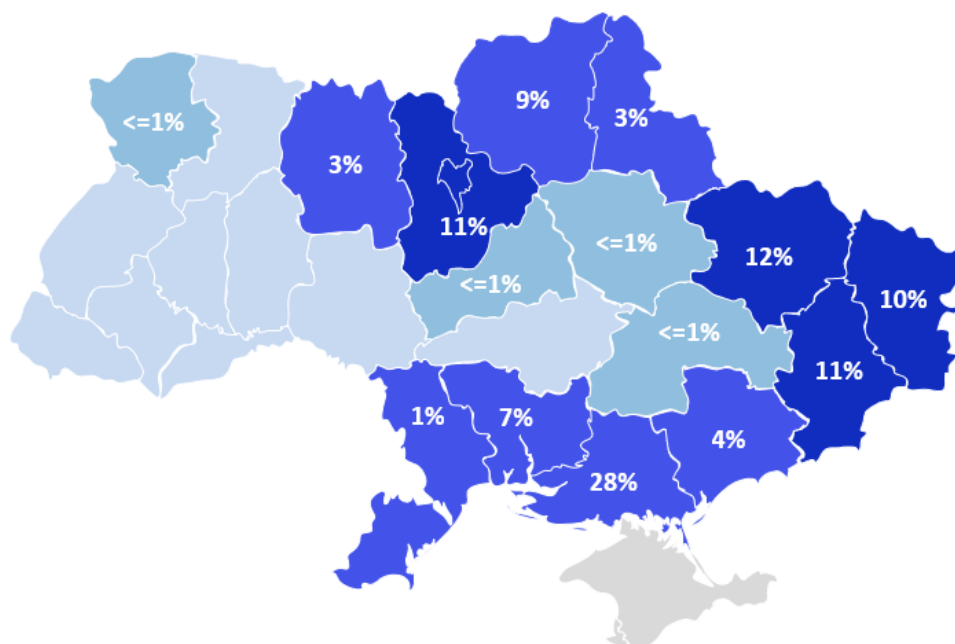
Since the beginning of the war, some work has been done to restore roads and bridges. In particular, 78 artificial structures on roads of national importance were reopened in 2022 (most of them in Kyiv (20), Chernihiv (20) and Kharkiv (17) regions), and 2 since the beginning of 2023 (3 more bridges are in the works). In addition, 2.2 thousand km of state and municipal roads were cleaned in 2022 (including about 612 km in Kharkiv, 588 km in Mykolaiv and 516 km in Kyiv regions).

#### Distribution of direct monetary damages to roads by region



Source: Kyiv School of Economics

#### Distribution of direct monetary damages to bridges and bridge crossings by region



Source: Kyiv School of Economics

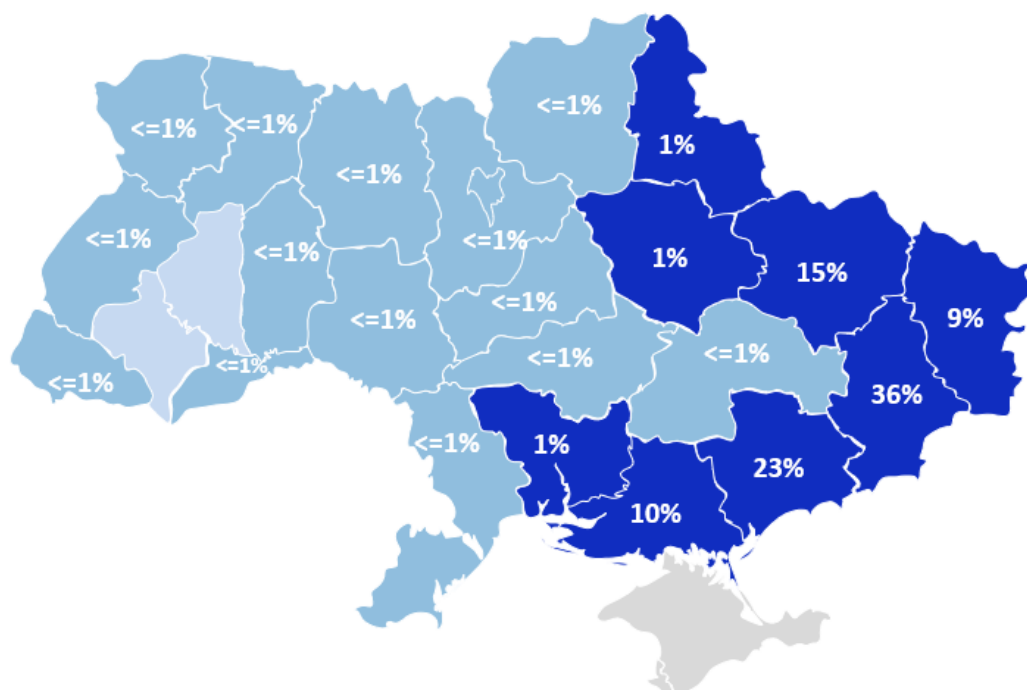
## Railway infrastructure

Since the outbreak of the war, the Ukrainian railway has demonstrated its role as a critical infrastructure facility by taking the brunt of the free evacuation of millions of Ukrainian citizens (as well as a large number of businesses) stranded in the war zone, and by delivering critical materials and equipment to these regions. In response, the Ukrainian railway has become an active target for Russian shelling and attacks.

According to preliminary estimates, the total length of the damaged railway track is up to 507 km; the number of damaged railway stations is 126, of which more than 53 were damaged or destroyed in the government-controlled area and the rest in the non-government-controlled areas. In addition, more than 700 km of railway tracks are located on the temporarily occupied (after 24.02) territory. The total number of damaged, destroyed and lost buildings belonging to Ukrzaliznytsia is estimated at 5,500 and about 4,000 of facilities. At the same time, there is a reason to believe that all Ukrzaliznytsia's movable assets that were not timely removed from such areas can be considered completely lost (destroyed or stolen by the aggressor troops).

Thus, the total direct damages to the railway are estimated at **\$4.3 bn.**

### Distribution of direct monetary damages to the railways by region



Source: Kyiv School of Economics

## Aviation industry

The aviation industry began to suffer losses from the military aggression even before it actually began. On 12 February, global insurance companies notified Ukrainian carriers that they would stop insuring Ukrainian aircraft due to the high threat of an invasion by Russia. This led to the risk of cancellation of international carriers' flights to Ukraine, and following a working meeting with the leadership of the Office of the President of Ukraine, the State Aviation Administration of Ukraine, UkSATSE, Boryspil International Airport and Ukrainian airlines, the government expressed its readiness to support air carriers by providing additional financial guarantees to support the aviation market.

With the outbreak of hostilities, the airspace over Ukraine was immediately closed and air traffic was suspended. At the same time, Russian troops began active missile attacks on all key airfields in Ukraine, trying to deprive the country of its air defence capabilities. As a result, 19 out of 35 airfields were damaged, including 12 civilian and 7 dual-purpose airfields (excluding military airfields). Some of the airfields were shelled several times.

Similar to the situation with roads, detailed information on the state of damage/opportunities for repair of airfields at most airports can only be established after detailed technical surveys, which, in turn, are possible only after the end of active hostilities at/in the area of airports (for those located in central, southern, eastern, and northern parts of Ukraine). However, according to preliminary estimates, the total amount of damages to the aviation industry (airports, airfields, aircraft) is about **\$2.1 bn.**

## Port industry

The total **direct damage** to port infrastructure and related businesses is estimated at \$496 million. This estimate includes both seaport infrastructure and inland waterway transport facilities that were damaged because of the war.

In total, property in at least four ports has been destroyed or damaged since the outbreak of the war. For example, a grain terminal in Mykolaiv's Nika-Tera port was destroyed.

Moderate port damage is due to two factors. Firstly, a port is a rather complex and spatially distributed object consisting of many large parts. Therefore, it is impossible to completely destroy such an object with a few precise missile strikes. Secondly, the aggressor captured or used its own and friendly cargo ships to export stocks of grain, ferrous metals, etc., and for this it needed working ports.

For example, the Metinvest Group reported that the occupiers planned to export 200,000 tonnes of products worth \$170 million from Mariupol's factories. In turn, as for grain, 400,000-500,000 tonnes (also worth hundreds of millions of dollars) were reported stolen from the four occupied southern regions, which is more than a third of local stocks. The ports of Mariupol, Berdiansk and Skadovsk are still occupied. While the port of Kherson can be considered unblocked after the de-occupation of Kherson, it is still not operational, as is the port of Mykolaiv and the port of Olvia. There is still no traffic on the Dnipro due to the blockade of the lower part of the river.

### Status of Ukrainian ports

## UKRAINIAN PORTS DURING THE WAR

TOP  
LEAD

Almost all Ukrainian ports are closed due to occupation, blockade, mine danger, and the danger of the piracy by Russia.

- 1 Will work as a logistics center
- 3 Entry and exit is not possible
- 3 Don't work
- 5 Occupied since 2014
- 3 Work as usual
- 3 Partially resumed work



Source: UA War Infographics

## Postal operators

The total **direct damages** to postal operators are estimated at **\$13 mln**. The amount is based on data from Ukrposhta and Nova Poshta, which have the largest market share. In total, since the beginning of the war, several hundred post offices, dozens of terminals/depots and vehicles, as well as a large number of parcels for which the operators are financially responsible, have been destroyed or damaged.

## Transport vehicles

In the territories and cities where the fiercest fighting took place, public transport infrastructure was destroyed, and people were left without private vehicles that were damaged or destroyed as a result of missile and artillery shelling.

**According to analytical calculations, direct damages to municipal transport enterprises and private carriers, including destroyed transport, amount to \$0.83 bn**, including destroyed trolleybuses, trams, and buses. **The direct damage to private passenger vehicles amounted to approximately \$1.86bn, or 207,000 vehicles. In addition, 1629 units of firefighting equipment worth \$89 million were lost.** The estimate of private passenger car losses is based on available data on the officially registered number of passenger cars and does not take into account possible losses of passenger cars not registered in Ukraine (in particular, the so-called “Euro cars”).

Losses of municipal transport were calculated using both indirect methods, taking into account a number of assumptions; and using accurate data on damaged/destroyed municipal property provided by the military administrations.

The greatest damage to municipal property, which includes municipal (public) transport, was caused in Luhansk and Donetsk regions, as well as in Kharkiv. This is due to the fact that the enemy mercilessly used heavy weapons to strike at civilian infrastructure. This resulted in the loss of an estimated 60% of public transport in Donetsk region and over 70% in Luhansk region. In these two regions, the industry providing urban and suburban passenger transport services has been virtually destroyed.

The largest number of private cars were also lost by citizens in these two eastern regions of Ukraine.

In addition, the losses of vehicles also include the destroyed Mriya aircraft in the amount of \$300 million (the cost of building a new aircraft of the model may be higher). At the same time, the losses of passenger aircraft are likely to be higher due to the possible destruction of other civilian/cargo aircraft during the shelling of Ukrainian airfields; however, in the absence of detailed information on the location of such aircraft at civilian airfields, this assessment will be made at a later stage.

## Digital infrastructure

The total direct damages to telecoms operators are estimated at **\$566 mln**.<sup>4</sup> The electronic communications sector includes:

- Internet networks of fixed-line operators;
- Radio networks of mobile operators;
- Backbone networks;
- Technical and related means of electronic communications.

At least 726 operators of electronic communications with fixed access to the Internet suffered damages as a result of the hostilities. After the de-occupation of settlements, the destruction of networks reaches 100%. Across the country, the quality of data transmission over fixed-line Internet access networks has decreased by an average of 13% (as of 01.05.2022).

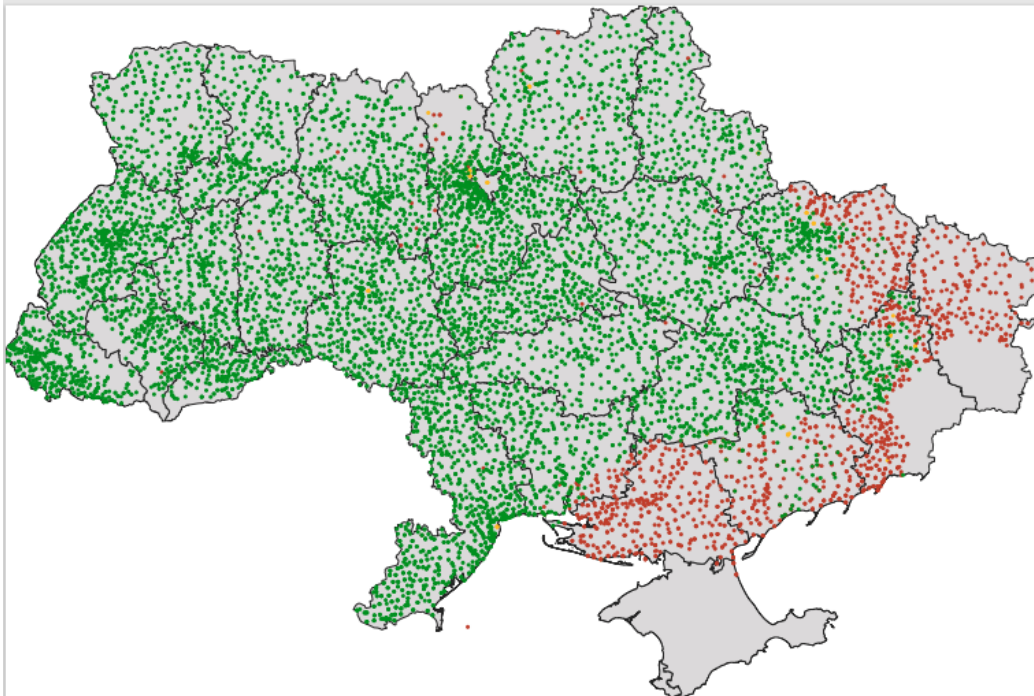
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<sup>4</sup> The estimates have not been updated from the previous report due to the lack of new comprehensive data.



In 12.2% of settlements, there is no access to mobile communications, and in 3.1% - partially available. There are 3,534 base stations of mobile operators out of service, which is almost 11% of the total. Over the past month, the total number of out-of-service base stations increased by 700. Across the country, the quality of data transmission via mobile Internet access networks has decreased by an average of 26% (as of 01.05.2022).

#### **Distribution of out-of-service mobile base stations as of May 2022**



*Source: Kyiv School of Economics*

The determination of the value of damages for owners of electronic communications network infrastructure or its components (including construction in progress) differs in different categories. The following classification is used for these purposes:

- National companies, electronic communications operators that provide electronic communications services to citizens of Ukraine throughout its territory;
- Medium-sized companies providing electronic communications services in several regions;
- Small companies providing electronic communications services within a region.

For national companies, direct damages are determined based on the results of an inspection/survey of the destroyed or damaged electronic communications network infrastructure facilities, if they are accessible (even, if possible, in the officially non-government-controlled areas). The amount of damage is established in natural units (km, pcs., etc.), and is also estimated in money, based on an approximate estimate of the cost of restoration work.

For small and medium-sized companies, direct damages are calculated through the estimated cost of restoring/reconstructing networks or through the average monthly fee for 24 months.

There are also a number of other problems. Operators of networks that are fully or mostly under occupation or in the combat zone maintain their networks whenever possible so that Ukrainian citizens can continue to use Internet access from the free territory. In this case, revenues are close to zero, but expenses remain.

At the same time, some of these operators have loans from banks. They are unable to pay for the use of the loan and repay the principal. At the same time, banks charge penalties for late payments and report them to credit bureaus as unreliable borrowers.

## Energy sector

**As of 24 February 2023, the direct damage to the Ukrainian energy infrastructure is estimated at \$8.1 bn.**

When assessing damage to the energy sector, both direct and indirect methods were used to calculate the cost of lost and damaged facilities.

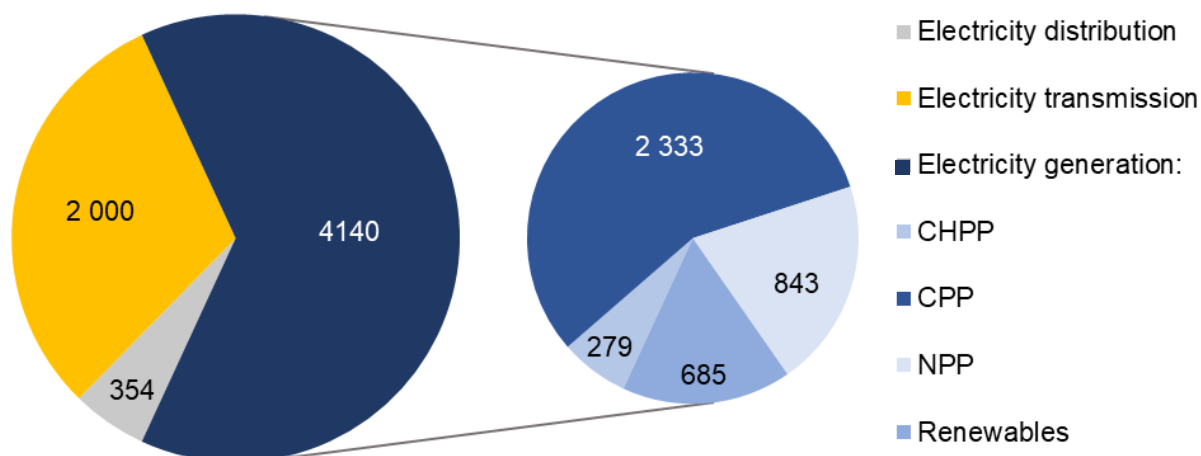
The cost of damaged assets is based on the original book value of property, plant and equipment, the cost of current repairs, and replacement cost (market value of replacement of the damaged assets).

The main information on damages to the energy sector was provided by the Ministry of Energy of Ukraine. To assess individual large facilities, an individual approach was used based on information from open sources, owners and managers of enterprises. Data on damage to power generation facilities was collected in aggregate and from open sources due to the high risk of dissemination of information on detailed damage to critical infrastructure facilities in the war.

The assessment may be complicated by the lack of detailed information on damage to facilities that are currently under occupation or physically impossible to access due to constant shelling and/or significant mine and ordnance contamination risk.

In the energy sector, the electricity generation and transmission objects suffer the most from Russian aggression. Russia continues to carry out targeted and large-scale attacks on facilities that generate, transmit and distribute electricity. The preliminary estimate of the total amount of damage to these facilities is almost \$6.5 bn. According to public statements by the Prime Minister of Ukraine, the Ministry of Infrastructure and the Ministry for Communities and Territories Development (now the Ministry of Reconstruction), since the beginning of the full-scale invasion, all coal power plants (CPPs) and hydroelectric power plants controlled by Ukraine, as well as 13 combined heat and power plants (CHPPs), have been damaged or destroyed.

### Direct infrastructure damage to electricity facilities, USD million



Source: Kyiv School of Economics based on data from the Ministry of Energy of Ukraine, The Energy Charter Secretariat, energy companies, open data

Large power generation facilities suffered a significant amount of damage. According to the Prime Minister of Ukraine, during one of the most recent massive missile attacks, 9 units of thermal power plants were damaged, and at least one of them was completely destroyed by a direct cruise missile strike. In total, the project team estimates the current direct damages to the thermal power sector at \$2.3 bn for CPPs and \$279 million for CHPPs. Damages to hydroelectric power plants (HPPs) and hydroaccumulating power plants (HAPPs) are currently estimated at \$464 million. At the same time, the cost of restoring the destroyed and damaged capacities of these power plants may significantly exceed the cost of damage due to substantial depreciation and technological obsolescence of the equipment.

In addition, the largest nuclear power plant in Europe, Zaporizhzhya NPP (ZNPP capacity was more than 10% of the total capacity of the Ukrainian power system before the Russian full-scale



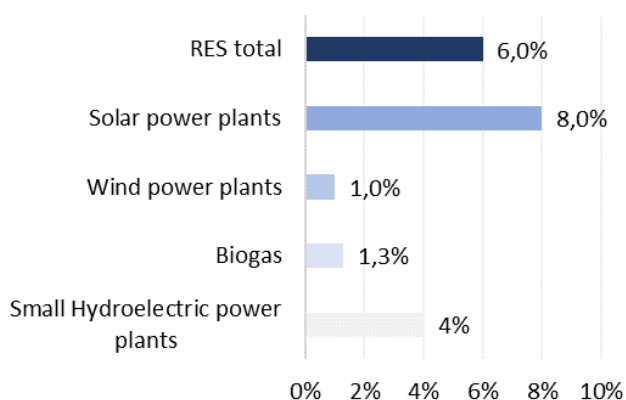
invasion), is still occupied by the Russian military, with limited control by the “Energoatom”. The occupied nuclear power plant does not supply electricity and meets its internal needs from the Ukrainian power grid, as well as from diesel generators in emergency cases. The IAEA and the Ministry of Energy call the situation with nuclear safety threatening.

Also, the territories occupied by the Russian Federation after 24 February 2022 include Vuhlehirska, Zaporizka and Luhanska CPPs, fierce combat is taking place around Kurakhivska CPP. The Kakhovka HPP remains occupied, and has also suffered significant damage as a result of deliberate shelling and bombing by Russian troops.

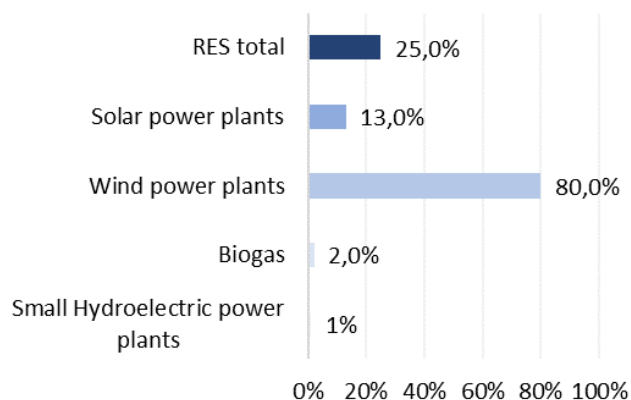
Renewable energy producers (RES) also suffer significant damages. According to the Energy Charter Secretariat, 13% of solar generation capacity is located in the occupied territories, and 8% has been damaged or destroyed; about 80% of wind generation is occupied and part of it has been damaged by shelling; 2% of bioenergy capacity is under occupation, and at least 4 biogas plants are known to have been destroyed.

The KSE team estimates direct damages to RES electricity producers (excluding large HPPs and HAPPs) at \$220 mln. This business also suffers significant financial losses. The occupied facilities have not been generating electricity for a year, yielding no revenue. Such losses are multiplied by the impossibility of commissioning new facilities which took resources, including loans, invested. According to RES associations, by the end of last year, only wind power plants with a total installed capacity of about 800 MW should have been completed and commissioned.

#### Destroyed or damaged RES facilities



#### Occupied RES facilities



Source: Energy Charter International based on public data

The ongoing active hostilities in Ukraine, as well as targeted massive missile and kamikaze-drones attacks, have also led to damage and destruction of electricity transmission and distribution facilities. According to preliminary estimates, the amount of direct damage caused by the full-scale invasion to the Transmission System Operator is estimated at \$2 bn, and to the distribution system operators at over \$350 mln.

In the first months of the full-scale invasion, the Russian Federation aimed its attacks at oil refineries and depots. As of February 24, 2022, 30 oil depots of various sizes and levels of modernization were damaged or completely destroyed, as well as the fuel stored in them. According to the KSE estimates, the direct damage dealt to these facilities amounts to almost \$260 million. In addition, the Russian Federation has repeatedly carried out missile strikes at the capacities of the only large active oil refineries — Shebelynka (Kharkiv region) and Kremenchuk (Poltava region).

## Communal services and utilities

The communal services and utilities, which is an important part of the life support systems of settlements, has become one of the targets of missile and artillery strikes by the Russian Federation. Constant shelling and hostilities have made it impossible or significantly complicated to carry out repairs, which has led to the long-lasting stop of heat and water supply systems. In some towns, residents do not receive utility services and do not have adequate access to drinking water until now.

For example, due to damage to the water supply system, most districts of Mykolaiv have been without centralised water supply since 12 April, and repairs were impossible due to constant shelling by the Russian Federation. Until the water pipeline could be repaired after the liberation of Kherson, the city has only technical water, and drinking water is still being delivered from other cities through the retail network in bottles. In addition, the housing and utilities sector in cities that have been under heavy artillery shelling suffered a significant level of destruction. The heating and water supply sectors experienced constant interruptions of supply in cities due to forced power outages and a drop in voltage for equipment, which led to the need to install generators and accelerated asset depreciation.

**According to preliminary estimates, as of February 2023, the value of direct damages to heat supply facilities (excluding CHPPs), water supply and sewerage facilities, and household waste management facilities is \$1.4 bn.**

According to preliminary estimates, during the period of the full-scale invasion, **5 combined heat and power plants were completely destroyed** in the areas where hostilities were or still are taking place (Okhtyrka, Sumy region; Kremenchuk, Poltava region; Sievierodonetsk, Luhansk region; Chernihiv and Avdiivka, Donetsk region) and another **8 were damaged**: (Eskhar, Kharkiv region; Sumy; Mykolaiv; Kharkiv (2 CHP plants) and Kyiv (3 CHP plants). For example, the destroyed Kremenchuk CHPP (Poltava region) covered about 70% of the city's needs, which means about 180,000 community residents who may have been left without heat and hot water supply for the entire heating season if repairs had not taken place. The value of direct damage to the CHPPs is included in the "Energy sector" section.

In addition, according to preliminary data from regional military administrations, 472 boiler houses were partially damaged or completely destroyed as a result of the hostilities, most of them located in Kharkiv, Kyiv, Chernihiv, Donetsk and Mykolaiv regions. 122 centralised heating points were partially damaged or completely destroyed, and over 145 kilometres of heating networks were completely destroyed.

According to preliminary estimates, more than 1,046 linear kilometres of water supply networks were destroyed, and 12 water treatment plants were partially damaged or completely destroyed. In addition, 82 water pumping stations were destroyed or damaged. Out of these, 52 were in the Kharkiv region, 13 in the Luhansk region, and 11 in the Donetsk region. In addition, 40 wells have been destroyed or damaged, most of them in the Kharkiv region.

Laboratories that performed analysis of the water supply in the regions were also destroyed or damaged. Thus, preliminary estimates indicate that about 3 such facilities were destroyed or damaged.

According to preliminary estimates, more than 327 linear kilometres of sewerage networks were damaged, and 70 sewage pumping stations were partially damaged or completely destroyed, most of them located in the Kharkiv region. Twenty-four sewage treatment plants were also destroyed or damaged.

According to preliminary estimates, 21 landfills for household waste were destroyed/damaged as a result of Russia's invasion of Ukraine. Also, 3 waste sorting lines and 3 biogas plants were completely destroyed. Waste collection vehicles were also damaged, with more than 200 garbage trucks destroyed.

## FINANCIAL SECTOR

The full-scale war has had a major impact on the financial sector, especially on its main component – banks. They were affected both directly and through problems with their clients' businesses (especially borrowers). The financial sector's direct damages, including damage to real estate, totalled **\$44 mln**.

Initially, banks were forced to reduce the number of branches in areas where there was a threat to staff safety. According to the [Financial Stability Report](#) of December 2022, at the beginning of March, only 21% of branches of systemically important banks were operating in or near the combat zone, compared to 60% in Ukraine as a whole.

However, thanks to the de-occupation of the northern regions, 85% of branches were already operating as of mid-June. After the de-occupation of certain territories in the East and South, banks began to reopen branches there as well. The share of operating branches in Mykolaiv and Kharkiv regions increased from 65% in August to 80% in November. In addition, banks are returning to Kherson.

Bank property has come under fire. According to the NBU's surveys of banks, as of December 2022, the residual value of bank property that was lost, destroyed, or over which control was lost amounted to **\$26 mln** (compared to June, the estimate was reduced due to the liberation of the territories). Approximately half of this is real estate, and the other half is other property (ATMs, furniture, computers, etc.). Financial institutions do not have accurate information about the destruction or loss of the remaining property. It will be possible to estimate the losses definitively only after the war is over or at least after the territories are liberated.

Russians have been robbing banks in the occupied territories. By the beginning of May, the amount of banknotes lost due to robberies or seizures of branches was **UAH 470 mln**. Banks destroyed another **UAH 60 mln** of national currency banknotes and took them to the NBU for further exchange.

## ENVIRONMENT

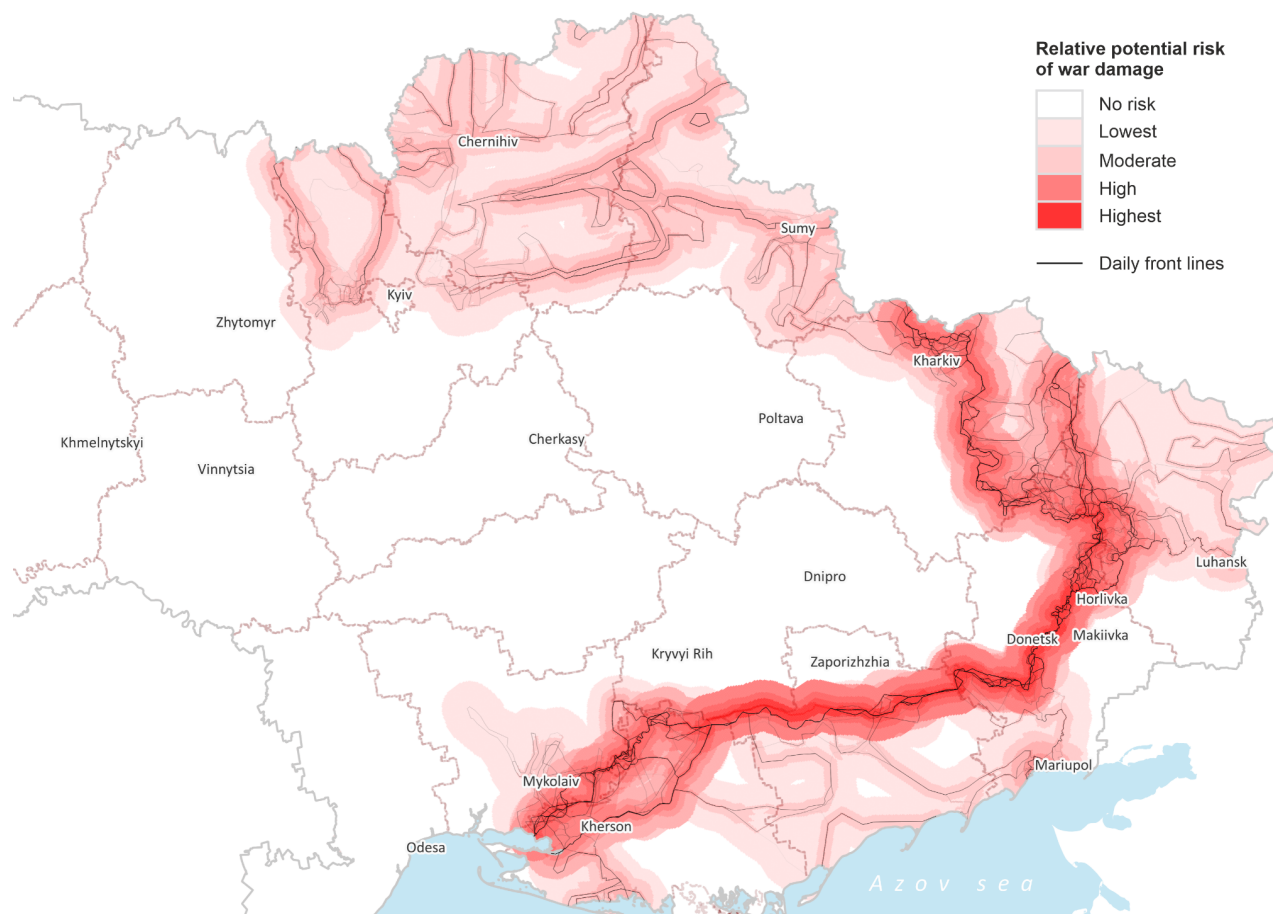
Russia's military aggression has led to a number of dangerous impacts on all environmental components – air, soil and landscapes, surface and groundwater, vegetation, and wildlife.

The main danger to the environment in the context of hostilities is the risk of pollution due to damage to industrial enterprises and infrastructure facilities caused by shell hits or emergency disruption of their operation due to the cessation of electricity, water, gas supply, disruption of technological processes, etc. Hostilities in the industrialised areas of eastern and southern Ukraine pose a particular risk.

Among the many industrial enterprises that were damaged or disrupted as a result of the hostilities were the most environmentally hazardous, such as the Chornobyl, Zaporizhzhia, Khmelnytskyi, Rivne and South Ukrainian NPPs, Kyiv, Dnipro, Kremenchuk, Dniester and Kakhovka HPPs, numerous thermal power plants and combined heat and power plants, chemical and metallurgical enterprises, mines, oil refineries, oil product storage facilities, etc.

During the war, there were numerous cases of infrastructure damage and power outages at coal mining enterprises. This resulted in the shutdown of mine water drainage systems and, in some cases, complete flooding of mines, which inevitably led to surface water pollution, flooding and contamination of surrounding areas and subsidence of the surface.

### Risks of soil damage in combat zones



Source: Kyiv School of Economics, Zoï Environment Network

Since 24 February 2022, there have been repeated disruptions in the operation of hydraulic structures, water supply and sewage systems and facilities, including those accompanied by accidental discharges of pollutants into water bodies.

According to the Ecodozor.org system, as of 1 March 2023, 1220 cases of disruption and damage to at least 629 industrial enterprises and critical infrastructure facilities were recorded due to the hostilities, which could have led to environmental pollution.

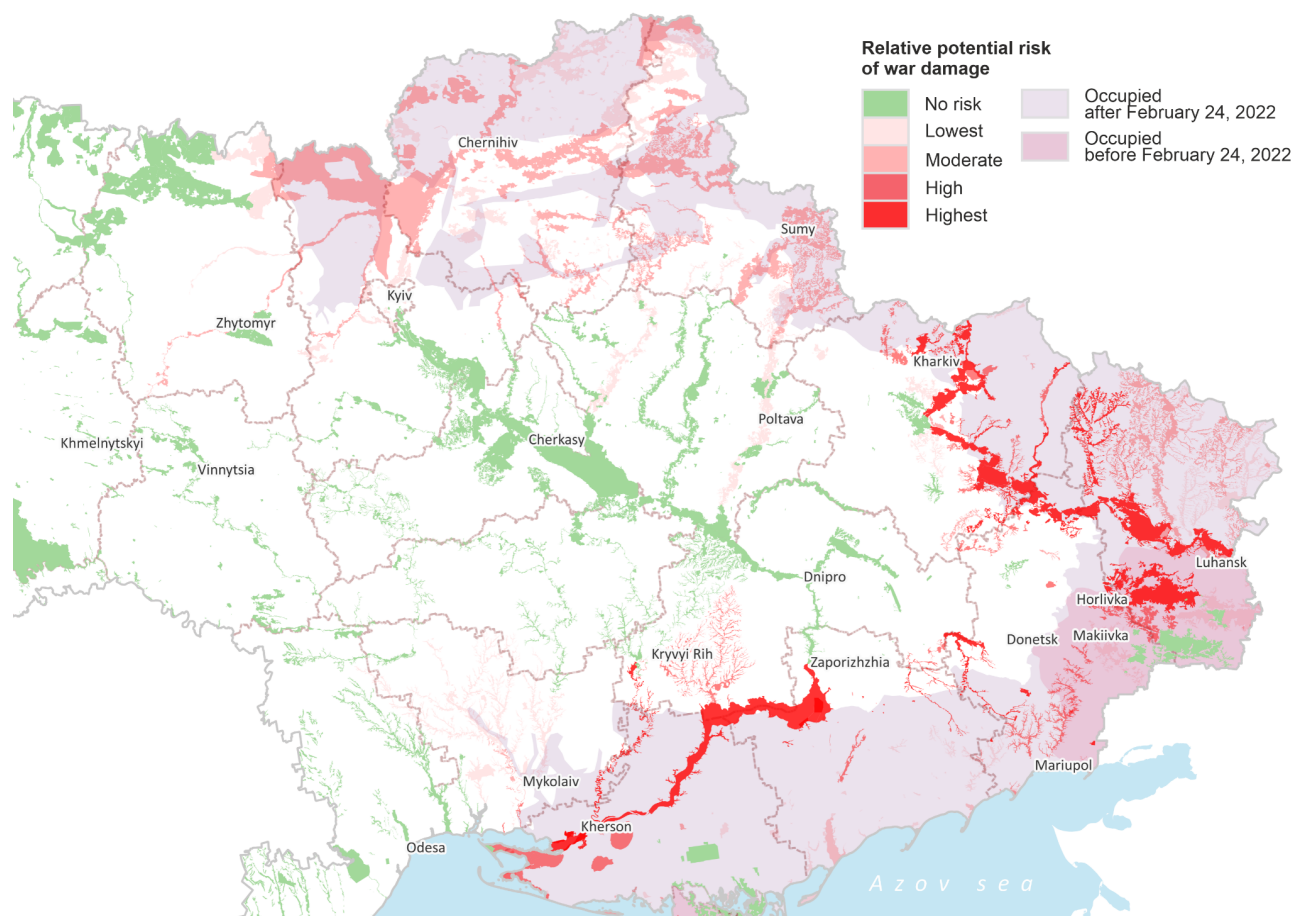
Military operations have complicated solid waste management, especially in settlements along the frontline. In addition to traditional household waste, there are remnants of military equipment, buildings, structures and infrastructure elements, the disposal of which requires additional capacity and is impossible without first demining the territory and clearing it of ammunition.

As a result of military manoeuvres, construction of fortifications, explosions and burning of ammunition, the surface layer of soil is disturbed.

According to the KSE and Zoï Environment Network, 188,000 square kilometres of soil are at risk of damage and contamination. A high risk of damage and contamination is found on 105,000 square kilometres of soil located up to 5 kilometres from the front lines.

The use of land damaged by the hostilities will be complicated by the need for recultivation, demining and the disposal of unexploded ammunition.

### Risks of damage to nature reserves



Source: Kyiv School of Economics, Zoï Environment Network

The hostilities on the territory of Ukraine have led to significant land pollution and damage to the landscapes of the nature reserve fund. Within the combat zone, 393 nature reserves and Emerald Network sites were located, which is more than a third of the total nature reserve fund of Ukraine. 347 sites were under occupation, and 257 sites were located within 5 km of the frontline.

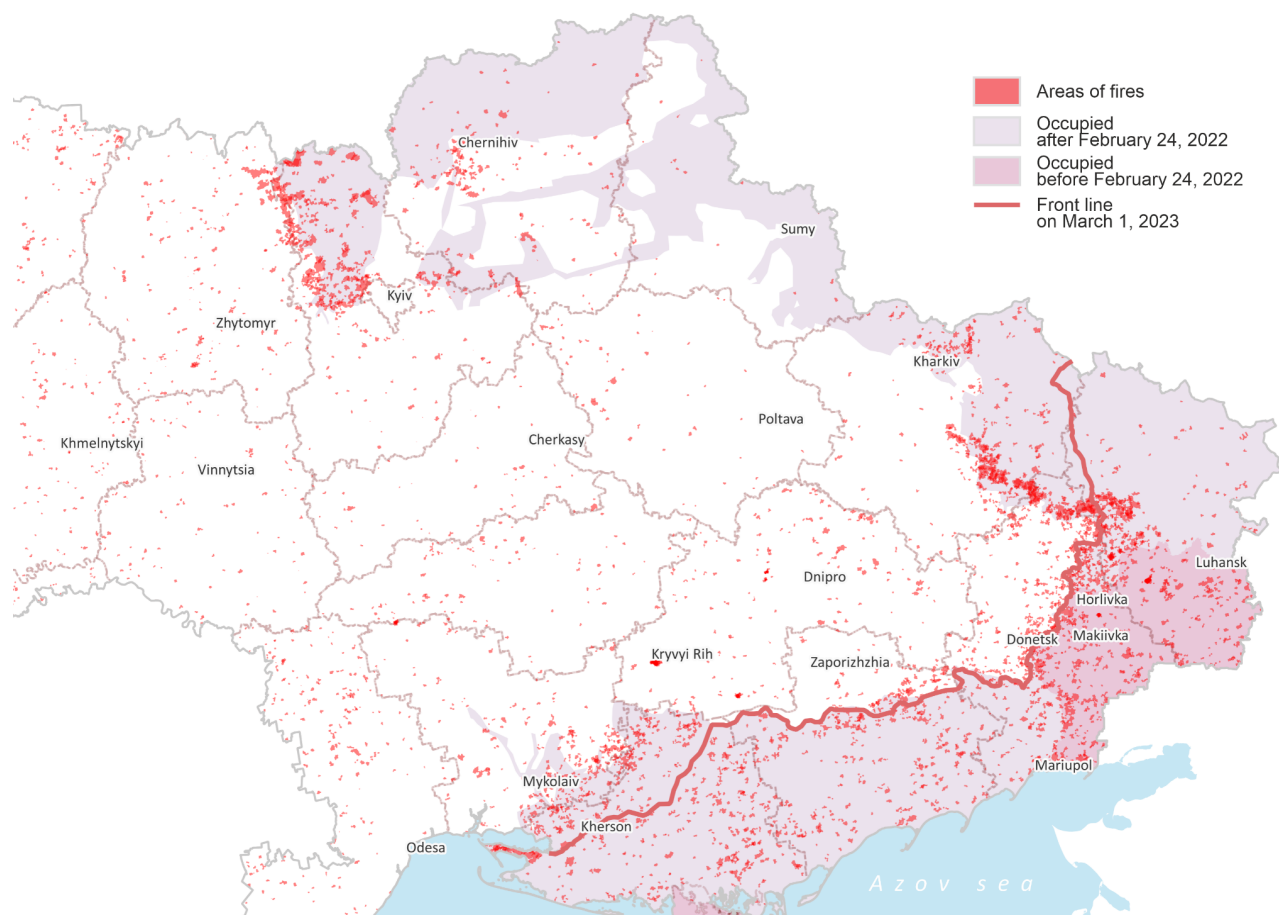
In total, as a result of the aggression, about 46,000 square kilometres of the nature reserve fund and the Emerald Network are at risk of damage and pollution, which is 43% of the total area of these sites in Ukraine.

The disruption of nature reserves also occurs due to the lack of protection and the cessation of funding, which leads to an increase in illegal logging, extraction of minerals, forest and grass fires.

Currently, the KSE and the Zoï Environment Network are developing a methodology for assessing damage to soils, including soils of nature reserves.



## Estimation of forest and grass fires in the combat zone



Source: Kyiv School of Economics, Zoï Environment Network

As a result of the hostilities, forests and forest protection plantations have suffered significant damage. The greatest risks to forest plantations are associated with forest fires caused by ammunition explosions or deliberate arson related to the tactics of warfare. In addition, significant forest areas have suffered from mechanical damage caused by military manoeuvres and ammunition explosions, which leads to the weakening or death of forest plantations.

Since firefighting and forestry activities along the front lines are dangerous until the combat operations are fully stopped and the forests are demined, the decline in forest cover in Ukraine remains a serious problem.

According to Zoï Environment Network, 298,000 hectares of forest and 1,438,000 hectares of grass fires were recorded in the combat zone, which, together with the burning of oil and oil products, caused significant air pollution.

The KSE estimates that 5.5 million tonnes of pollutant emissions have been released into the air due to the hostilities in Ukraine.

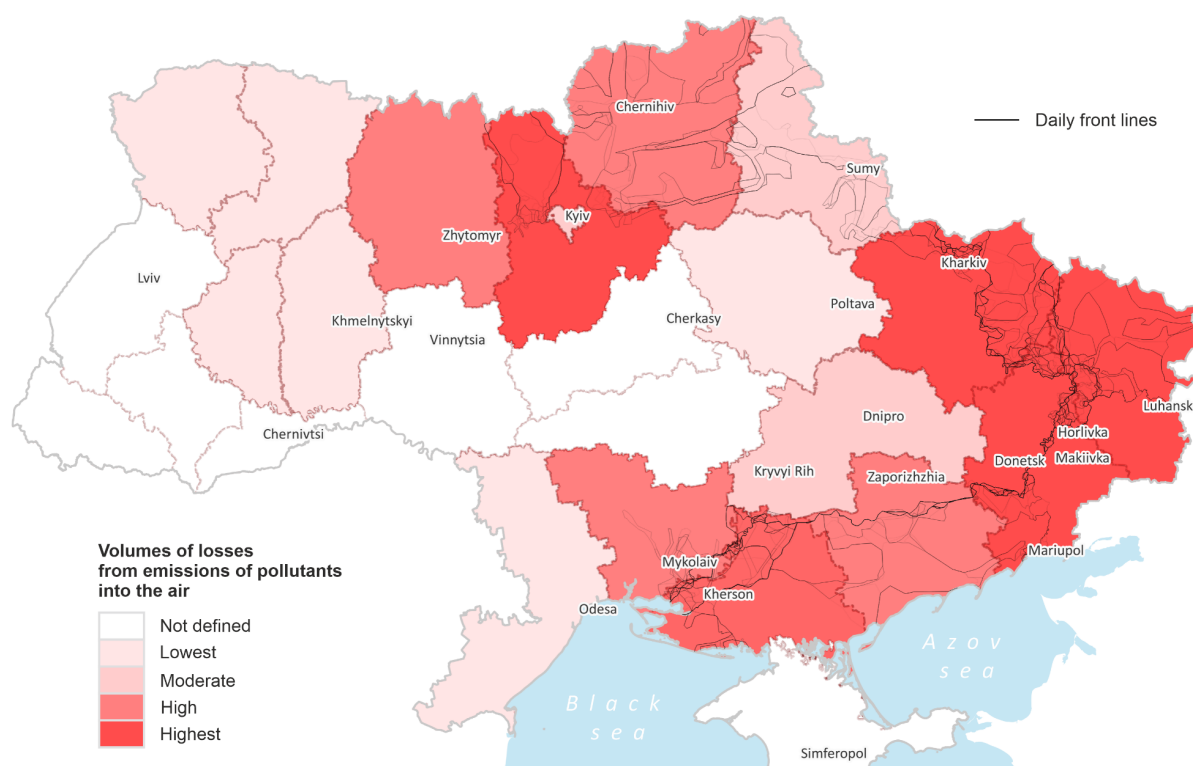
The damage from air pollutant emissions is almost \$25.8 bn, of which \$15 bn is damage from forest fires, \$10 bn is damage from grass fires, and \$752 million is damage from the burning of oil and oil products. In addition, to restore the damaged housing, utilities and transport infrastructure, additional emissions of pollutants into the air will be required in the amount of USD 1.1 bn.

Damage from air emissions should be compensated in amounts that will allow for equivalent environmental clean-up measures, as well as measures to prevent and adapt to climate change.

## Emissions of pollutants into the atmosphere

Pollutants	Emissions, t	Damage, mln USD
Nitrogen oxides	76857	2651,07
Carbon monoxide	2145133	1849,76
Non-methane volatile organic compounds	197765	255,73
Sulphur oxides	16168	559,37
Dust	1391182	1799,09
Substances in the form of suspended solid particles larger than 2.5 microns and smaller than 10 microns	900197	1164,15
Substances in the form of suspended solid particles 2.5 microns and less	736535	16855,06
Lead	0,470	1,409
Cadmium	0,020	0,011
Mercury	2,347	7,044
Arsenic	0,047	0,004
Chromium	7,824	14,87
Copper	5,165	0,479
Nickel	0,203	0,465
Selenium	0,047	0,023
Zinc	16,43	0,170
Polychlorinated dibenzo-para-dioxins and dibenzofurans	4,872	439,84
Benz(a)pyrene	2,126	191,77
<b>Total</b>	<b>5 463 879</b>	<b>25 790</b>

## The amount of damage from pollutant emissions into the air, caused by military operations



Source: Kyiv School of Economics, Zoï Environment Network

The outbreak of the war has virtually paralysed many aspects of environmental protection activities. The destruction of the environmental protection system in the combat zones has led to the loss of information on the state of the environment, and in some areas, there is no environmental monitoring, no provision of ecosystem services and no measures to improve the environment, reduce greenhouse gas emissions and adapt to climate change.

In order to reduce the negative environmental impact of hostilities, immediate measures should be taken to protect and restore ecosystems in the affected areas. Such measures may include land recultivation, reforestation, water purification, ammunition and mine clearance, and measures to prevent further pollution. It is important to maintain the attention of the international community and society to the problem of the environmental consequences of the war in Ukraine and to take all possible efforts to eliminate them.

## **DEMINING**

Since the beginning of the war, about 270,000 km<sup>2</sup> of Ukraine's territory has been affected by the war, either through direct hostilities, mining of combat areas, or as a result of artillery shelling, strategic aviation, etc. The mines, other explosive ordnance (EO), and their remnants pose a direct threat to the lives and health of Ukrainian citizens, and impede normal economic activity in the affected areas.

The State Emergency Service of Ukraine (SES) estimates that around 185,000 km<sup>2</sup>, or approximately 30% of Ukraine's territory, could potentially be contaminated with EOs and needs to be surveyed for mines and cleared. Since the beginning of the war, the SES has surveyed and cleared 704 km<sup>2</sup>, mostly in Kyiv and Chernihiv oblasts, which have been de-occupied since April 2022, and has cleared around 200,000 EOs. Based on the current results of mine action, the density of cleared EOs is 284 explosive hazards per 1 km<sup>2</sup> of cleared territory, and may be significantly higher in areas of prolonged and active hostilities.



## ANNEXES

### Annex 1.

#### Assessment of direct damage to housing stock caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Destroyed				
Multi-apartment buildings	pc.	178 921	6 016	28,494
Private houses	pc.	8 984 976	66 618	4,692
Dormitories	pc.	7 114	79	0,195
Damaged				
Multi-apartment buildings	pc.	178 921	11 535	17,919
Private houses	pc.	8 984 976	69 391	2,133
Dormitories	pc.	7 114	223	0,183
<b>Total direct damage to infrastructure</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>53,62</b>

Source: State Statistics Service of Ukraine, Ministry of Communities and Territories Development of Ukraine, Order of the Ministry of Communities and Territories Development of Ukraine No. 53 of 17.02.2022, data from regional military administrations, official NBU exchange rates, market data; calculations of the Ministry of Communities and Territories Development of Ukraine together with KSE

## Annex 2.

### Assessment of direct damage to the healthcare sector caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Destructed				
Hospitals	pc.	1135	71	0,97
Polyclinics and regional centres for disease control and prevention	pc.	1131*	13	0,04
Outpatient clinics	pc.	1131*	113	0,06
Blood centres	pc.	28	2	0,01
Other (medical offices, laboratories, medical warehouses, dormitories, forensic bureaus)	pc.		115	0,09
Damaged				
Hospitals	pc.	1135	291	0,46
Polyclinics and regional centres for disease control and prevention	pc.	1138*	60	0,04
Outpatient clinics	pc.	1138*	317	0,04
Blood centres	pc.	28	6	0,00
Other (medical offices, laboratories, medical warehouses, dormitories, forensic bureaus)	pc.		228	0,08
<b>Total direct damage to infrastructure</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>1,8</b>

Source: Data on the number of damaged public healthcare facilities - MoH; Data on the number of damaged private healthcare facilities - public sources; Data on the cost of replacing one healthcare facility are calculated using several methods: (1) For facilities for which the number of square metres and/or beds is known, the data of the Ministry of Communities and Territories Development of Ukraine on the average cost of construction of 1 square metre of healthcare facilities are used; (2) For facilities for which the number of square metres and/or beds is unknown, the results of tenders in the Prozorro system on the cost of ordering the construction of similar healthcare facilities in 2020-2021 are used

\* outpatient clinics and polyclinics in total

### Annex 3.

#### Assessment of direct damage to the social care sector caused by the war

Damages types	Unit of quantity	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>			
Destructed			
Orphanages	pc.	6	0,003
Boarding schools	pc.	31	0,055
Facilities for the elderly	pc.	14	0,009
Social centres	pc.	43	0,025
Health resorts	pc.	46	0,079
Children's camps	pc.	13	0,016
Institutions for the homeless	pc.	1	0,0001
<b>Total direct damage to infrastructure</b>	<b>x</b>	<b>x</b>	<b>0,2</b>

Source: number and cost of damaged objects – Ministry of Communities and Territories Development; amount of additional expenditures for social protection - Ministry of Social Policy; KSE calculations

\* Number of damaged objects and their estimated cost according to the Ministry of Community and Territorial Development

## Annex 4.

### Assessment of direct damage to education and science caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Destructed				
Secondary education institutions	pc.	13991	434	1,687
Pre-school education facilities	pc.	15335	230	0,495
Vocational education institutions	pc.		23	0,246
Higher education institutions	pc.	515	204	2,369
Institutions of professional pre-higher education	pc.	129	2	0,011
Out-of-school education facilities	pc.		10	0,051
Specialised education institutions	pc.		12	0,055
Damaged				
Secondary education institutions	pc.	13991	1063	1,654
Pre-school education facilities	pc.	15335	679	0,583
Vocational education institutions	pc.		39	0,169
Higher education institutions	pc.	515	324	1,503
Institutions of professional pre-higher education	pc.	129	16	0,029
Out-of-school education facilities	pc.		16	0,033
Specialised education institutions	pc.		28	0,051
Scientific institutions	pc.	213*	90**	0,008
<b>Total direct damage to infrastructure</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>8,94</b>

Source: Ministry of Education and Science; Ministry of Regional Development; National Academy of Sciences; KSE calculations

\* the number according to the State Register of Scientific Institutions supported by the state; the list is not exhaustive. <http://rnib.rit.org.ua/rni?page=4>

\*\* currently includes an assessment of damaged NAS institutions only; the assessment of damages to other scientific institutions will be carried out at the following stages

## Annex 5.

### Assessment of direct damage to culture, sports and tourism caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Destructed				
Religious institutions	pc.	n/a	58	0,1
Sports culture	pc.	16199	59	0,2
Cultural sphere	pc.	34340	214	1,0
Tourism sector	pc.	n/a	50	0,0
Damaged				
Religious institutions	pc.	n/a	290	0,0
Sports culture	pc.	16199	284	0,3
Cultural sphere	pc.	34340	1586	0,4
Tourism sector	pc.	n/a	114	0,1
<b>Total direct damage to infrastructure</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>2,2</b>

Source: Data of the Ministry of Regional Development on the number and value of damaged objects, data of the State Statistics Service on the initial number of objects; other – KSE calculations

## Annex 6.

### Largest affected industrial assets (according to available information on damaged assets)

No.	Company	Branch	Status	Estimated damages, bn USD
1	Illich Iron and Steel Works	Metallurgy	Destructed	2 385
2	Azovstal	Metallurgy	Destructed	1 777
3	Motor Sich	Mechanical engineering	Damaged	450
4	Ukrtatnafta	Oil refining	Destructed	405
5	Zorya - Mashproekt	Mechanical engineering	Destructed	264
6	Ukrainian Energy Machines	Mechanical engineering	Damaged	181
7	Avdiivka Coke Plant	Coke and Chemicals	Damaged	166
8	Philip Morris Ukraine	Production of cigarettes	Destructed	154
9	Antonov	Aircraft construction	Damaged	151
10	Lysychansk Oil Investments Company	Oil refining	Destructed	126
11	Organic systems	Food industry	Destructed	121
12	Novokramatorskyi Machine-Building Plant	Mechanical engineering	Damaged	113
13	Rubizhne Cardboard and Packaging Plant	Paper production		98
14	Mykolaiv Alumina Plant	Metallurgy	Damaged	97
15	Dneprospetsstal	Metallurgy	Damaged	87
16	Sandora	Food industry	Damaged	82
17	Energomashspetsstal	Mechanical engineering	Damaged	78
18	Odesa Port Plant	Chemical industry	Damaged	77
19	Coca-Cola Beverages Ukraine	Food industry	Damaged	75
20	Odesa Oil Refinery	Oil refining	Damaged	74
21	Severodonetsk Azot Association	Chemical industry	Damaged	70
22	Zaporizhzhia Iron Ore Plant	Ore mining	Inventory only	51

No.	Company	Branch	Status	Estimated damages, bn USD
23	Altcom road construction	Construction	Damaged	55
24	Farmak (product warehouse)	Pharmaceuticals	Damaged	54
25	Kub-Gaz	Gas production	Destructed	50

Source: KSE calculations, reports on the destruction of individual facilities, open data

## Annex 7.

### Assessment of direct damage to the industrial sector caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Destructed				
Large and medium-sized private enterprises	pc.	5270	14	5,4
Small private enterprises and individual entrepreneurs	pc.	78060	n/a	2,2
State-owned enterprises	pc.	1665	18	0,3
Damaged				
Large and medium-sized private enterprises	pc.	5270	64	2,0
Small private enterprises and individual entrepreneurs	pc.	78060	n/a	0,8
State-owned enterprises	pc.	1665	330	0,6
<b>Total direct damage to infrastructure</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>11,3</b>

Sources: reports on the destruction of individual objects, municipalities (level of destruction in cities), State Statistics Service; KSE calculations

## Annex 8.

### Assessment of direct damage to retail trade caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
<b>Destructed</b>				<b>1,8</b>
Retail trade facilities	pc.	40277	n/a	1,5
Shopping centres	pc.	329	8	0,3
<b>Damaged</b>				<b>0,8</b>
Retail trade facilities	pc.	40277	n/a	0,7
Shopping centres	pc.	329	18	0,1
<b>Total direct damage to branch</b>				<b>2,59</b>

Source: State Statistics Service, Ukrainian Council of Shopping Centers, Retail Association of Ukraine



## Annex 9.

### Assessment of direct damage to the agro-industrial complex and land resources caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Destructed				
Agricultural machinery	pc.	764323	109601	4,3
Grain storage facilities	capacity, ths t	75084	8198	1,2
Dead animals (including poultry)	ths heads	203292	2230	0,1
Destroyed apiaries	bee colonies	2272740	86902	0,0
Perennial crops	ha	197100	20104	0,5
Destroyed and stolen inputs	t	962951	135993	0,1
Destroyed and stolen finished agricultural products	t	25486613	4037542	1,9
Damaged				
Slaughter of animals due to the impossibility of keeping them	ths heads	203292	14072	0,1
Dead and missing bees	bee colonies	2272740	192526	0,0
Agricultural machinery	pc.	764323	50749	0,4
Grain storage facilities	capacity, ths. t	75084	3249	0,1
<b>Total direct damage to infrastructure</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>8,7</b>

Source: KSE Agrocentre (Centre for Food and Land Use Research) calculations

## Annex 10.

### Assessment of direct damage to the transport sector caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Damaged/destroyed				
trolleybuses*	pc.	2980	344	0,03
Trams*	pc.	1922	152	0,2
buses	pc.	241426	13 812	0,6
passenger cars **	mln pcs	10,10	207 457	1,86
fire trucks	pc.	4216	1 629	0,09
Mriya aircraft	pc.	1	1	0,3
<b>Total direct damage to infrastructure***</b>	<b>x</b>	<b>x</b>	<b>223 395</b>	<b>3,10</b>

Source:

Number of cars registered in Ukraine [https://dostup.pravda.com.ua/request/statistika\\_kilkosti\\_zarieiestrov](https://dostup.pravda.com.ua/request/statistika_kilkosti_zarieiestrov):

Data on losses of public transport – for four regions (Kharkiv, Donetsk, Luhansk, Dnipro) - information from civil-military administrations; for other regions – KSE assumptions

data on trolleybus and tram fleets:

[http://www.ukrstat.gov.ua/druk/publicat/kat\\_u/2021/zb/10/zb\\_Transpot.pdf](http://www.ukrstat.gov.ua/druk/publicat/kat_u/2021/zb/10/zb_Transpot.pdf)

data on the bus fleet: [https://dostup.pravda.com.ua/request/statistika\\_kilkosti\\_zarieiestrov](https://dostup.pravda.com.ua/request/statistika_kilkosti_zarieiestrov)

Data on the cost of restoring the Mriya aircraft - Ukroboronprom

\*\* only officially registered private cars are included, excluding cars imported without customs clearance into the territory of Ukraine

\*\*\* at the current stage, the following are not taken into account: (1) loss of trucks; (2) loss of other vehicles, including those owned by the authorities; (3) loss of aircraft (except for the Mriya aircraft, the loss of which is publicly available)

The assumption for the calculation is that the average replacement cost of one unit of public transport is 1/3 of the replacement cost (the cost of purchasing similar objects at ProZorro tenders in 2021, at the exchange rate at the end of 2021). For buses: we take the average between the cost of a bus and a minibus, as the exact structure of the bus fleet (distribution between large and minibuses) is not known.

## Annex 11.

### Assessment of direct damage to infrastructure caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Destructed				
Airports	pc.	34	9	1,5
Property of postal operators	x	x	x	0,002
Damaged				
Motorways of national importance	km	47 ths. km	8 746	9,3
Roads of local importance	km	120 ths. km	8 595	9,1
Municipal roads (cities and other settlements)	km	270 ths. km	7 717	8,2
Bridges and bridge crossings	pc.	11 076	344	2,6
Assets of Ukrzaliznytsia	other	n/a	-	4,3
Infrastructure of seaports and inland waterway transport (ports; berths; warehouses; terminals; movable property)	other	n/a	-	0,5
Airports	pc.	34	9	0,3
Air bases	pc.	1	1	0,04
UKSATSE	pc.	n/a	1	0,2
Property of postal operators	x	x	x	0,01
<b>Total direct damage to infrastructure</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>36,2</b>

Source: Public road system - KSE calculations; Rail transport - Ukrzaliznytsia data and calculations, KSE calculations; Aviation industry - official statistics, public data, KSE calculations; Seaport and inland waterway transport infrastructure - MIU data; Postal operators - Nova Poshta, Ukrposhta; KSE calculations.

## Annex 12.

### Assessment of direct damage to digital infrastructure caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
<b>Direct damages</b>				
Destructed				
Fixed line operators	pc.	4162	726	0,3
Mobile operators	x	x	x	0,2
<b>Total direct damage to branch</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>0,6</b>

Source: Ministry of Digital Transformation, National Commission for the State Regulation of Communications and Informatisation, telecoms operators

## Annex 13.

### Assessment of direct damage to banks caused by the war

Damages types	Estimated damages, bn USD
<b>Direct damages</b>	
Destroyed/ Damaged*	
Property of banks	0,026
Cash in bank branches	0,018
<b>Total direct damage to assets</b>	<b>0,044</b>

Source: National Bank of Ukraine; Financial Stability Report, December 2022  
[https://bank.gov.ua/admin\\_uploads/article/FSR\\_2022-H2.pdf?v=4](https://bank.gov.ua/admin_uploads/article/FSR_2022-H2.pdf?v=4)

\* At the current stage, the section includes only data on bank losses; it does not include direct losses and indirect losses of other financial institutions

## Annex 14.

### Assessment of direct damage to the housing and utilities sector caused by the war

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
District heating objects destroyed and damaged				
Boiler houses	pc.	19 025	472	0,083
Heating networks	lin. m	18 987 083	145337	0,238
Central heating points	pc.	5 523	122	0,009
Water supply and sanitation destroyed				
Water treatment plants	pc.	400	9	0,019
Sewage treatment plants	pc.	967	17	0,055
Water supply pumping stations	pc.	5 646	82	0,063
Sewage pumping stations	pc.	2 908	52	0,065
Water supply networks	lin. m	98 076 470	1 046 278	0,288
Sewerage networks	lin. m	37 053 200	327 446	0,42
Boreholes	pc.	22 134	33	0,0014
Laboratories	pc.	н.д.	2	0,0004
Clean water tanks	pc.	2 129	20	0,013
Water towers	pc.	6 947	24	0,0044
The circulation of household waste has been destroyed				
Containers for household waste collection	pc.	н.д.	18 344	0,011
Garbage trucks	pc.	3 669	206	0,042
Landfills for household waste disposal	pc.	5 969	11	0,033
Waste sorting lines	pc.	34	3	0,004
Container sites	pc.	н.д.	309	0,0003
Biogas plants	pc.	18	3	0,005
The circulation of household waste has been damaged				
Containers for household waste collection	pc.	н.д.	0	0
Garbage trucks	pc.	3 669	0	0
Landfills for household waste disposal	pc.	5 969	10	0,0121
Waste sorting lines	pc.	34	0	0
Container platforms	pc.	н.д.	151	0,0001
Biogas plants	pc.	18	0	0
Water supply and sanitation damaged				
Water treatment plants	pc.	400	3	0,003
Sewage treatment plants	pc.	967	7	0,009
Water supply pumping stations	pc.	5 646	0	0
Sewage pumping stations	pc.	2 908	18	0,009
Water supply networks	lin. m	98 076 470	-	0
Sewerage networks	lin. m	37 053 200	-	0
Wells	pc.	22 134	7	0,00019
Laboratories	pc.	н.д.	1	0,0001

Damages types	Unit of quantity	Initial number of facilities	Number of damaged facilities	Estimated damages, bn USD
Clean water tanks	pc.	2 129	2	0,001
Water towers	pc.	6 947	5	0,0004
<b>Total direct damage to infrastructure</b>				<b>1,39</b>

Source: State Statistics Service of Ukraine, Ministry of Communities and Territories Development of Ukraine, regional military administrations, official NBU exchange rates, market data, expert assumptions, etc.



## Annex 15.

### Assessment of direct damage to the energy sector caused by the war

Subsector	Estimated damage, bn USD
<b>Direct damages</b>	
Power sector, including:	6,49
Electricity generation, including:	4,14
Coal power plants	2,33
Combined heat and power plants	0,28
Nuclear power plants	0,84
Renewable energy	0,69
Electricity transmission	2,00
Electricity distribution	0,35
Oil and gas sector, including:	1,19
Gas transmission	0,78
Gas distribution	0,15
Storage of oil and oil products	0,26
Coal mining industry	0,41
<b>Total direct damage to infrastructure</b>	<b>8,1</b>

Source: data from the Ministry of Energy of Ukraine, data from regional military administrations, official NBU exchange rates, market data, expert assumptions, etc.