FACTSHEET

# Ukraine's Cold Spot Risk Assessment 2024/2025

June 2024 | Ukraine

## Key findings

- **The Cold Spot Index (CSI) for winter 2024/25 identified Kharkivskyi, Bohodukhivskyi and Chuhuivskyi (Kharkivska oblast) and Sumskyi (Sumska oblast) as the raions with the highest winter-related risks** due to a combination of severe winter conditions, high levels of vulnerability (significant presence of internally displaced persons (IDPs) and elderly populations), and significant conflict-related damage, including to energy infrastructure.
- **Conflict-related damage has significantly impacted Ukraine's energy infrastructure**, exacerbating the vulnerability of populations to winter conditions through frequent power outages disrupting essential services like heating and water supply. **The winterization response should remain flexible and adaptable** to address potential further deterioration of the energy infrastructure in response to emerging localized challenges.

## Introduction

Ukraine's continental climate means it experiences significant variation in annual temperature, with warm to hot summers and cold winters. With a duration of approximately six months (October to March), Ukraine's winter average temperature ranges between -4.8 to 2 °C and regularly drops to -20 °C.[1] Every oblast (region) in Ukraine is prone to experiencing days with temperatures below -10 °C, resulting in a nationwide exposure to severe cold temperatures.[2] Exposure to severe cold weather increases the risk of mortality by exacerbating chronic conditions like heart disease, strokes, and respiratory illnesses. It may also result in cold-related injuries, hypothermia, and frostbite.[3]

Traditionally, and especially in urban areas, Ukrainians have coped with severe cold weather by relying on central power plants for house heating and hot water.[4] Since the beginning of the full-scale invasion by the Russian Federation in 2022, the energy sector has sustained significant war-related damage due to targeted long-range aerial strikes, resulting in 10.6 USD billion in damages for the energy sector, and 2.1 USD billion for the district heating sector by December 2023.[5] Energy companies have also experienced cyberattacks.[6] Additionally, during the first five months of 2024, 172 attacks to power infrastructure have been reported in the areas controlled by the Government of Ukraine (GoU),[7] and it is expected that attacks will continue throughout the year, adding to cumulative damage and complicating efforts to rapidly repair infrastructure.[8]

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Such impacts on Ukraine's energy sector have resulted in frequent power outages, leaving millions of people without electricity, in turn disrupting water supply and heating systems. This is of particular concern as temperatures fall below freezing across much of the country during the winter season.[9]

With this assessment, **REACH aims to support winterization response planning by identifying "cold spots", areas where winter-related hazards intersect with socio-economic vulnerabilities and lack of coping capacities (LOCC)**, with a focus on damaged energy infrastructure.[10] Based on the INFORM methodology,[11] this assessment incorporates dimensions of hazards, exposure, susceptibility, and LOCC to support high-level prioritization of the winterization response towards effective allocation of winterization resources. The findings from this assessment can be integrated with data from other sources to validate and enhance the accuracy of winterization strategies, ensuring a coordinated and comprehensive response to the winter-related challenges across different regions. REACH might update this analysis closer to the winter to address emerging challenges and evolving conditions, particularly further deterioration of energy infrastructure.

**Lessons learned in the coordination of previous winter response**
Lessons learned from the 2023-2024 response[12] emphasize the need for early implementation to ensure timely delivery of assistance, a focus on the most vulnerable populations, and the adaptation of strategies to evolving conditions, such as energy infrastructure damage and logistical challenges. The Cold Spot Risk Assessment for 2024/2025 integrates these lessons by identifying regions with the highest winter hazards, socio-economic vulnerabilities, and lack of coping capacities, thereby supporting targeted and effective allocation of resources.

## Ukraine's Cold Spot Index (CSI) for winter 2024/25

The Cold Spot Index (CSI) is a tool which supports the identification of areas most at risk during winter by combining several key dimensions to assess vulnerability and capacity to cope with winter conditions (see Annex A for the methodology description). The CSI includes:

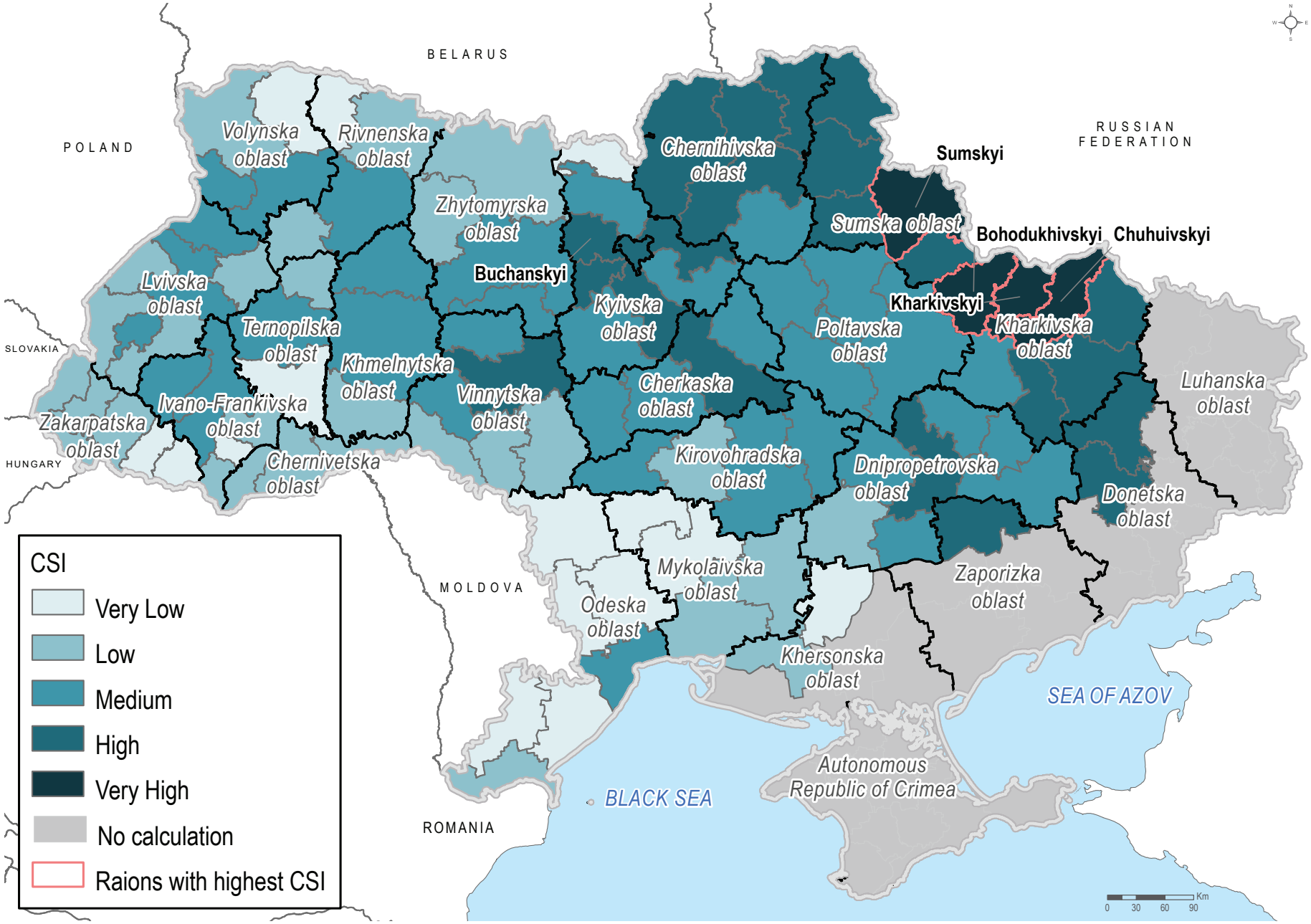
- **Hazard:** This dimension assesses the severity and frequency of winter-related hazards, such as cold waves, frost days, and snowfall. Historical data on these factors are analyzed to determine the likelihood and intensity of winter hazards in different regions.
- **Exposure:** This dimension examines the population density as of August 2023[13] to determine how many people are at risk in each region. Higher population density indicates more people potentially affected by winter hazards.
- **Susceptibility:** This dimension evaluates the inherent vulnerabilities of the population, including the percentage of the elderly population as of August 2023,[14] the percentage of internally displaced persons (IDPs) per raion as of March 2024,[15] and the number of people living in active collective sites as of May 2024.[16] These factors contribute to understanding how vulnerable the population is to winter conditions.
- **Lack of Coping Capacity (LOCC):** This dimension assesses the ability to respond to and recover from winter-related hazards, with a focus on cumulative damage to power and electricity infrastructure from October 2023 to May 2024,[17] conflict incidents density per 100 sq km from May 1 2023 to May 9 2024,[18] and the level of power outages from March to May 2024.[19] These indicators highlight the infrastructural challenges and capacity limitations that exacerbate vulnerability.

## Findings

**Kharkivska and Sumska oblasts in northeast Ukraine are identified as having the highest calculated Cold Spot Index (CSI)** due to a combination of harsh winter conditions, high population density, socio-economic vulnerabilities, and significant conflict-related damage. The raions of **Kharkivskyi**, **Bohodukhivskyi, Chuhuivskyi** (Kharkivska oblast) and **Sumskyi** (Sumska oblast) exhibit very high CSI levels, as highlighted in Map 1 (see Annex B for the list of raions CSI levels). These regions face severe winter conditions and medium to high levels of susceptibility due to the presence of IDPs, elderly populations, and people living in collective sites. Additionally, Kharkivskyi is the raion with the second highest population density in Ukraine, resulting in very high exposure levels.

Proximity to the front line or the Russian border has resulted in these raions experiencing substantial conflict-related damage in 2024, further exacerbating their vulnerabilities. This has led to a high to very high LOCC, making it challenging for local populations to manage and recover from winter hazards.

These findings suggest a need to prioritize these high-risk areas in the winterization response, with a focus on activities that enable the continuity of essential services such as heating and water supply. Flexible and adaptive strategies will be necessary to address potential further deterioration of energy infrastructure and to respond to emerging localized challenges.

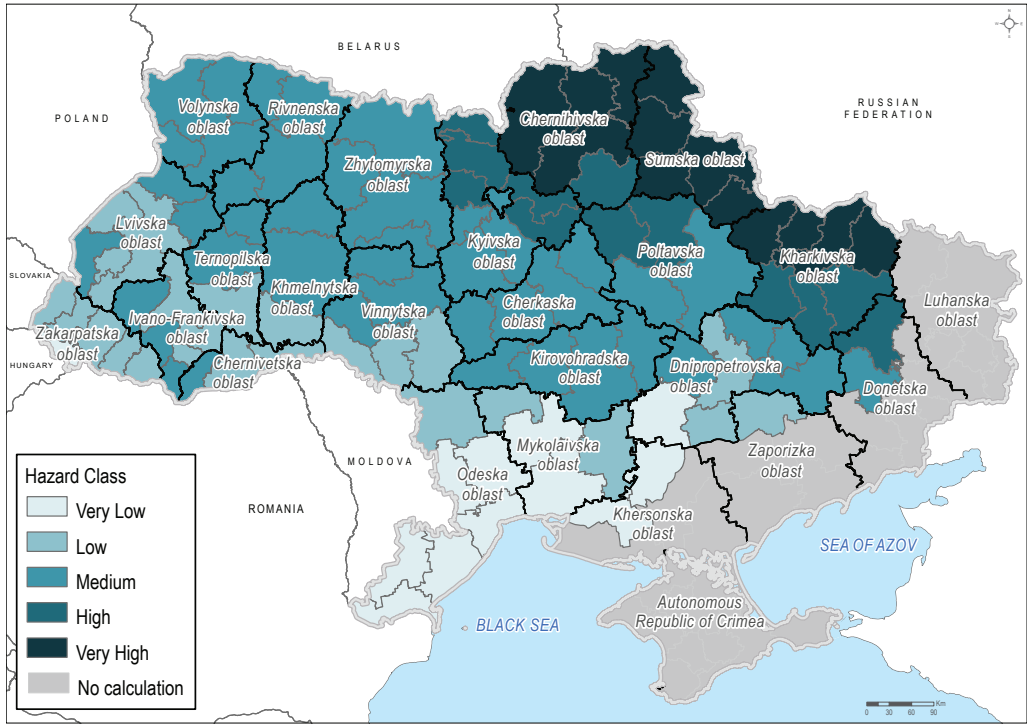



Map 1. Cold Spot Risk Index (CSI) highlighting the raions with the highest level.

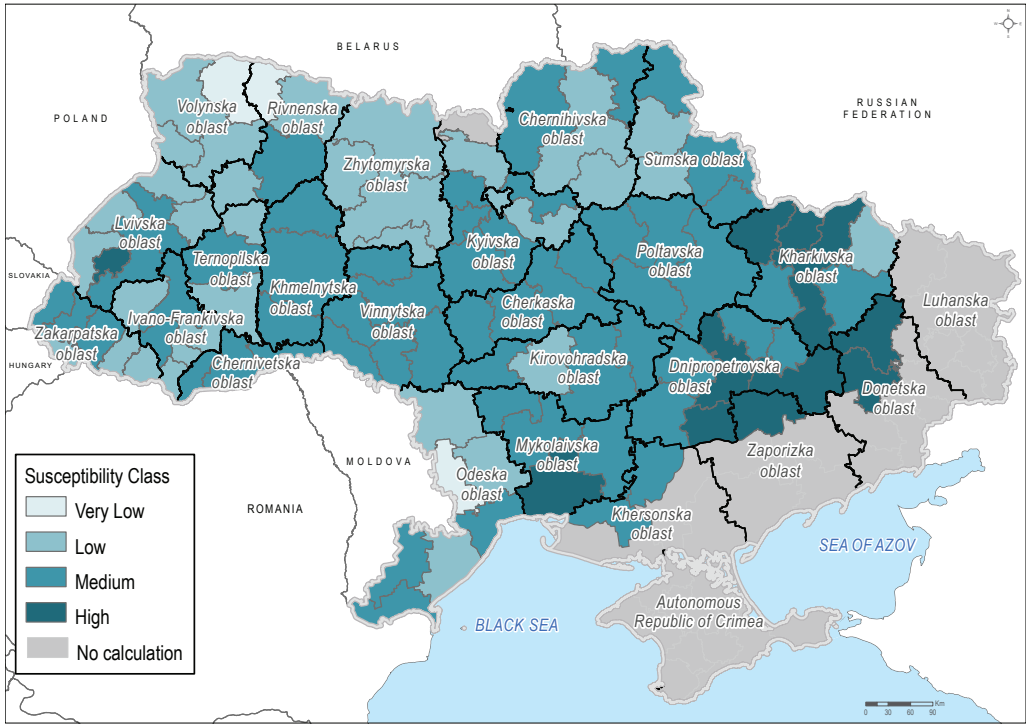
## Hazard, susceptibility and LOCC

The northeastern regions, including Chernihivska, Sumska, Kharkivska and Donetska oblasts, face the highest winter hazards due to their proximity to colder air masses. Central regions like Poltavska and Kyivska also exhibit high hazard levels. Western areas such as Zakarpatska, Lvivska, and Ivano-Frankivska experience lower hazards, moderated by the Carpathian Mountains, while southern regions like Odeska and Mykolaivska have very low risk due to the Black Sea's influence.

The "Susceptibility Class" illustrates varying levels of vulnerability to winter conditions across Ukraine's oblasts. High susceptibility areas, such as Kharkivska, Dnipropetrovska, Donetska, Zaporizka, and Mykolaivska oblasts, face significant socio-economic vulnerabilities, including a high presence of IDPs, elderly populations, and people living in collective sites, which heighten their risk during winter.



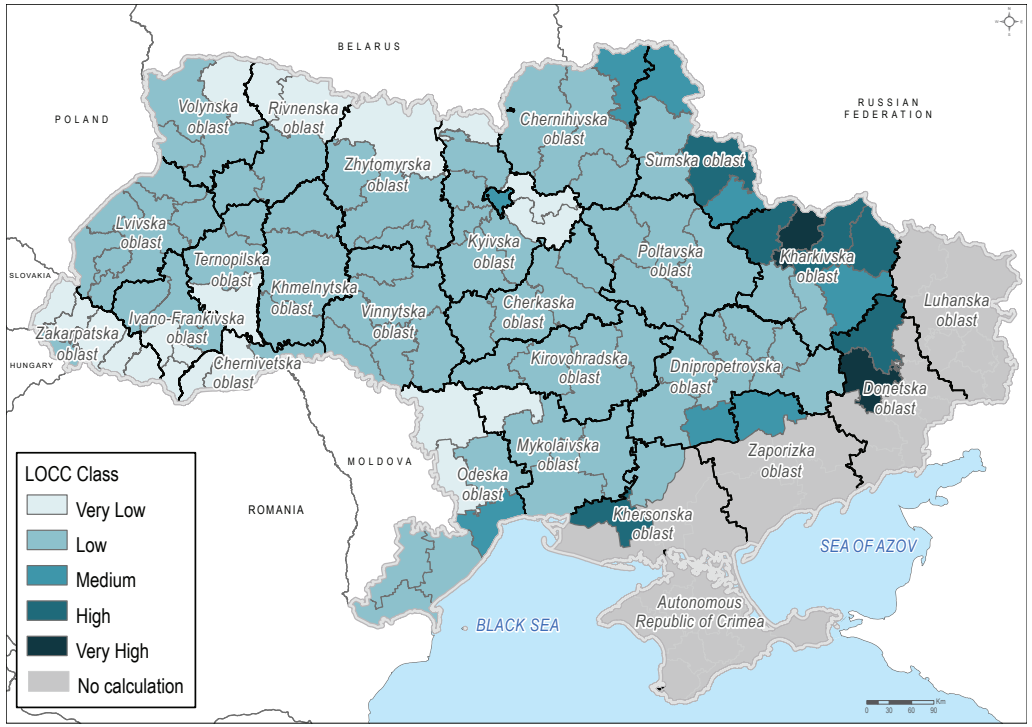

Map 2. Winter-related hazards level across Ukraine per raion.




Map 3. Level of susceptibility to winter conditions across Ukraine per raion.

The "Lack of Coping Capacities Class" Map illustrates varying levels of LOCC across Ukraine's oblasts, highlighting the regions' ability to respond to and recover from winter hazards. High LOCC areas, such as Kharkivska, Donetska, and Khersonska oblasts, face significant challenges due to cumulative damage to power and electricity infrastructure, high density of conflict incidents, and frequent power outages, all of which severely limit their capacity to cope with winter conditions.

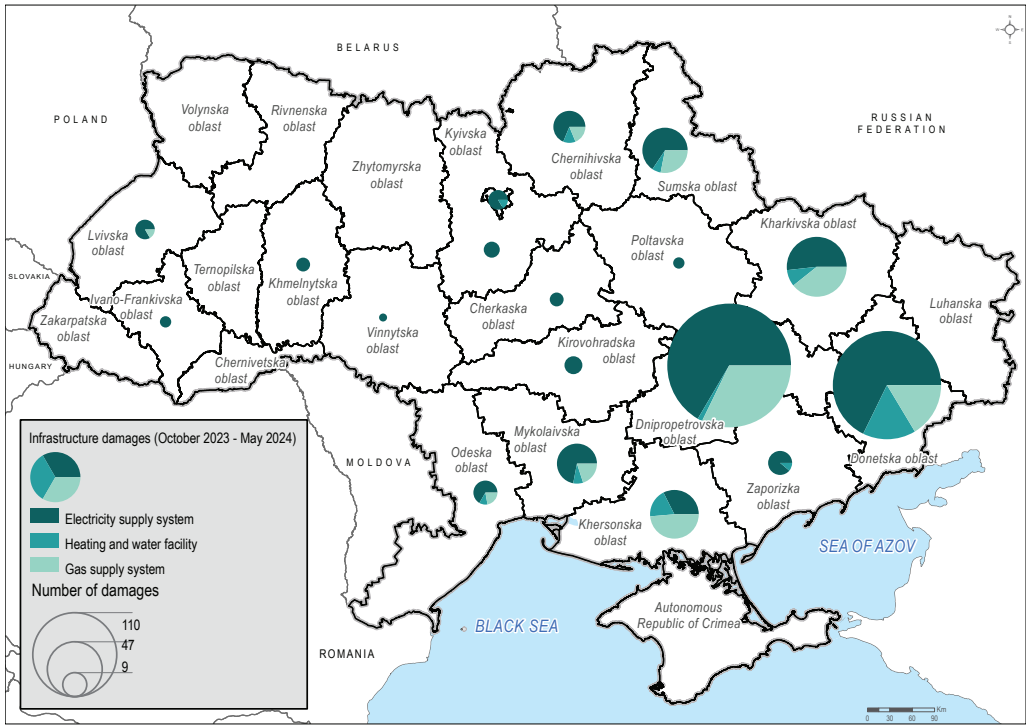
Regions like Zaporizka and Dnipropetrovska, Sumska, Odeska and Chernihivska exhibit medium LOCC, reflecting moderate infrastructural and capacity challenges. Western regions, including Lvivska and Zakarpatska, display lower LOCC, indicating better infrastructure and fewer disruptions. This underscores the need to focus winterization efforts on regions with high LOCC to enhance their resilience and ensure adequate support during the winter season.




Map 4. LOCC class to winter conditions across Ukraine per raion.

Map 5 provides a detailed visualization of the cumulative damage to electricity, heating, and gas supply infrastructure. The size of the circles on the map indicates the severity of war-related incidents, with the largest circles representing the hardest-hit oblasts.

Dnipropetrovska, Donetska, and Kharkivska oblasts, which are on the front line, have experienced the most extensive damage. Among the three types of infrastructure assessed, electricity supply systems have suffered the most significant damage across nearly all oblasts.




Map 5. Number of incidents to electricity, heating and gas infrastructure (October 2023 - May 2024).[20]

## Conclusion

This Cold Spot Risk Assessment for winter 2024/2025 underscores the need to prioritize winterization efforts in the most vulnerable regions and populations of Ukraine. The Cold Spot Index (CSI) for winter 2024/25 identifies that Kharkivska and Sumska oblasts, particularly the raions of Kharkivskyi, Bohodukhivskyi, Chuhuivskyi, and Sumskyi, face the highest winter-related risks due to a combination of severe winter conditions, the presence of vulnerable populations such as IDPs and the elderly, and significant conflict-related damage to critical infrastructure.

The compounded risks identified in this assessment highlight the necessity for targeted and flexible winterization strategies. This analysis can be integrated with other data sources to improve the responsiveness of winterization plans, allowing for adaptive measures that address evolving local challenges and infrastructure damage.

## References and notes


1 IRC, **What Ukrainians need to survive winter**, November 2023; WHO, **Ukraine: 2023-2024 winter risk assessment**, November 2023.
2 WHO, **Ukraine: 2023-2024 winter risk assessment**, November 2023.
3 Ibid.
4 ADRA, **Surviving harsh Ukrainian winter**, December 2022.
5 World Bank, **Ukraine third rapid needs assessment (RDNA3)**, February 2024.
6 Ibid.
7 INSO, **Conflict data dashboard**, restricted data, accessed May 2024.
8 ISW, **Russian offensive campaign assessment**, January 2024.
9 World Bank, **Ukraine third rapid needs assessment (RDNA3)**, February 2024; Electriciens Sans Frontieres, **Ukraine emergency: Describing all our activities in the field**, 2023.
10 Certain groups, such as the elderly, children under five, individuals with chronic illnesses, internally displaced people, and those with lower socioeconomic status, are more susceptible due to factors like poor housing conditions, reduced mobility, health conditions, and limited access to healthcare (WHO, **Ukraine: 2023-2024 winter risk assessment**, November 2023).
11 European Commission, **INFORM risk methodology**, 2017.
12 Shelter Cluster Ukraine, **Lessons learned for winterization 2023-24**, April 2024.
13 UNFPA, **Common Operational Dataset on Population Statistics, Ukraine**, 2023. Restricted circulation.
14 Ibid.
15 IOM, **Ukraine - Area Baseline Assessment - Round 34**, April 2024.
16 CCCM Cluster Ukraine, **Mapping of the active collective sites**, April 2024.
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18 ACLED, **Ukraine conflict monitor, restricted data**, accessed May 2024.
19 INSO, **Ukraine quarterly report: 01 March – 16 May | Q1 2024**.
20 Calculations based on **ACAPS Ukraine damages dataset**.
21 IASC, **IASC Reference Group on Risk, Early Warning and Preparedness,** February 2019.
22 Calculations based on data from MODIS, **Land Surface Temperature and Emissivity (MOD11)**
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24 Calculations based on observations collected by **MODIS**.
25 UNFPA, **Common Operational Dataset on Population Statistics, Ukraine**, 2023. Restricted
26 Ibid.
27 IOM, **Ukraine - Area Baseline Assessment - Round 34**, April 2024.
28 CCCM Cluster Ukraine, **Mapping of the active collective sites**, April 2024.
29 INSO, **Conflict data dashboard**, restricted data, accessed May 2024.
30 ACLED, **Ukraine conflict monitor, restricted data**, accessed May 2024.
31 INSO, **Ukraine quarterly report: 01 March – 16 May | Q1 2024**.


## ABOUT REACH

REACH Initiative facilitates the development of information tools and products that enhance the capacity of aid actors to make evidence-based decisions in emergency, recovery and development contexts. The methodologies used by REACH include primary data collection and in-depth analysis, and all activities are conducted through inter-agency aid coordination mechanisms. REACH is a joint initiative of IMPACT Initiatives, ACTED and the United Nations Institute for Training and Research - Operational Satellite Applications Programme (UNITAR-UNOSAT).


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# Annex A - Methodology note

This analysis is based on the disaster risk model established by the Inter-Agency Standing Committee (IASC) Reference Group on Risk, Early Warning, and Preparedness and the European Commission.[21] It conceptualizes risk as the interplay of hazard, exposure, and vulnerability, the latter comprising susceptibility and lack of coping capacities.

A geo-spatial analysis was conducted using aggregated data from various indicators to identify areas most affected by winter-related hazards and vulnerabilities. This analysis used datasets at the raion level. The analysis covered 107 raions (administrative level 2) mostly under the control of the GoU as of May 2024. Cold spots were identified based on four groups of indicators: hazard, exposure, susceptibility, and lack of coping capacity (LOCC). The selected datasets for each group include:

- **Hazard** (the following datasets consider the data obtained from the last 20 years): mean number of frost days per year;[22] frequency of cold waves per year;[23] and mean snow days per year.[24]
- **Exposure:** Population density as of August 2023.[25]
- **Susceptibility:** Percentage of elderly population as of August 2023;[26] percentage of IDPs per raion as of March 2024;[27] and number of people living in active collective sites as of May 2024.[28]
- **LOCC:** Cumulative damage to power and electricity infrastructure (October 2023 - May 2024);[29] conflict incidents density per 100 sq km (01.05.2023 – 09.05.2024);[30] and level of power outages (March - May 2024).[31]

Selection criteria for datasets included their quality and suitability. Selected data sets for each indicator were aggregated at the raion level. Classes assigned to raions for each of the indicators (hazard, exposure, susceptibility, and LOCC) were overlaid to calculate the raion's overall Cold Spot Index (CSI) using the following formula:

$$\textbf{CSI} = (\text{Hazard} \times 0.35) + (\text{Exposure} \times 0.25) + \left(\frac{(\text{Susceptibility} + \text{LOCC})}{2} \times 0.4\right)$$

This formula determines cold spot risk as a combination of hazard (35% weight), exposure (25% weight), and vulnerability (40% weight, comprising susceptibility and LOCC). Indicators and CSI values were categorized into five classes, ranging from 'Very Low' to 'Very High', to rank the raions accordingly.

**Limitations:** There are two main limitations regarding the data sources used to calculate the cold spots scores. Firstly, as there has not been an official census of the Ukrainian population since 2001, figures for the population, including for vulnerable groups, rely on unofficial estimates. Inaccuracy of these estimates would reduce the accuracy of the exposure and susceptibility indicators. Secondly, data used to calculate LOCC is updated as of May 2024. Anticipated additional damage to energy infrastructure—specifically power and heat generation facilities and distribution networks—in the months ahead of the winter season is difficult to quantify and has not been included in the calculation. Further degradation of this infrastructure will further reduce the coping capacities of affected regions.

## Annex B - Raions CSI levels

| Raion | Oblast | CSI |
|---|---|---|
| Kharkivskyi | Kharkivska | Very high |
| Sumskyi | Sumska | Very high |
| Chuhuivskyi | Kharkivska | Very high |
| Bohodukhivskyi | Kharkivska | Very high |
| Buchanskyi | Kyivska | High |
| Kyivska | Kyivska | High |
| Kramatorskyi | Donetska | High |
| Chernihivskyi | Chernihivska | High |
| Kupianskyi | Kharkivska | High |
| Shostkynskyi | Sumska | High |
| Okhtyrskyi | Sumska | High |
| Novhorod-Siverskyi | Chernihivska | High |
| Pokrovskyi | Donetska | High |
| Brovarskyi | Kyivska | High |
| Dniprovskyi | Dnipropetrovska | High |
| Zaporizkyi | Zaporizka | High |
| Iziumskyi | Kharkivska | High |
| Lozivskyi | Kharkivska | High |
| Romenskyi | Sumska | High |
| Nizhynskyi | Chernihivska | High |
| Koriukivskyi | Chernihivska | High |
| Konotopskyi | Sumska | High |
| Vinnytskyi | Vinnytska | High |
| Obukhivskyi | Kyivska | High |
| Fastivskyi | Kyivska | High |
| Cherkaskyi | Cherkaska | High |
| Lvivskyi | Lvivska | Medium |
| Drohobytskyi | Lvivska | Medium |
| Myrhorodskyi | Poltavska | Medium |
| Lubenskyi | Poltavska | Medium |
| Krasnohradskyi | Kharkivska | Medium |
| Nikopolskyi | Dnipropetrovska | Medium |
| Odeskyi | Odeska | Medium |
| Zhmerynskyi | Vinnytska | Medium |
| Umanskyi | Cherkaska | Medium |
| Ternopilskyi | Ternopilska | Medium |
| Shepetivskyi | Khmelnytska | Medium |
| Rivnenskyi | Rivnenska | Medium |
| Poltavskyi | Poltavska | Medium |
| Pavlohradskyi | Dnipropetrovska | Medium |
| Oleksandriiskyi | Kirovohradska | Medium |
| Novomoskovskyi | Dnipropetrovska | Medium |
| Kropyvnytskyi | Kirovohradska | Medium |
| Kremenchutskyi | Poltavska | Medium |
| Khmilnytskyi | Vinnytska | Medium |
| Khmelnytskyi | Khmelnytska | Medium |
| Kamianskyi | Dnipropetrovska | Medium |
| Bilotserkivskyi | Kyivska | Medium |
| Synelnykivskyi | Dnipropetrovska | Medium |
| Boryspilskyi | Kyivska | Medium |
| Ivano-Frankivskyi | Ivano-Frankivska | Medium |
| Vyshhorodskyi | Kyivska | Medium |
| Prylutskyi | Chernihivska | Medium |
| Zhytomyrskyi | Zhytomyrska | Medium |
| Volodymyr-Volynskyi | Volynska | Medium |
| Lutskyi | Volynska | Medium |
| Kaluskyi | Ivano-Frankivska | Medium |
| Chervonohradskyi | Lvivska | Medium |
| Berdychivskyi | Zhytomyrska | Medium |
| Nadvirnianskyi | Ivano-Frankivska | Medium |
| Zvenyhorodskyi | Cherkaska | Low |
| Zolotoniskyi | Cherkaska | Low |
| Holovanivskyi | Kirovohradska | Low |
| Uzhhorodskyi | Zakarpatska | Low |
| Mukachivskyi | Zakarpatska | Low |
| Cnernivetskyi | Chernivetska | Low |
| Stryiskyi | Lvivska | Low |
| Kamianets-Podilskyi | Khmelnytska | Low |
| Dnistrovskyi | Chernivetska | Low |
| Kryvorizkyi | Dnipropetrovska | Low |
| Zolochivskyi | Lvivska | Low |
| Sambirskyi | Lvivska | Low |
| Novoukrainskyi | Kirovohradska | Low |
| Novohrad-Volynskyi | Zhytomyrska | Low |
| Kremenetskyi | Ternopilska | Low |
| Kovelskyi | Volynska | Low |
| Dubenskyi | Rivnenska | Low |
| Vyzhnytskyi | Chernivetska | Low |
| Mykolaivskyi | Mykolaivska | Low |
| Khersonskyi | Khersonska | Low |
| Yavorivskyi | Lvivska | Low |
| Kolomyiskyi | Ivano-Frankivska | Low |
| Khustskyi | Zakarpatska | Low |
| Tulchynskyi | Vinnytska | Low |
| Mohyliv-Podilskyi | Vinnytska | Low |
| Haisynskyi | Vinnytska | Low |
| Bashtanskyi | Mykolaivska | Low |
| Berehivskyi | Zakarpatska | Low |
| Verkhovynskyi | Ivano-Frankivska | Low |
| Sarnenskyi | Rivnenska | Low |
| Korostenskyi | Zhytomyrska | Low |
| Izmailskyi | Odeska | Very low |
| Tiachivskyi | Zakarpatska | Very low |
| Kosivskyi | Ivano-Frankivska | Very low |
| Pervomaiskyi | Mykolaivska | Very low |
| Varaskyi | Rivnenska | Very low |
| Kamin-Kashyrskyi | Volynska | Very low |
| Voznesenskyi | Mykolaivska | Very low |
| Bolhradskyi | Odeska | Very low |
| Beryslavskyi | Khersonska | Very low |
| Chornobylska z.v. | Kyivska | Very low |
| Rakhivskyi | Zakarpatska | Very low |
| Podilskyi | Odeska | Very low |
| Chortkivskyi | Ternopilska | Very low |
| Bilhorod-Dnistrovskyi | Odeska | Very low |
| Berezivskyi | Odeska | Very low |
| Rozdilnianskyi | Odeska | Very low |