UNHCR
The UN Refugee Agency

Valentina Mitrofanovna Shtulberg, 77, from Kharkiv, holds her Bible at the Refugee Accommodation Centre in Mihailovca, Râșcani. "It's old, but I tried to take great care of it. It reminds me of who I was before the war. This is the piece of home that keeps me grounded in the world that turned upside down."
© UNHCR / Eugenia Ciurcă

POLICY BRIEF
FORECASTING REFUGEE RETURN TO UKRAINE AMID ONGOING WAR AND UNCERTAINTY

Contents

Acknowledgements

The development of the agent-based modelling prototype is led by the Department of Computer Science, Brunel University of London. The forecasts in this report were made using the SEAVEA toolkit and the ARCHER2 supercomputer at EPCC in Edinburgh, UK.

July 2025

Executive Summary

Despite the ongoing war, the Government of Ukraine and its international partners are dedicating increasing focus on national recovery—and the policies, reforms and investments needed to rebuild. Forced displacement is massive, with nearly a quarter of the pre-war population having fled their homes, including some 5.6 million refugees and more than 3.7 million internally displaced. Gaining a comprehensive understanding of the scope of return — including the socio-economic characteristics of who is likely to return, under what conditions, to which parts of the country, and the subsequent programmes, services and support required to ensure sustainability of returns — is critical to ensuring an equitable recovery that leaves no one behind.

Building on successive rounds of intentions surveys undertaken among the Ukrainian refugee population in European host states, UNHCR partnered with Brunel University of London to develop an innovative agent-based modelling prototype to forecast potential returns under five different hypothetical scenarios. Guided by an informal advisory group of technical experts from international financial institutions, regional institutions and development actors, Ukraine's Ministry of Economy and the Kyiv School of Economics, the model provides key insights into a range of factors that will likely influence future return trends and subsequent recovery needs in different oblasts across Ukraine, in accordance with five plausible future scenarios. The results outlined in this brief are simulated based on a scenario of 'fragile peace' with concessions. The prototype can produce simulations relating to five different, defined scenarios, simulating variations in expected return trends.

Objectives

- To prioritize geographical areas and sectors for reconstruction and reintegration in Ukraine
- To better understand the need for socio-economic inclusion support and implications on human capital available
- To provide insights into the potential demand for services (health, education, housing, and social services)
- To support policy making (labor market integration; social cohesion; social spending; infrastructure needs)

Expected outputs

- Estimated returns over time according to different scenarios (war outcomes/legal status)
- Identify who is most likely to return, particularly specific socio-demographic profile
- Forecast from which host countries and to which oblasts returns are most likely to occur

Key Takeaways from the prototype

- **Return is highly scenario-dependent** and based on a combination of individual factors, including age, education and employment status, and conditions in areas of intended return with significant variations in anticipated return numbers in different scenarios.

- **The profile of potential returnees does not mirror the overall socio-demographic profile of the larger refugee population.** The majority of prospective returnees across all five hypothetical scenarios tend to be older, with fewer family responsibilities, and more likely to own intact property in Ukraine. Youth, families with children, and those working are less likely to return by the end of the simulation.

- **Returns will not be evenly distributed across oblasts of origin**. Differences are observed in the different simulations (according to five different scenarios) in terms of percentage of returnees versus refugees from a specific oblast, percentage of those returning to their oblast of origin versus. a different oblast, and certain demographic data, though less pronounced.

- **Returns will not happen all at once but will progressively increase over time**, influenced by multiple drivers dependent on the specific scenario, such as safety, social ties both in the host country and inside Ukraine, such as living standards.

- **Host country variations matter**. Refugees in countries with strong inclusion policies, work opportunities, and considerable diaspora populations, are less likely to return than those in countries with more limited inclusion potential.

- **Legal status influences return decision-making.** The potential expiry of temporary protection arrangements, potential shifts in asylum policies and access to other types of residence permits or stay arrangements, are expected to significantly impact returns under most scenarios, showing a considerable increase after March 2027.

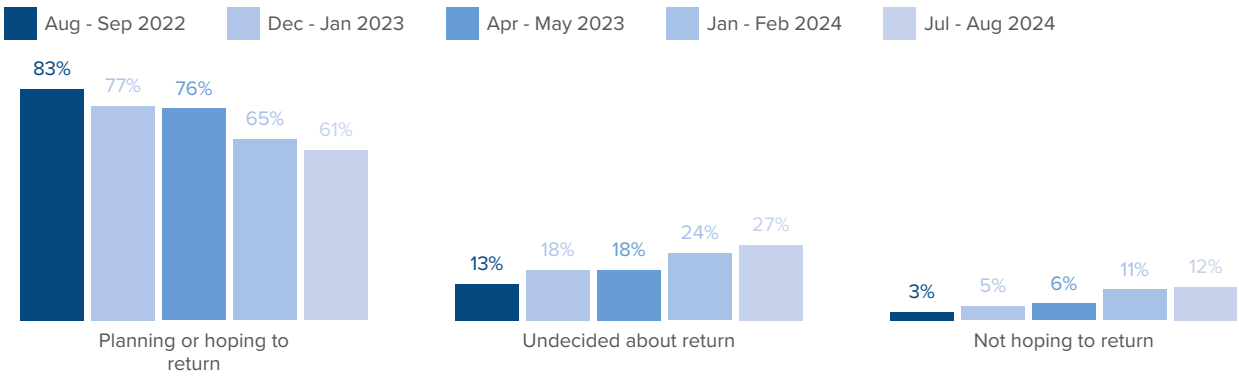
- **Results are expected to change over time**. Based on changes in refugees' socio-demographic profiles - including factors such as household composition (affected particularly by family reunification), access to employment in host counties and age (relevant when it comes to education, retirement and conscription) – projected return figures and profiles will look different, even if assumptions and scenarios remain. The forecasting model will therefore continue to be updated with new data and assumptions revised as the situation develops, thereby increasing the accuracy of forecasts.

1. Introduction

Russia's 2022 full-scale invasion of Ukraine has resulted in widespread displacement and refugee flows, extensive civilian casualties, massive destruction of homes and public infrastructure, disruption of essential services, severe economic contraction and capital flight, and massive dislocation of the country's workforce. Currently, an estimated 3.7 million people are internally displaced within Ukraine, while approximately 5.6 million Ukrainians are living abroad as refugees, predominantly in Europe.[1] In the midst of the ongoing war, the Government of Ukraine has prioritised national recovery, including efforts to rebuild its human capital. The government's vision for human capital development, outlined in the Ukraine Plan, is built around four priorities: (1) education and skills; (2) access to healthcare and rehabilitation of services; (3) reintegration of Ukrainians into the labor market and recovery from the social and economic impacts of the war, and; (4) increasing 'the quantity' of the physically, economically, and socially active population. These aims are highly ambitious for a country which, prior to the war, faced emigration and a declining labor force, imbalances and skills gaps. Policies to rebuild Ukraine's human capital in an inclusive way must therefore be achieved through smart policies and programmes, targeted investments, and an understanding of who is most likely to return where, under which conditions, and what subsequent measures are needed to sustain returns and successful reintegration. Data to forecast return trends to inform recovery investments and prioritization is therefore essential.

UNHCR, in partnership with Ipsos SA, has undertaken periodic surveys of refugee intentions in all host countries in Europe since 2022, with results outlined in the Lives on Hold series. Over time, the number of refugees expressing an intention to return one day has gradually declined, as the war and attacks continue, and people increasingly integrate into host communities. Safety and security continue to be cited as the predominant inhibitor of return, followed by access to jobs and livelihoods, housing, and functioning services.

REFUGEES INTENTIONS TO RETURN



While the surveys suggest proportionately higher return intentions among female headed households and older people, they do not provide the granular information required for effective recovery planning inside Ukraine. To provide insight into this key question, UNHCR partnered with the Department of Computer Science at Brunel University of London to develop an agent-based model to forecast potential return to Ukraine, supported by an informal advisory board comprised of technical experts from international financial institutions and development actors, concerned EU Directorates, Ukraine's Ministry of Economy and the Kyiv School of Economics.

1. As of mid-June 2023, an estimated 1.2 million Ukrainians were recorded in the Russian Federation under different legal forms of stay (other than refugee or temporary asylum status) and reported by UNHCR as persons in a refugee-like situation. However, this figure has not been updated since June 2023, and therefore can no longer be included in UNHCR's official statistics for 2024.

2. What is agent-based modelling?

Agent-based modelling (ABM) is a powerful tool that allows researchers and policymakers to simulate complex systems to understand the subsequent behavior and decision-making patterns of individuals in different scenarios. Unlike traditional models that rely on aggregate data, ABM focuses on individual-level dynamics, seeking to capture the heterogeneity and complexity within a given system—and project how macro-level phenomena are derived from different micro-level behaviors. Each "agent" in this model represents a Ukrainian refugee with specific traits: age, gender, family structure, legal status, education, employment situation, and more. These agents make choices in a virtual environment that reflects real-world conditions: security threats, access to utilities, housing conditions, education, and employment options.

ABM also allows researchers to introduce changes in the context (scenarios), to simulate their potential impact on individual behaviors and actions. This allows policymakers to better understand complex social systems and therefore anticipate and test the outcomes of different policy interventions. Unlike traditional forecasting models, agent-based modelling accounts for diversity in experiences and motivations. It can simulate an interplay of factors, such as whether a mother with children and no housing in Kyiv would be more or less likely to return under a partial ceasefire or stay abroad due to access to healthcare and schooling. The huge repository of household-level socio-economic data collected by UNHCR and Ipsos SA serves as a basis for coding unique attributes of individual 'agents' to inform how they might behave within the system, which was developed based on a huge array of public source data. Sensitivity analysis was then undertaken to identify which input parameters have the greatest influence on key results, to assess the robustness of findings, and enhance confidence in the model's predictions based on five different **hypothetical scenarios**.

SCENARIOS AND ASSUMPTIONS	
Ukraine Victory	Ukraine reclaims the Temporarily Occupied Territories by the end of 2026. Temporary protection remains extended to March 2027.
Fragile peace with concessions. Russia retains de facto control over the Temporarily Occupied Territories in the illegally annexed oblasts of Ukraine.	By the end of 2025, gradual reduction in active combat / hostilities while the illegally annexed oblasts of Ukraine remain largely under Russian Temporary Occupation. Temporary protection for refugees originating from non-ToT (Temporarily Occupied Territories) ends by March 2027.
Partial ceasefire (frozen war)	Active large-scale combat ceases, but political and military tensions persist; frontline is frozen by end 2025. TP end for refugees originating from non-ToT by March 2027.
Ongoing war (status quo)	Continued hostilities along frontline until the end of 2028, aerial attacks continue at current or increased intensity. Temporary protection continues and Ukrainians progressively shift to other legal frameworks (e.g. work or study permit, asylum).
End of war on conditions put forward by Russian Federation	Capture of significant portions of Ukrainian territory by end of 2026.

Mariia, 70, and Anatolii, 74, have spent over 50 years together in their village of Khatnie, Kharkiv region, before war forced them to flee. At the beginning of the full-scale invasion in 2022, their village was occupied for seven months. During that time, the couple risked their lives to hide their sons and protect symbols of their Ukrainian identity. © UNHCR/Oleksii Barkov

3. The potential of agent-based modelling to forecast return—and what it can tell us

The development of the agent-based modelling prototype is a starting point to better understand how large-scale returns may occur in a context of continuing uncertainty and volatility—with encouraging results. UNHCR and Brunel University of London, in collaboration with the Informal Advisory Board of technical experts, will continue to undertake sensitivity analysis, seek evaluation by external experts, and feed new data into the modelling—which over time will improve the granularity, accuracy and applicability of the results.[2] While no forecasting models can serve as a crystal ball, the agent-based modelling provides a lens through which government policymakers and other stakeholders and contributors to Ukraine's recovery can begin to understand future return patterns, profiles of those who are likely to return, and plan and prioritise accordingly. Furthermore, drawing on decades of experience supporting refugees in returning and reintegrating into their home countries, UNHCR has found that access to reliable information, preparedness, and targeted investments in areas prioritized by refugees for return are key enablers of sustainable return and reintegration.

2. Please note that most baseline data dates back to 2024, including intentions and socio-economic insight surveys, such as secondary data. With more recent baseline data, for example, on level of employment and return intentions, results are therefore expected to change.

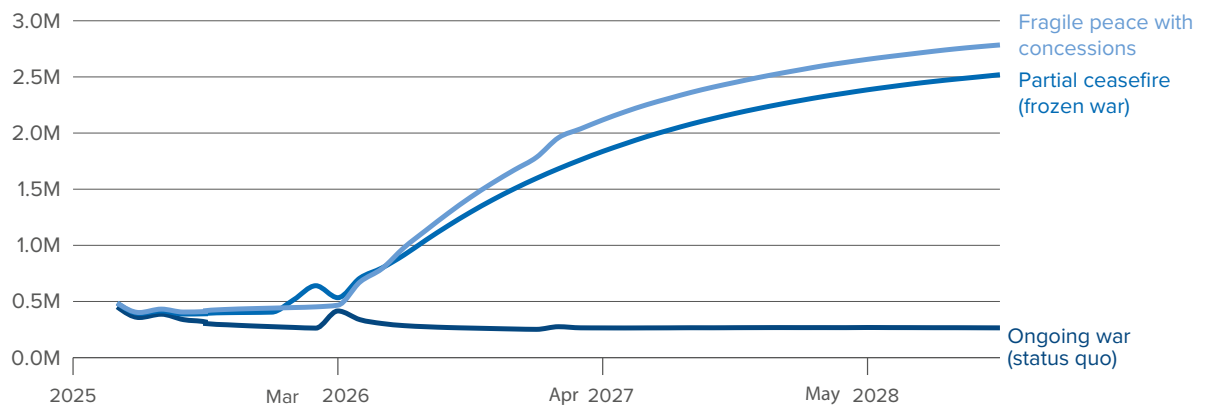
4. Preliminary results

The following section provides an initial overview of the type of information that can be generated when applying the agent-based modelling prototype against one of the five defined scenarios. Results were generated using a supercomputer, incorporating multiple rounds of feedback from informal advisory group members and combined with a rigorous sensitivity analysis to enhance robustness of the results and better reflect the relative weight of different variables in decision-making. To test the capabilities of the forecasting model, scenario two from the table above (Fragile peace with concessions, wherein Russia retains de facto control over the Temporarily Occupied Territories in the illegally annexed oblasts of Ukraine) was used for the simulation. This does not imply an endorsement of the specific scenario, rather it provides a frame of reference in which a significant change in the current status quo can be observed regarding future returns.[3] Furthermore, the projected results reflect conditions at a specific point in time and remain subject to change, depending on further refinement of the model and evolving assumptions. These could include dynamic contextual factors such as policy shifts, security developments, and major geopolitical events, in addition to changes in individual socio-demographic profiles and motivations.

Return variations under three scenarios

The forecasting model highlights the extent to which projected returns are highly dependent on contextual factors and specific scenarios. For instance, only 266,000 returns are forecasted in the next three years if the status quo persists, while the projections increase significantly under a scenario of a frozen war with fewer, and more localized, attacks and under a fragile peace with de facto temporary territorial concessions.

RETURNS BY SCENARIO (CUMULATIVE RETURNS BY END OF SIMULATION)



3. The UN position on a 'just' peace in Ukraine is one that fully respects the UN Charter, international law, the relevant resolutions of the UN General Assembly, including the territorial integrity of Ukraine. The Secretary General has likewise stressed that a ceasefire may pave the way for a solution based on the above requirements.

Potential return by host country (scenario 2)

Projected returns differ considerably between host countries. While estimates remain preliminary, return decisions are influenced by a range of factors, including the breadth of inclusion policies, availability of work opportunities, household composition, main oblasts of origin of refugees in the different host countries, the size of the diaspora in the host country, legal residence options and access to services. Therefore, returns do not necessarily mirror the socio-demographic profiles of refugees in a given host country.

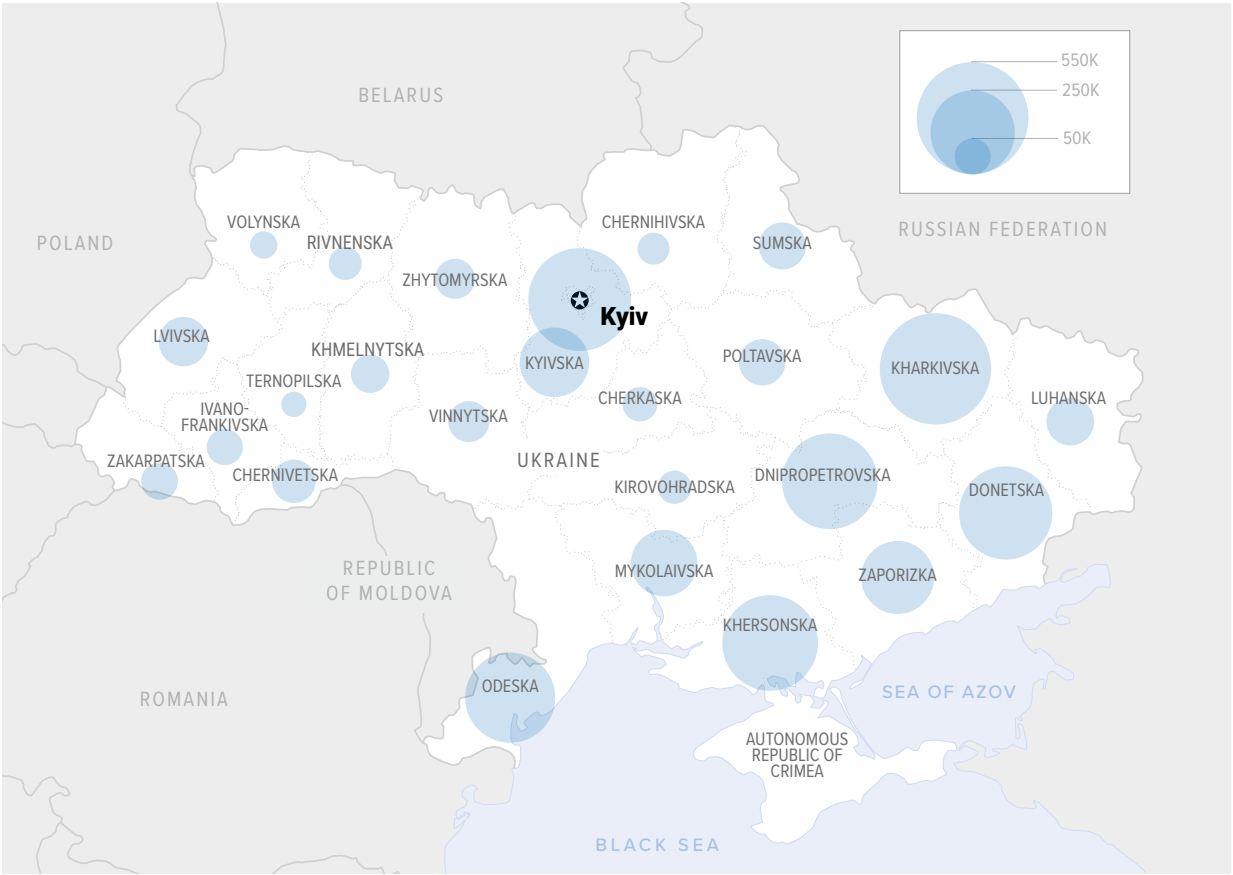
RETURN BY MAIN HOST COUNTRIES (CUMULATIVE RETURNS BY END OF SIMULATION)

Host country	Refugees by start of simulation	Refugees by end of simulation	Returnees	% Returnees
Germany	1,184,900	408,600	776,300	66%
Poland	997,200	572'800	424,400	43%
Czechia	365,100	90,000	275,100	75%
Spain	233,900	61,400	172,500	74%
Romania	182,900	62,900	120,000	66%
Italy	165,300	42,400	122,900	74%
Slovakia	132,600	52,100	80,500	61%
Republic of Moldova	127,800	24,900	102,900	81%
Netherlands	123,400	35,600	87,800	71%
Ireland	111,800	30,500	81,300	73%
Others	758,900	200,00	558,800	74%
TOTAL	**4,383,800**	**1,581,300**	**2,802,500**	64%

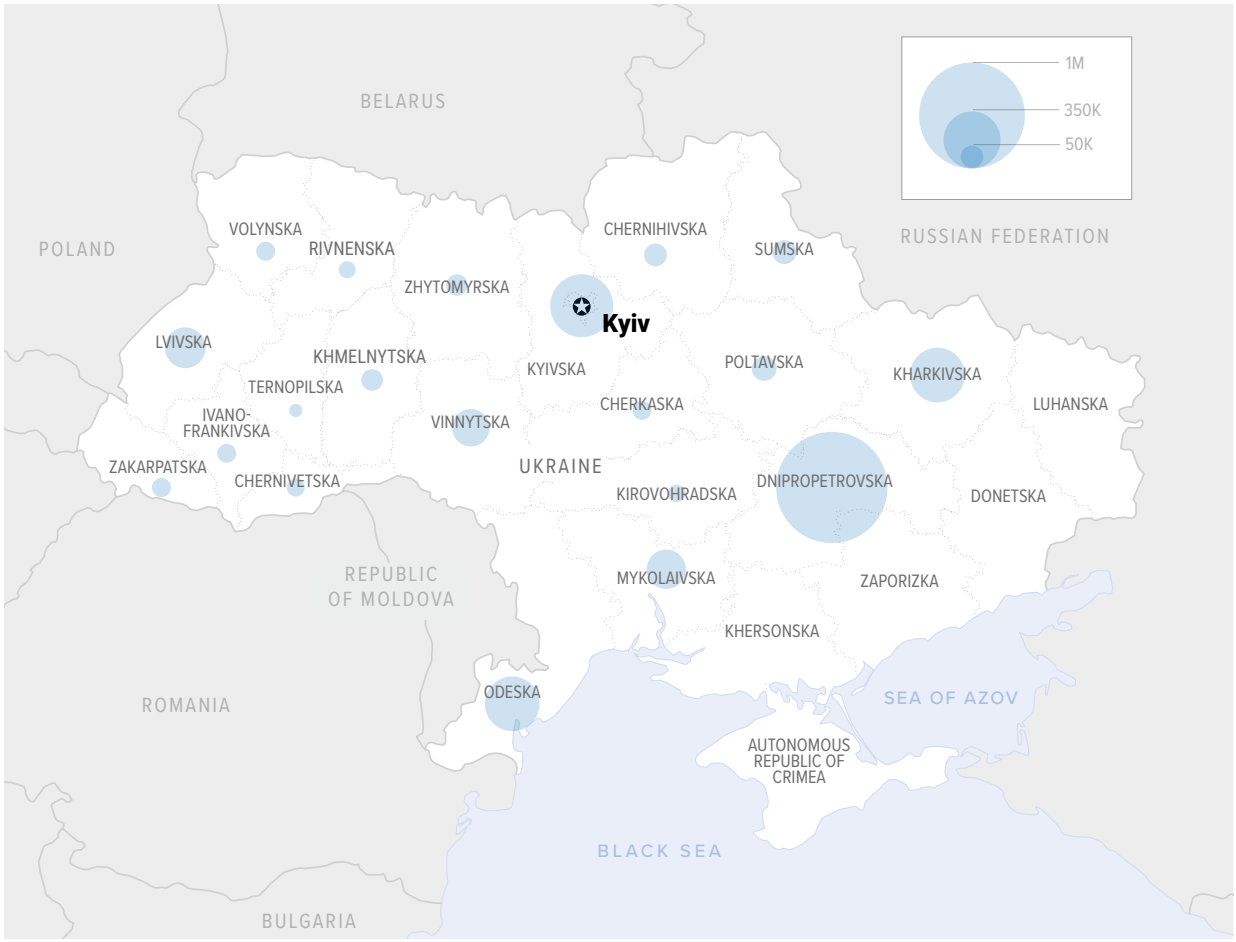
Return forecasts by oblast (scenario 2)

Return to oblasts different than those of origin. While security factors remain key determinants under this scenario, additional factors, such as the level of access to healthcare, education and utilities, job prospects also play a role in settlement decisions. In addition, individual aspects, such as family members remaining in the oblast of origin or adjacent and property ownership and war-related damages of homes are also key factors. Based on this, preliminary results show that a significant percentage of refugees would return to a different oblast. This particularly applies to those whose property has been fully damaged, or those who do not own property, or whose oblasts of origin remain temporarily occupied. In Dnipropetrovska for example, returns are forecasted to be 2.5 times higher than the number of refugees originating from this oblast (1,080,000 vs. 409,000), with only 21% or returnees originating from Dnipropetrovska. Similar findings are observed for Vinnytska, with 67% originating from a different oblast. Overall, the model projects that 62% of refugee returnees would return to their oblast of origin by the end of the simulation, while 38% would likely settle in a different oblast.

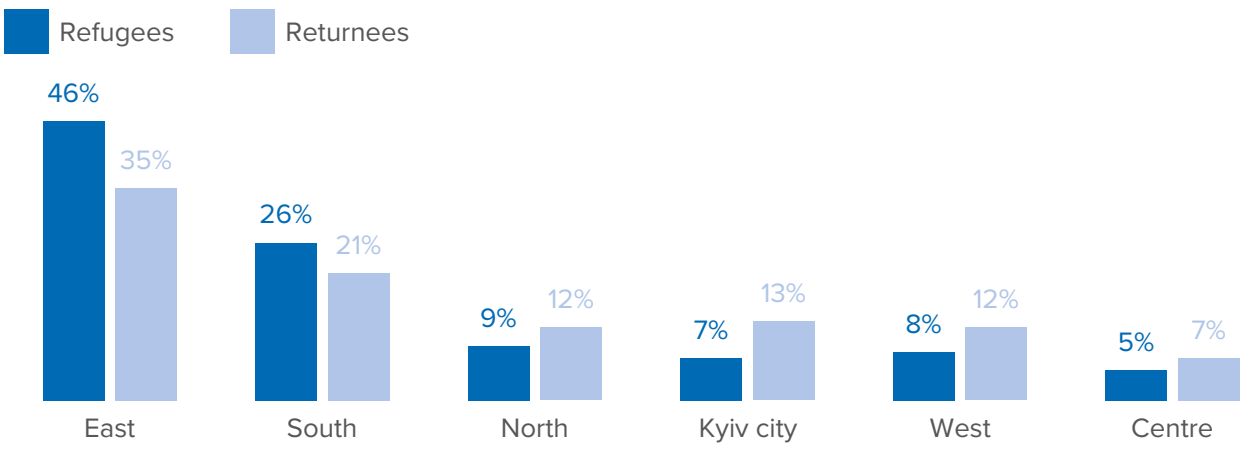
REFUGEES BY OBLAST OF ORIGIN (REFUGEES FROM UKRAINE IN EU+ MOLDOVA)



RETURNS BY OBLAST (CUMULATIVE RETURNS BY THE END OF SIMULATION (SCENARIO: PEACE WITH CONCESSIONS)



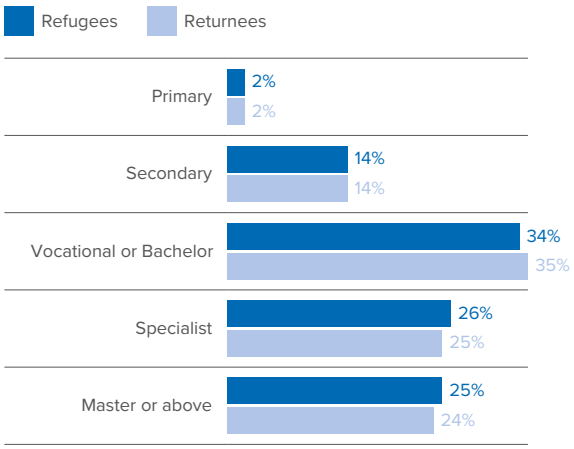
MACRO-REGION OF ORIGIN: RETURNEES VS REFUGEES BY END -OF SIMULATION



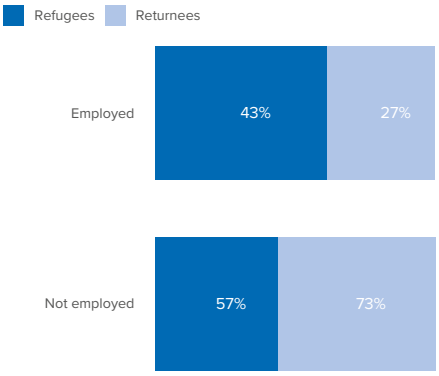
Education levels and employment experience (scenario 2)

While educational levels of those projected to return and refugees who opt to remain in host countries are similar, employment in the host country emerges as one of the most significant factors influencing return. While 43 % of the total number of Ukrainian refugees are employed in host countries as per the simulation, the majority (73%) of people projected to return were either unemployed or not available to the labor market before leaving the host country. As employment rates and levels are expected to further increase over time (due to, for example, local language acquisition, continued job-matching or re-skilling opportunities), the total number of projected returns is expected to show a corresponding decrease.

EDUCATION LEVELS: RETURNEES VS REFUGEES BY END BY OF SIMULATION (18-59)



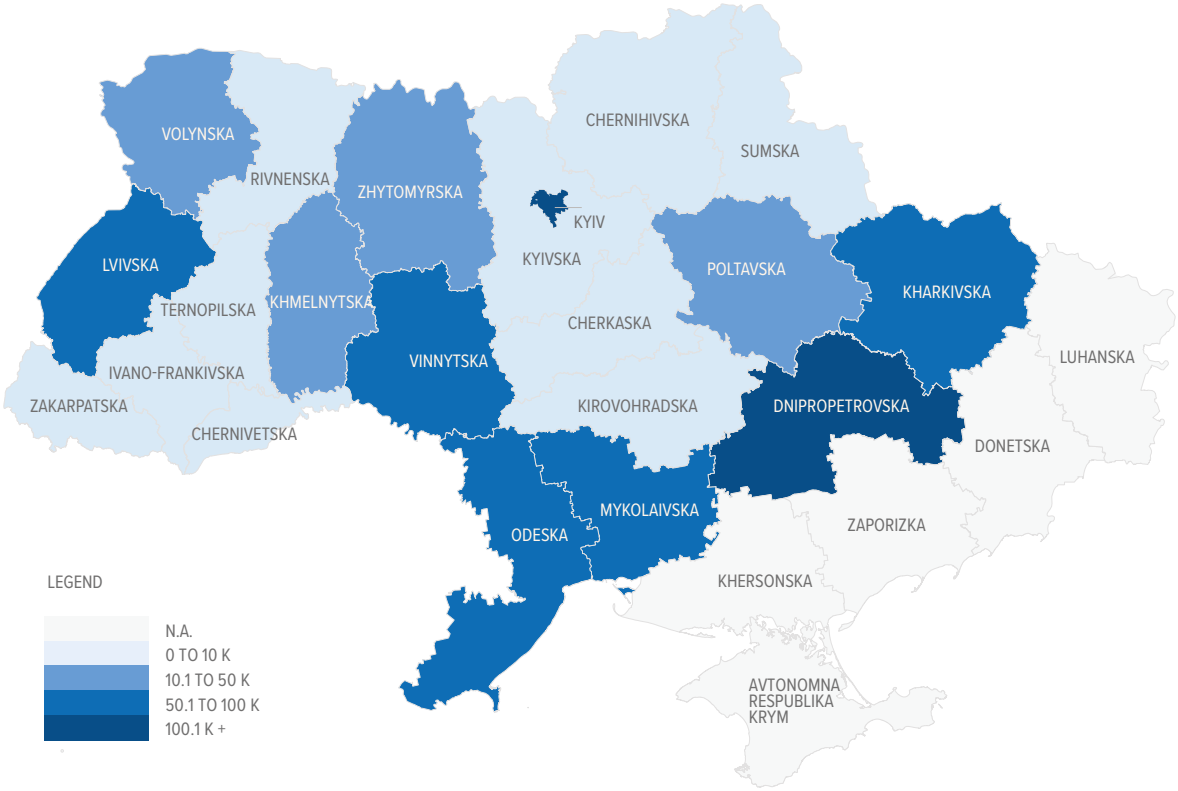
EMPLOYMENT STATUS (18-59): RETURN (AT RETURN TIME VS REFUGEES (BY END BY OF SIMULATION)



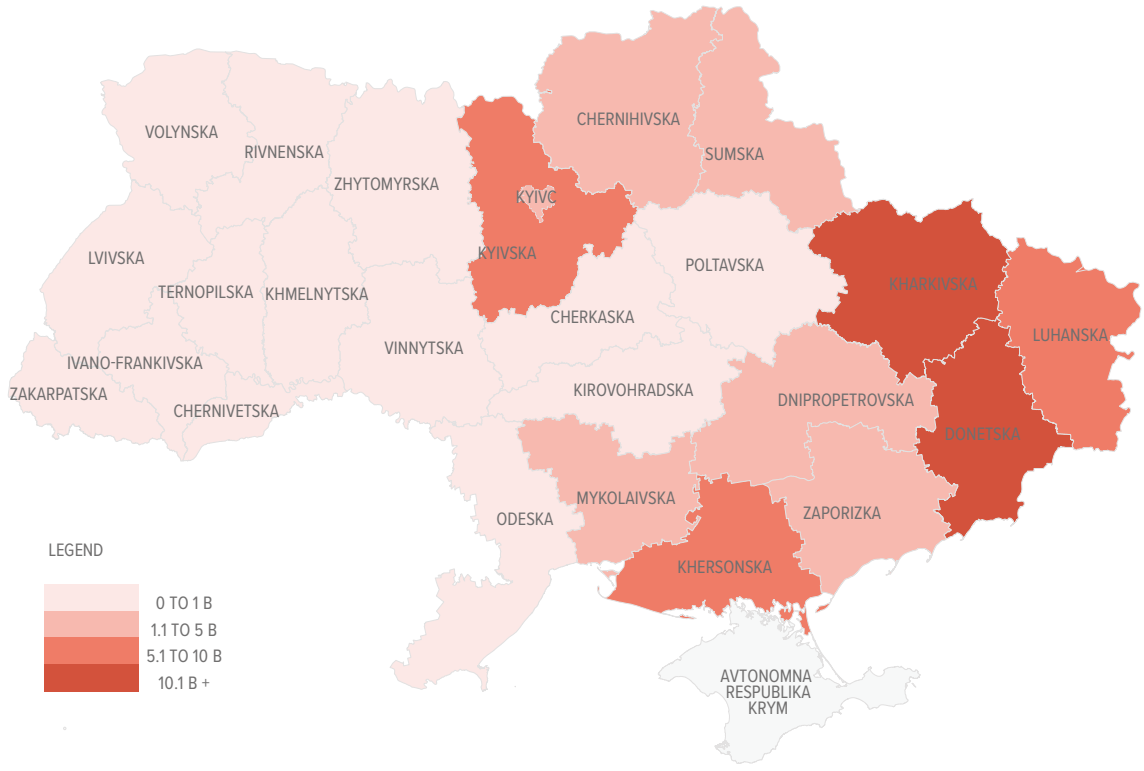
Housing: current vs. expected needs among returnees (scenario 2)

Access to durable housing is a necessary precondition for sustainable return, enabling returnees to recover and rebuild their lives. The forecasting model provides an interesting comparison between expected returnees by oblast and projected investment requirements in the housing sector, outlined in the fourth Rapid Damage Needs Assessment (RDNA4). Housing needs for returnees are calculated based on the estimated number of returns to a different oblast than the one of origin (38% of all returnees) and the estimated number of returns to an oblast of origin where the returnee has damaged, unknown or no property (25% of this subgroup, as the majority of those projected to return to their own oblast owns intact property - 75% as per this simulation). Findings show significant differences between the oblasts with the highest housing recovery needs as per the RDNA4, and the main oblasts of return in the scenario 2 simulation. While expected IDP and refugee returns are only one factor for calculating investment needs in the housing sector, the relatively high number of returns to different oblasts as described in chapter 4.3 - and the more granular data available through the model on the status of property - can help further refine investment estimates and determine actual needs.

ESTIMATED NUMBER OF RETURNEES WITH HOUSING NEEDS BY OBLAST OF RETURN



ESTIMATED VALUE OF HOUSING SECTOR NEEDS PER OBLAST ACCORDING TO RDNA 4 (IN USD BILLIONS)



5. Implications of return forecasting on recovery planning and development of sound (re)inclusion policies

While the findings summarized above are still preliminary, with the model requiring further refinement and regular updates based on a) the evolution of the war and situation inside Ukraine, b) changes in refugees' socio-demographic profiles and c) developments in legal frameworks of host countries, the forecasting model holds strong potential to inform recovery and reintegration planning, guide prioritization of investments within Ukraine, and shape policies of refugee-hosting countries. More specifically, the agent-based model could support as follows:

- **Inform reconstruction prioritization:** Progressively accurate forecasting can help identify oblasts likely to receive a high number of returnees in which early investments in housing, social and public services scaling are crucial —especially in health, housing, education, and utilities. In addition to sheer numbers, the model can also help to better understand specific needs of prospective returnees in key sectors, based on agents' socio-demographic profiles, household composition, property situation and employment level in host countries.

- **Test the impact of potential policies or investments on future return intentions:** the model underscores the correlation between intentions, actual needs of the returnee population, and the requisite investments needed to sustain return and facilitate effective reintegration. This would also include investments to foster social cohesion and confidence building.

- **Contribute to socio-economic reintegration:** Linked to the above, at the individual level, results can feed into the design of programs tailored to returnee profiles—vocational training, psychosocial support, job-matching for skilled returnees, care services, employability schemes, housing solutions, among others.

- **Promote effective inclusion in host countries:** Where return of specific socio-demographic profiles is unlikely in the short term, findings can improve the design of long-term inclusion policies, offsetting stagnation or marginalization, fostering linkages to Ukraine, and enabling refugees to contribute to their host societies by further developing their human capital in line with their potential, all of which will ultimately enhance long term sustainable return prospects.

- **Contribute to regional coordination and coherence:** Inform harmonized policies among EU Member States, including post-TPD, that support Ukrainians' ability to develop and contribute with their human capital and enable voluntary and sustainable returns, while mitigating fragmentation, preventing involuntary returns and exacerbating situations of hardship for highly vulnerable individuals.

- **Inform the ongoing transition from emergency response to durable solutions:** Guide a shift from emergency humanitarian support to programmes that foster sustainable inclusion and reintegration where feasible, while maintaining readiness for renewed outflows (for example, in case of energy collapse or escalation).

- **Enhance capacities for modelling return across refugee situations elsewhere:** While the forecasting model is being developed specifically for the Ukraine situation, its parameters can be adjusted to serve a large variety of return situations, contingent on available data to inform the model.

POLICY BRIEF
FORECASTING REFUGEE RETURN TO UKRAINE AMID ONGOING WAR AND UNCERTAINTY

July 2025

UNHCR
The UN Refugee Agency